AI Predicting Lesson Plans: The Influence of Teacher and Textbook

Maya Bialik
Boston University

Pelin Jackson
Boston University

Leslie Dietiker
Boston University

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Abstract

In order to learn about AI's capacity to support teacher lesson planning, this study investigates whether ChatGPT-o3 can predict how two high school mathematics teachers with different instructional orientations design lessons when given curriculum materials with different design intentions. When provided with lesson plans designed by the same teachers with other curriculum materials and an interview that captured each teacher's approaches to instruction, the AI-generated lesson plans closely resembled the teachers' plans in how new and old content were introduced and how activities were sequenced. When the curriculum materials and the teachers' orientations were misaligned, the AI responded by introducing new content in a manner aligned with the teacher's orientation. Interestingly, in all cases, AI increased the proportion of student-driven content.

Introduction

Could AI support teachers by designing lessons that align with the teacher's assumptions about and views on teaching and learning, i.e., their instructional orientations? Mathematics teachers dedicate significant time and effort to planning lessons (Hammer & Ufer, 2023), often using curriculum materials as part of this process (Remillard, 2005; Brown, 2009). This planning process is demanding, especially considering the many responsibilities teachers shoulder (Lin et al., 2024). Additional complexity arises when there is a misalignment between the design intentions of curriculum materials (curriculum designers' goals and visions for how teaching and learning should unfold in the classroom) and teachers' instructional orientations (Dietiker & Riling, 2018). Thus, there is a need to develop ways of supporting teachers in lesson planning that may reduce their workload and, in turn, improve their overall professional practice (John et al., 2024; Hu et al., 2025). One promising approach in this regard is leveraging the affordances of AI tools to support teachers as they plan lessons with curriculum materials (e.g., Keppler et al., 2024). This approach is not unreasonable, given that teachers are increasingly turning to AI to support their instruction (e.g., Song et al., 2025).

However, generative AI is not neutral, and it has the potential to replace teachers' curricular intentions with its own instructional biases (Bozkurt et al., 2024). Therefore, intervention is needed to enable a teacher to use AI to design a lesson without overriding their curricular vision (Drake & Sherin, 2009). Accordingly, we ask the following research questions: When AI is trained with a teacher's existing lesson designs, to what extent can it predict this teacher's lesson plan when provided with the corresponding textbook lesson? Does AI prioritize certain forms of instruction?

Theoretical Framework

For this study, we define curriculum as the design of content for the purposes of supporting learning. It takes different forms, such as a textbook or a teacher's lesson plans. Even when a teacher plans with the support of a textbook, the resulting lesson is different from that in the textbook, and both are designed with intention and influenced by the instructional orientation of its designers (i.e., teacher or textbook writer). When curriculum (teacher's or textbook's) is designed so that mathematical content is made explicit through direct statements of fact, we refer to it as teacher- or textbook-driven (condensed to teacher-driven). When it is designed so that students produce mathematical ideas through activity, we refer to it as student-driven. When the instructional orientations of teachers and textbook designers differ, tensions may emerge (i.e., "pulls" between differing visions for mathematical teaching and learning), which can compel teachers to create adaptations that mediate or resolve these differences (Dietiker & Riling, 2018).

A lesson is a bounded unit of curriculum that consists of multiple elements (e.g., investigations, lectures, tasks) that are designed to be enacted across one or more class sessions. Lessons may vary in length, topic, and formality, and can contain a mixture of new content (i.e., concepts and procedures) and previously learned material. Within a lesson, an act is a coherent unit of instruction focused on a single curricular element and form of engagement—such as working on a task, discussing a worked example, or presenting an idea. Each act is either teacher-driven new content (e.g., lecture), teacher-driven old content (e.g., teacher-led review), student-driven new content (e.g., exploration), or student-driven old content (e.g., practice exercises for students). Acts are the building blocks of a lesson's instructional sequence, and their sequence forms the lesson's narrative.

