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Use of Artificial Intelligence in the flipped classroom.

Uso de la Inteligencia Artificial en la clase invertida.

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Editorial

Abstract. This paper proposes a reformulation of the flipped classroom model, supported by artificial intelligence, to shift direct instruction outside the classroom and reserve in-person time for activities of greater human and cognitive value. In this approach, AI guides the student through explanations, structured practice, and immediate feedback before the in-person session, while the classroom is dedicated to discussion, resolving conceptual errors, practical application, and collaborative learning. The model is structured around three pillars: (1) the outsourcing of instruction and guided practice by AI following the sequence "I do, we do, you do"; (2) the personalized contextualization of examples and problems without altering the disciplinary content; and (3) immediate and adaptive formative feedback. Although initially developed for university algebra, the approach is transferable to other disciplines such as biology, economics, physics, or literature. Far from being an isolated innovation, the proposal integrates pedagogical approaches widely supported by research: the flipped classroom, gradual empowerment, explicit instruction, formative feedback, contextualized learning, and active learning strategies. The model's distinctive contribution lies in how AI enables these practices to be implemented more efficiently and in a more personalized way. Taken together, the proposal redefines the role of educational technology: AI does not replace the teacher, but rather takes on repetitive and scalable tasks—explanation, practice, and immediate feedback—to free up human time for meaningful interaction, interpreting difficulties, discussion, and building a community in the classroom.

Keywords: flipped classroom, artificial intelligence, feedback, instructional design, educational innovation.

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In a recent reading, we came across an interview with Dr. Doreen Mayrell, a professor at Colin College in McKinney, Texas, USA, about how to invert the teaching of university algebra so that class time focuses on practical applications, misconceptions, and mathematics that students feel connected to (1). I believe her teachings are transferable to any discipline.

The class investment structure is as follows:

- Artificial intelligence (AI) handles direct instruction and guided practice outside the classroom (she calls it the "I do, we do, you do" approach). Students arrive prepared with notes and questions, and in-person time is reserved for activities requiring human interaction (discussion, application, and correction of conceptual errors). This approach would work similarly in biology (AI guides the study of concepts and terminology, while the classroom is used for labs and case studies), or in other fields.
- The second key element is personalizing the context without altering the content. In mathematics, she replaces marbles with handbags or coins from a video game. In other subjects, the equivalent would be adapting the examples and scenarios to the student's world: an economics concept explained through a business they are interested in, a physics principle applied to their sport, or a literary text connected to topics that matter to them.
- And the third pillar, immediate feedback, is perhaps the most universal. In any subject, knowing instantly where your reasoning went astray and receiving additional exercises tailored to that error is more effective than waiting days for the teacher to return a corrected assignment.

Dr. Mayrell's model doesn't invent anything from scratch. What it does is combine several well-documented pedagogical approaches and use AI as a tool to implement them more efficiently. These are the foundations on which it is based:

1. Flipped Classroom. The concept was popularized by Jonathan Bergmann and Aaron Sams, two chemistry teachers who began recording their lectures for students to watch at home, dedicating class time to problem-solving. Their book, Flip Your Classroom: Reach Every Student in Every Class Every Day (2012), is the foundational reference (2). The central idea is that the transmission of information (the more passive part of learning) should occur outside the classroom, and time with the teacher should be reserved for more cognitively demanding activities. Dr. Mayrell follows this exact model, but replaces the recorded video with an AI tutor.
2. Gradual release of responsibility ("I do, we do, you do"). This framework stems from the work of Pearson and Gallagher (3), who proposed a model in which cognitive responsibility is progressively transferred from the teacher to the student. First, the teacher demonstrates, then they practice together, and finally, the student works independently. It is one of the most research-supported direct instruction structures.
3. Explicit direct instruction. Although sometimes confused with traditional lectures, direct instruction as described by Rosenshine in his "Principles of Instruction" (4) involves presenting the content in clear steps, modeling the procedure, checking for understanding, and providing guided practice before independent practice. The AI tutor in this model fulfills that role: presenting, guiding, and checking before the student arrives in the classroom.
4. Immediate formative feedback. The work of John Hattie, especially in Visible Learning (5), places feedback among the factors with the greatest impact on learning, provided it is

timely, specific, and aimed at closing the gap between what the student knows and what they need to know. AI enables something a teacher alone cannot do: provide individualized feedback to each student at the moment they make a mistake.

5. Contextualized and situated learning. The idea that learning improves when connected to contexts meaningful to the student has its roots in Lave and Wenger's work on situated learning (6) and in Ausubel's theory of meaningful learning (7), which holds that new knowledge is best integrated when anchored to what the student already knows and cares about. When Dr. Mayrell transforms a marbles problem into one involving purses or video game coins, she is applying this principle: the mathematical content remains the same, but the contextual scaffolding makes it more accessible.
6. Active learning. The decision to reserve class time for paper-and-pencil work and group discussion aligns with decades of research on active learning. Freeman et al. (8) published a meta-analysis in the Proceedings of the National Academy of Sciences that reviewed 225 studies and concluded that active learning reduces failure rates and improves performance compared to traditional lectures.

What makes Dr. Mayrell's model interesting is not any of these ideas individually, but how she assembles them. AI doesn't replace the teacher or turn the class into a technological exercise. It absorbs the tasks that technology can do well (explaining, providing repetitive practice, offering immediate feedback, personalizing contexts) so that human time can be dedicated to what technology cannot: reading the confusion on a student's face, facilitating discussion, and building community. Naturally, this model also raises questions about technological dependence, the quality of automated feedback, and inequalities of access—issues that will require rigorous empirical evaluation.

At the end of the article, an infographic detailing this model is presented.

The question is not whether AI will enter the university classroom, but what aspects of teaching we will decide to reserve for human interaction.

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