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Chapter 3 Focus

Some recent developments on artificial intelligence in Education

Éric Bruillard*

The book co-authored with Joël Boissière was published prior to the surge of artificial intelligence (AI) in education, particularly marked by the remarkable success of generative AI in producing text, images, and other media. It seemed essential to me to enhance the published text by incorporating certain elements that illuminate the ongoing transformations in this field.

Initially, we are witnessing an avalanche of texts, reactions, and debates, as if the advent of generative AI were poised to revolutionize everything, raising a multitude of challenges (such as cheating and other concerns) within educational systems. Yet, generative AI can also be viewed merely as a new iteration—an incomplete tool that has emerged within the socio-economic and educational spheres. Its use provokes critical questions as it undertakes tasks traditionally assigned to students or performed by teachers in their professional roles. However, it is worth noting a distinctive shift in the positioning of AI within educational practices. It is no longer perceived as a machine designed to replace the teacher, but rather as an assistant that supports students in accomplishing their tasks.

1 Mixed-Initiative Dialogues

Tracing the history of AI in education, the earliest teaching program leveraging AI techniques was a system called *Scholar*, developed by Carbonell in 1970. This program employed a mode of interaction known as mixed initiative, wherein both the learner and the system could alternately take the initiative and ask questions. Figure 1 provides an example of such a dialogue. The student (S) queries the system (C) in natural language—albeit using relatively simple sentences—and the system is capable of answering broad questions such as “Tell me about...” while subsequently returning to the prior topic of discussion.

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Figure 1: Session with SCHOLAR (Barr et Feigenbaum, 1982., p. 238)
Computer interventions are in **bold** and comments in *italics*.

C) What is the language of Argentina? S) Probably Spanish **C) Very good.** **Approximately what is the area of Argentina?** *...Student changes topic.* S) Tell me something about Peru. **C) Peru is a country.** **It is located in South America.** **The capital of Peru is Lima.** **Now answer the question you didn't answer before.** *... finally answers the question* S) The area of Argentina is 1,100,000 square miles.	**C) Approximately true, but a more exact value is 1,200,000.** **The eastern bordering country of Peru is -** *... Student makes a mistake which is corrected.* S) Catholicism. **C) False: Catholicism is not a country but a religion.** **The correct answer is: Brazil.** **Where is Peru?** *... and once again changes topic.* S) Is Asuncion hot? **C) Since Asuncion is part of Paraguay, yes.** S) What is the most important difference between Peru and Paraguay?

Thus, the initial research focused on a type of conversational agent, whose use proved particularly valuable during phases of exploration and, above all, review, through alternating questions and elaborations. The subsequent history of AI in education largely centered on the development of intelligent tutors, a field that faced significant challenges and was largely abandoned in the 1990s. By the 2000s, AI in education could only claim modest successes, except in the realm of conversational agents (dialogue models) and a few tutors, such as the Algebra Tutor in the United States, which were consistently tested in classrooms.

Moreover, there was a notable success in approaches that empowered humans through machines designed to adapt to their modes of thinking. These systems positioned themselves not as tutors but as assistants, tools, or "learners," introducing a new way of interacting with computers that became dominant. This shift led to the widespread adoption of various incomplete solvers—calculators, spellcheckers, measuring instruments, translators, and the like. However, it also placed a significant responsibility on schools to teach students how to use these imperfect tools effectively, a responsibility that educational systems have rarely fully embraced.

2 The Gradual Development of AI as an Assistant: From AI to AIs

In the evolution of computing, there has been a progressive effort to position AI as an assistant. However, the claim of "intelligence" required that machines be capable of autonomously handling certain tasks. For example, in the early 2000s, alongside search engines, intelligent search assistants or smart agents were introduced, designed to conduct searches on behalf of users. These systems, however, required users to articulate to the machine what they sought to find. Yet, challenges arose: (1) how to explain the query or (2) how to demonstrate it (e.g., selecting by example, showing rather than telling), and how to describe the elements that should be automatically extracted from an information stream.

In the broader field of office automation, AI also demonstrated its potential utility as an assistant—a virtual aide metaphorically perched on one's shoulder, observing tasks and suggesting corrections or improvements. This concept materialized in the form of the well-known "Clippit" or "Clippy," the animated paperclip assistant introduced alongside other animated characters in Office 97.