Methods

Data Collection

This study is part of a larger research project involving six practicing high school mathematics teachers from the greater Boston area who were interviewed about their instructional orientations and asked to plan lessons using four different curriculum materials. These lessons, referred to as A through D and taken from the textbooks *Glencoe's Algebra 1* (A), *Big Ideas Math Algebra 1: A Common Core Curriculum* (B), *CPM's Core Connections Algebra* (C), and *IMP Year 1* (D), differ in design intentions. A and B introduce new content primarily through exposition (e.g., explicit statements of fact), and C and D introduce new content through student-led explorations (where students engage in problem solving to generate new understandings).

For this study, we focused on the lesson planning practices of two teachers, Ms. Templeton[1] and Ms. Schneider, using data on how these two teachers planned four lessons on systems of equations, each from a different textbook. We prompted ChatGPT-o3 to predict how each would plan with A and D, creating two cases of alignment (Ms. Templeton and A are both teacher-driven, Ms. Schneider and D are both student-driven), as well as two cases of misalignment.

We used ChatGPT-o3 because ChatGPT is a widely and increasingly used AI tool in the US (Gallup, 2025), and the reasoning (o3) model allowed us to monitor the AI's "chain of thought" to ensure there were no major confusions (OpenAI, 2025). We used four sub-prompts: (1) PDFs of the three non-focal textbook lessons; (2) lesson plans organized in tables with acts for those lessons; (3) a transcript of an interview on the teacher's instructional views and values; and (4) the PDF of the focal textbook lesson along with a statement on teachers' active engagement with textbooks,

[1]The first letter of each pseudonym corresponds to the teacher's instructional orientation: "T" for teacher-driven and "S" for student-driven.

drawing on Brown (2009), Remillard (2005), and Dietiker et al. (2018). For the full prompt, see Figure 1.

Data Analysis

After the AI generated predictions about how Ms. Templeton and Ms. Schneider would plan with A and D, we identified acts. For each act, we coded for new and old content, as well as teacher-driven or student-driven focus. We then compared those predictions to the actual lesson plans of these teachers based on the data from the larger study. First, two researchers worked together to reach a consensus on matching each act of the teacher-planned and AI-planned lessons, based on its function in the lesson and/or the textbook content it addressed. We then compared the teacher's and AI's lesson plans for similarities and differences between (a) the instructional sequences, (b) instructional modes (whole class, groups, etc.), (c) the nature of content (i.e., new, old), and (d) instructional orientations (i.e., student-driven, teacher-driven). In cases of disagreement, the third researcher was consulted.

Findings

When the curriculum materials were more closely aligned with the teacher's instructional orientation, the AI's predictions were more accurate than when they were unaligned. Notably, the AI tended to make lessons more student-driven.

Cases of Alignment: Comparison of Student-Driven vs. Teacher-Driven Content

In cases of alignment, the AI's predictions regarding the proportion of student-driven versus teacher-driven activities, and whether these would involve new or old content, closely mirrored the teacher's lesson plans, with slight variations (Figure 2).

For D, both Ms. Schneider's and the AI's plans placed a strong emphasis on student-driven new content, and the proportions were similar (44.4% vs. 40% respectively). However, whereas Ms. Schneider's plan balanced student-centered new content and teacher-centered new content, the AI placed a greater emphasis on student-driven new content compared to teacher-driven new content. In this sense, the AI's plan was even more student-driven than Ms. Schneider's lesson plan.

Similarly, for A, the AI accurately predicted Ms. Templeton would include neither student-led new content nor teacher-led review of old content. However, the AI added greater emphasis on student-driven old content compared to Ms. Templeton (62.5% vs. 40.0% respectively). So, again, the AI increased the emphasis on student-driven activity.

Cases of Alignment: Comparing the Instructional Sequence

In cases of alignment, the AI was also successful in predicting the sequence of activities within a lesson (Figure 3). For D, the AI accurately anticipated that Ms. Schneider would begin with a warm-up to assess prior knowledge, followed by a whole-class discussion to orient students toward new content. It also predicted that this would be followed by student-led explorations, followed by practice exercises, and student reflection.

