

REPORT SUMMARY

THE
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Welcome to the Machine

Opportunities and risks of generative Artificial Intelligence for education

Dr Michael Johnston

It is less than two years since artificial intelligence (AI) emerged as an accessible technology. It is already transforming activity in many areas of society and the economy. AI is developing fast and will continue to do so.

In education, discussion of AI ranges from concern about its implications for cheating in assessment, to claims that it will make much of traditional schooling obsolete. It is important to develop guiding principles for its use in classrooms that will continue to apply as the technology becomes more and more powerful.

AI should be used to support, rather than replace, students' learning of foundational knowledge and skills. It offers valuable opportunities to enhance teaching and learning, but only if its use is guided by skilled and knowledgeable teachers. AI will not fundamentally alter what is important for students to learn, or how they learn.

Key points:

- It will remain important for students to learn disciplinary knowledge in subjects such as science, history, and mathematics. Critical thinking and creativity depend on knowledge.
- It will remain important for students to learn to write. Writing is not only a means of communication. It is also a tool of thinking.
- The science of learning can guide thinking about the use of AI in education.

Disciplinary knowledge

Disciplinary knowledge in subjects like science, history and mathematics provides cognitive tools for testing ideas. It is crucial for developing critical thinking skills. It fosters democratic citizenship. So, while AI will have profound impact as a tool of teaching, it will not make the learning of disciplinary knowledge obsolete.

Short-term working memory has a central role in learning disciplinary knowledge. Working memory has a limited capacity and its contents decay rapidly. The limitations of working memory create a bottleneck for processing new information.

Knowledge must be transferred of to long-term memory for durable learning before attempting to build on it with new learning. Otherwise working memory becomes overloaded, and learning is impeded. If students rely on technology to perform cognitive operations before securely embedding them in long-term memory, new learning is likely to be similarly impeded.

Some theorists argue that, because AI can provide easy access to knowledge, it is unnecessary for students to learn knowledge themselves. Instead, it is argued, they can focus on higher-order skills like critical thinking and creativity. However, both critical thinking and creativity rely on having well-structured knowledge automatically accessible in long-term memory. Without knowledge, critical thinking is shallow and creativity results in chaos.

Writing

Writing is a powerful means of communication, but it is more than this. It is also a means of enhancing thinking. Writing enables us to record our thoughts while we develop them further. In this way it partially overcomes the limitations of working memory.

AI can produce better written documents than most students, and most adults. Even so, it does not mean that students no longer need to learn to write themselves. If students are allowed to use AI to complete writing tasks, they will be deprived of a powerful tool for developing their thinking.

Guiding the educational use of AI with the science of learning

The science of learning cautions against uses of AI in education that could undermine the learning of essential knowledge and skills. AI should not be used to replace the intellectual, emotional, and social aspects of teacher-student relationships.

AI may be used to enhance learning when it is used under the supervision of a human teacher. If the use of AI is guided by understanding of working memory limitations, and the importance of systematically building knowledge in long-term memory, it will be able improve teachers' productivity.

For example, AI might be used to help students develop their mathematical problem-solving and writing skills through tailored practice and feedback. It could encourage students to think for themselves by asking open ended questions and to improve their thinking by critiquing their responses.

One of the most powerful tools at teachers' disposal is formative feedback. AI has much potential to provide targeted and specific feedback to students. By analysing students' work, it could correct errors before they become entrenched, reinforce what students have already learned, and give advice on their next steps towards their current learning goals.

AI has potential to enhance student assessment and create personalised profiles through advanced statistical analysis of large datasets. It could even streamline credentialing if its evaluation of student work becomes sufficiently reliable and valid.

Summary

The use of AI in education should be guided by cognitive principles to enhance disciplinary learning, not as a shortcut to bypass the difficult process of knowledge and skill acquisition.

While AI offers significant potential benefits, its use in education requires careful design and the guidance of skilled human teachers. It must support rather than undermine human learning.

ABOUT THE AUTHOR

Dr Michael Johnston is a Senior Research Fellow at the New Zealand Initiative. He is a cognitive psychologist by training and completed his PhD at the University of Melbourne in 1997. He commenced his academic career as a lecturer in psychology and became interested in educational assessment and measurement during a six-year tenure as Senior Statistician at the New Zealand Qualifications Authority. In 2011 he took up an academic role in the Faculty of Education at Victoria University of Wellington, where, prior to his appointment at the New Zealand Initiative, he was Associate Dean (Academic).