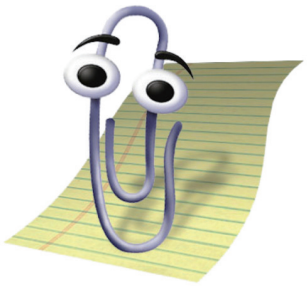

Figure 2: *Clippy: assistant paperclip**

* https://nohat.cc/f/clippit-microsoft-clippy/m2i8G6d3N4A0A0N4-201907231703.html (last access on july 2024 (same date for the links hereafter))

The assistant was designed to provide users with immediate help for various projects, relying on a series of Bayesian algorithms to determine the type of assistance required (e.g., typing cues). However, marketing research revealed that many users disliked this addition to the interface. Over time, Office users overwhelmingly rejected it, leading to its deactivation by default in Office XP and then its removal altogether[1]. As Rosalind Picard aptly noted in 2008, "While Clippit is a genius about Microsoft Office, he is an idiot about people, especially about handling emotions."[2]

Simultaneously, intelligent conversational agents were emerging in the realm of distance learning, capable of responding to student inquiries. One notable example is Jill Watson (Goel & Polepeddi, 2018), which operated only upon student request[3]. Today, Jill Watson harnesses the capabilities of ChatGPT (Taneja et al., 2024). Meanwhile, assistants such as Siri, Google Assistant, Alexa, Cortana, Bixby, and Djingo became integral to smartphones, enabling users to interact with and control other connected devices. These systems interpret and understand user requests, often providing highly relevant responses.

This evolution reintroduced the interplay between tutor, tool, and assistant roles. It revived the concept of mixed-initiative dialogues from the 1970s, now with much more open conversations and multilingual capabilities. These agents also link seamlessly with other programs to execute a wide range of tasks—generating text, creating images, programming, editing, translating, and more. These advancements transformed AI into *AIs*, emphasizing their expanded role as conversational agents with enhanced dialogue capabilities, supporting a broader spectrum of tasks.

Bill Gates (2023) observed that Clippy failed because it was a robot, not an agent, explaining its lack of success. He argued that AI would fundamentally transform how humans interact with computers:

> *"Agents are not only going to change how everyone interacts with computers. They're also going to upend the software industry, bringing about the biggest revolution in computing since we went from typing commands to tapping on icons."*

In education, adopting incomplete solvers via conversational agents will necessitate a rethinking of curricula, learning tasks, progression frameworks, and assessment methods. Crucially, it will involve decisions about the delegation of authority to machines. Historically, educational institutions have often

1 See, https://www.01net.com/actualites/clippyle-trombone-assistantdevrait-faire-son-retour-dans-la-suite-office-de-microsoft-2046056.html et https://www.youtube.com/watch?v=Dl3zNHfrFu0

2 See https://dspace.mit.edu/bitstream/handle/1721.1/137903/07.picard-EI-chapter.pdf?sequence=2&isAllowed=y

3 See also, AI-Powered Adaptive Learning: A Conversation with the Inventor of Jill Watson. https://www.onlineeducation.com/features/ai-teaching-assistant-jill-watson

responded to new tools by imposing partial or complete bans. Such prohibitions are usually short-lived, but embracing digital assistants complicates assessment tasks, challenging educational systems by potentially lowering exam success rates.

Some generative AIs have been labeled “stochastic parrots” (Bender et al., 2021), a metaphor reflecting their reliance on probabilistic models to generate human-like text without comprehension. This limitation can result in absurd outputs (e.g., hands with more than five fingers), underscoring the need for AI systems to explain their outputs—a capability they currently lack. While the reliability of responses in well-established knowledge domains, such as school curricula, is likely to improve, these systems will remain unable to justify their answers.

In educational settings, a “Columbo-style” interaction might develop, reminiscent of the iconic Californian detective who always knew the culprit but sought to uncover the evidence. Similarly, students may be presented with the correct answers and tasked with explaining or justifying them. This is a demanding process that many students may struggle to complete. If students are only given the answers, what will they truly have learned?

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