Similarly, for A, the AI accurately predicted that Ms. Templeton would begin with a warm-up, followed by a teacher-led exposition introducing key vocabulary and concepts. This would be followed by worked examples that presented new content through step-by-step guidance, and conclude with student-led practice to reinforce the material.

Cases of Misalignment: Comparison of Student-Driven vs. Teacher-Driven Content

Overall, when the orientations of the teacher and textbook were misaligned, both the AI and the teacher attempted to reconcile the tension between the curriculum materials and the teacher's goals (Figure 4). However, AI's predictions diverged more acutely from the teachers' plans when compared to the cases of alignment.

With A, the AI accurately predicted that Ms. Schneider would allocate most of her lesson to student-driven content (old and new). However, Ms. Schneider emphasized student-led explorations as a greater proportion of the planned lesson (50%) compared to the AI (33.3%). Another notable difference was that the AI predicted that Ms. Schneider's plan would not include any acts where the new content would be introduced by the teacher. Again, the AI designed a lesson that was more student-driven than Ms. Schneider's lesson.

With D, the AI accurately predicted that Ms. Templeton's plan would have no new content emerge via student-driven activities. However, the AI allocated a higher proportion to student-driven old content, resulting once again in a lesson with more student-driven activity overall. Another notable difference was that Ms. Templeton's plan did not include any new content, whereas AI dedicated 16.7% of the lesson to teacher-driven new content. This is because when Ms. Templeton was planning with D, she interpreted the entire lesson to be a review of previously learned content, not recognizing that the textbook intended for the new content to emerge through student-led explorations. However, the AI instead allowed new content to emerge.

Cases of Misalignment: Comparing the Instructional Sequence

Even when the teacher's and textbook's orientations were misaligned, AI was still successful in predicting the sequence of activities, albeit with slightly more variation (Figure 5). For A, the AI correctly predicted that Ms. Schneider would include a warm-up, followed by a whole-class discussion, and then student-led explorations. However, at this point, the AI and Ms. Schneider diverged slightly. AI inserted practice problems during the exploration phase, whereas Ms. Schneider introduced all new content first and then followed with student-led practice.

For D, the AI predicted a similar sequence to what Ms. Templeton planned: they both planned a warm-up, a whole-class discussion covering key vocabulary and concepts, teacher-led exposition demonstrating procedures, and a set of practice problems.

Across Cases: AI Additions and Omissions

Overall, the AI added more acts than it omitted (Table 1). It added an exit ticket and additional practice to three out of four lesson plans. It also both omitted and added expositions, explorations, and share-outs (groups present while the teacher records common steps) across the other teachers and lessons.

Discussion

Our study demonstrates that if teachers use AI to plan lessons, AI can produce lesson plans that are strikingly similar to those that would be designed by them, regardless of their instructional orientations and the textbook's design. While prior work has suggested that AI tools may default to teacher-driven approaches when given no context (Chen et al., 2025), our findings indicate that when provided with relevant context, AI can flexibly design lessons that align with a teacher's

Table 1: Added and omitted lesson acts.

	Additions	Omissions
Ms. Schneider with A	Exploration	Exposition
	Practice	Exploration
	Exit Ticket	
Ms. Schneider with D	2 Exploration	
	Exposition	
	Practice	
Ms. Templeton with A	2 Practice	Share-Out
	Exit Ticket	
Ms. Templeton with D	Share-Out	Exposition
	Exit Ticket	

instructional orientation, whether it is student or teacher-driven. Even when asked to plan with curriculum materials that are misaligned with the teacher's instructional orientations, the AI was able to predict how the teacher would prefer for new content to be introduced. Moreover, we observed that across all lessons, the AI-generated plans included more student-driven activities than the teacher's plan, even if the difference was slight in some cases.

We would also like to highlight that the AI was particularly successful in predicting how the activities would unfold in the lesson. Even in cases of misalignment, the AI's predicted instructional sequences closely matched those in the teacher's lesson plans. This may be attributed to AI being trained on training corpora that may include stories. Despite only having two teachers, this investigation shows that having AI predict lesson designs is promising.

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We asked a teacher to plan lessons with three textbooks, one at a time across different planning sessions. The textbooks are called Big Ideas, CPM, and Interactive Mathematics Program. I am going to upload the PDFs from these textbooks now. Each PDF is a lesson about systems of equations. The one from Big Ideas is about introduction to special systems of equations. CPM is introduction to solving systems of equations by elimination, and Interactive Mathematics Program is about introduction to solving systems of equations by substitution. Wait for further instructions before doing anything.

Got it—I'm standing by whenever you're ready.

I am also going to upload tables representing how this teacher planned lessons with these three textbooks. Please note that in the last column, we coded each act based on two dimensions: who was expected to generate the math ideas (i.e., teacher/textbook or student) and whether the content in focus was new or review of previously-learned content. For new versus old content, we are referring to whether at that moment in the lesson that content is new or old for the students. For instance, if students are working on quadratic equations and have already learned the quadratic formula at the beginning of the lesson, any subsequent task that asks them to apply the formula—without introducing new content, concepts, or insights—would be coded as involving previously covered content. Wait for further instructions before doing anything.

All set—I'm standing by for your next instructions.

I am also going to include an interview conducted with this teacher to give you more insights about their teaching orientations and background. Wait for further instructions before doing anything.

Ready whenever you are—just let me know what you'd like me to do next!

I will now upload a fourth textbook, Glencoe with a lesson about introduction to solving systems of equations by graphing. I would like you to predict how the same teacher will plan a lesson with this textbook, by creating a table in the same format as the other planned lessons. But please also add a "why" column where you write down the rationale for the teacher's choices. Make sure the table lays out what the teacher would do in order, step by step, and which textbook components they use for which step with page numbers. Make sure the format mimics the format of other tables that I uploaded. Thus, it will be formatted as Column 1: Act; Column 2: Content; Column 3: Activity; Column 4: Student-Centered vs Teacher Centered and New vs Old; Column 5: Why.

It is important to point out that teachers interact with curriculum actively. They don't passively relay these materials. They can choose to take them up in ways that align with their orientations. By orientations, I am referring to the assumptions they have about teaching, learning, curriculum, students, mathematics, and more. Based on these assumptions, they may choose to use tasks as they are, change certain components to better fit their assumptions, choose not to include certain tasks, or improvise new elements that aren't in the textbook. Consider what you can learn about this teacher's orientations, and how those orientations and beliefs would affect the table you generate. Here is the Glencoe textbook. You may now generate the table for Glencoe.

Figure 1: The full prompt given to the AI.

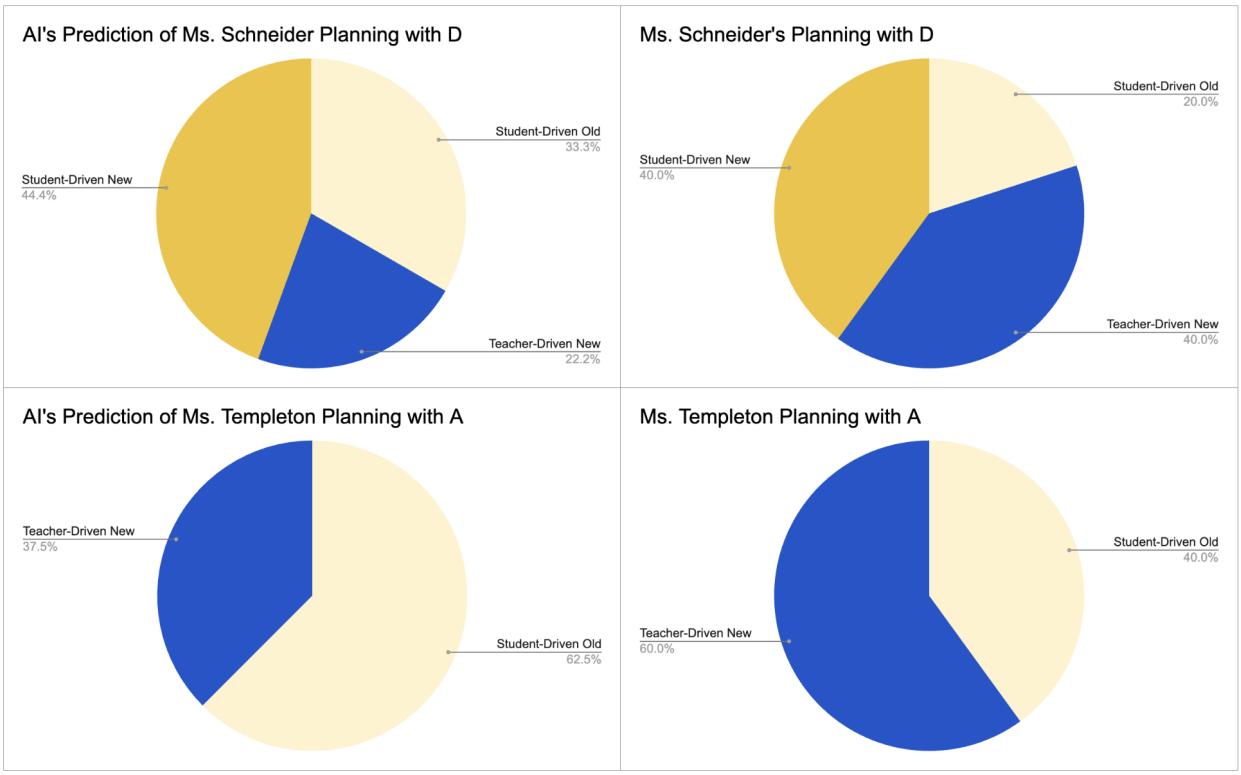

Figure 2: Comparison of AI-generated and teacher-generated lesson plans in cases of alignment.

Figure 3

AI-generated vs. Teacher-generated Instructional Sequence in Cases of Alignment

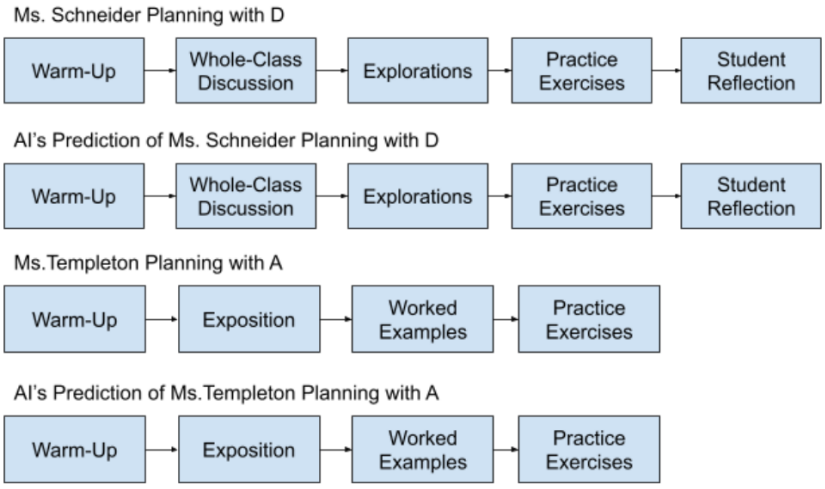

Figure 3: AI-generated vs. teacher-generated instructional sequence in cases of alignment.

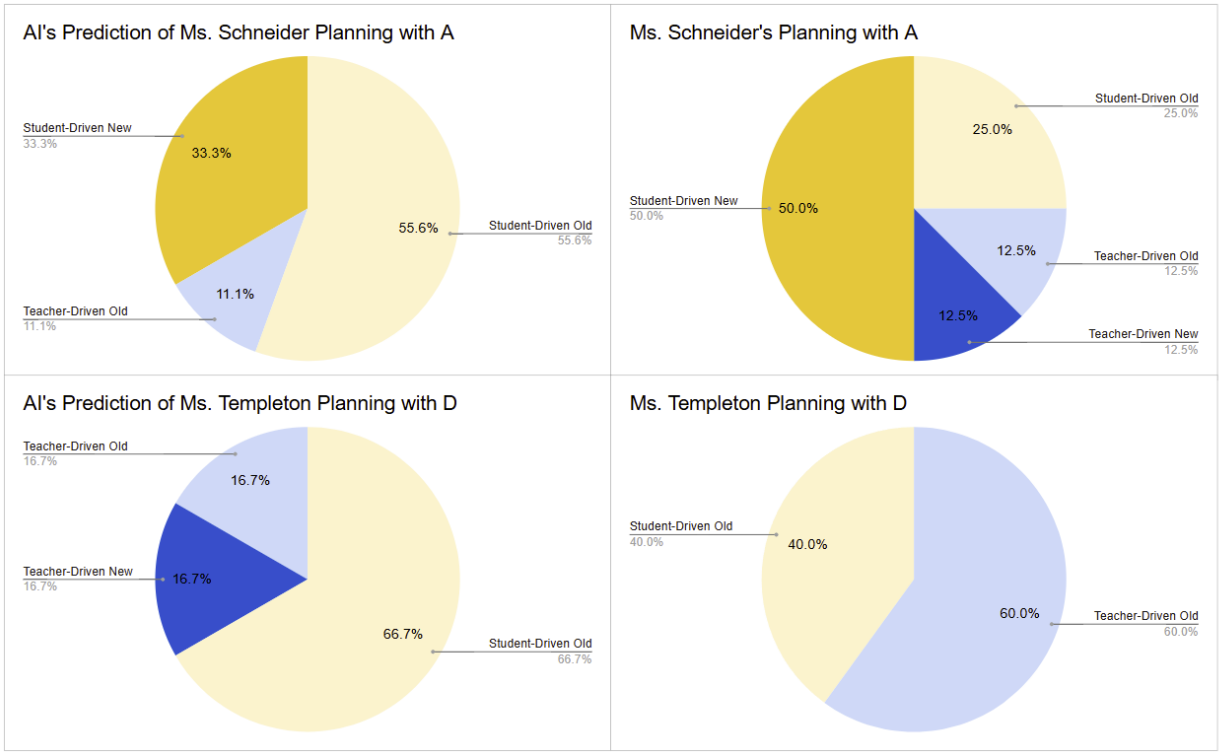

Figure 4: Comparison of AI-generated and teacher-generated lesson plans in cases of misalignment.

Figure 5

AI-generated vs. Teacher-generated Instructional Sequence in Cases of Misalignment

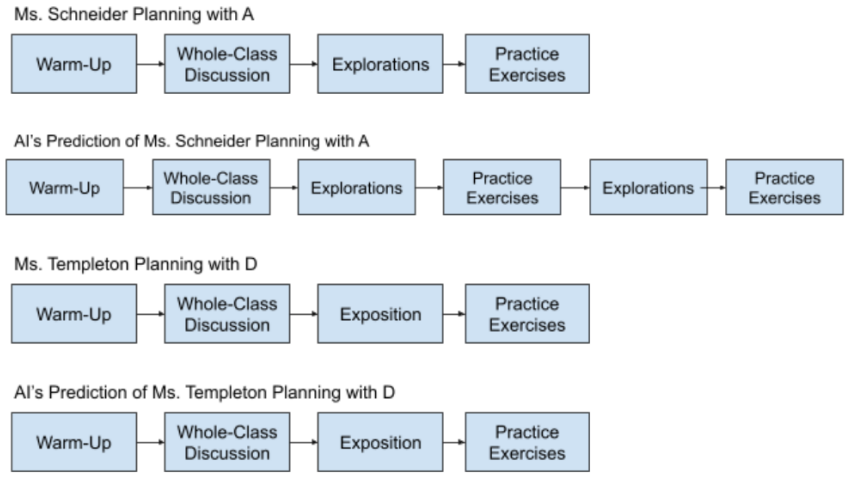

Figure 5: AI-generated vs. teacher-generated instructional sequence in cases of misalignment.