

Discussing Early Efforts Integrating ChatGPT into Mathematics Teacher Preparation Courses

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ChatGPT, generative artificial intelligence (AI) developed by OpenAI, has the potential to improve teaching and learning by reducing the amount of time teachers spend on time-consuming tasks, improving the quality of materials through tailored prompts, while also allowing teachers more time devoted to the individual needs of their students (Rasul et al., 2023). In the spring of 2023, ChatGPT 3.5 was used as a behind-the-scenes creator of tailored examples for preservice teachers (PSTs) in my undergraduate mathematics methods courses, while more recent efforts include in-class exploration. For example, during the fall 2023 semester, PSTs were paired to explore ChatGPT to then share what they learned with their peers. The takeaways that they were excited about included rubric creation, assessment creation, and differentiation suggestions. The two approaches to supporting PSTs to collaborate with ChatGPT discussed in this paper include (a) lesson design experiences and (b) real-time interactions.

Lesson Design Experiences

Experiences with lesson design involved the professor providing PSTs with pre-generated ChatGPT lesson plans. In the spring 2023 semester, secondary PSTs were provided a ChatGPT-created 5E lesson plan for their chosen standard as part of a summative assignment comprised of the design and microteaching of one mini-lesson. Inspired by past experiences with PSTs relying too heavily on activities from sites such as TeachersPayTeachers.com, the goal was to provide PSTs with a base example of a 5E lesson plan on their selected standard so that they were forced to examine a more intentionally cohesive lesson plan. Following the perceived initial success stemming from the provision of one lesson plan, the notion arose to provide PSTs with four different lesson plans on a same standard. The goal for the lesson plan comparison was to familiarize PSTs with various lesson plan types and expose them to alternative approaches to teaching a concept. In the spring 2024 semester, pairs of secondary PSTs were provided four different ChatGPT-created lesson plans: direct instruction, 5E, inquiry, and phenomenon-based. ChatGPT was asked for “a quality 50-minute (lesson plan type) on (specific state standard).” To be certain each lesson plan was sufficiently unique, sometimes a second query was made specifically requesting the lesson plan type but “not (repeated theme).” The resulting lesson plans, while not necessarily adhering to the requested type, provided four different approaches to teaching a single academic standard. The activity was also framed with the lens of being critical consumers of AI-generated lesson plans – what were affordances and constraints?


Real-Time Think Partner

In a middle grades mathematics methods course, after asking PSTs to practice writing a learning goal and a performance goal (NCTM, 2017) for homework for a

mathematics standard of their choice, the PSTs were partnered in class to reflect on each other's efforts. After initial discussions, the professor prompted ChatGPT to complete a similar task with a selected standard (see Figure 1). Students were then instructed to take turns in their pairs, prompting ChatGPT with the same prompt, but copying and pasting their selected standard and then comparing ChatGPT's response to their own constructed homework response.

Figure 1:
ChatGPT's Goals for KY.7.SP.0 (Kentucky Department of Education, 2019)

Please provide both a performance goal and a learning goal for this standard: Create displays, including circle graphs (pie charts), scaled pictographs and bar graphs, to compare and analyze distributions of categorical data from both matching and different-sized samples.



Performance Goal:
Create visually accurate and informative displays, including circle graphs (pie charts), scaled pictographs, and bar graphs, that effectively compare and analyze distributions of categorical data from both matching and different-sized samples. The displays should accurately represent the data, display appropriate labels, titles, and scales, and convey meaningful insights about the data's distribution and patterns.

Learning Goal:
By the end of this standard, students should be able to proficiently generate various types of displays, such as circle graphs (pie charts), scaled pictographs, and bar graphs. They should understand how to select the appropriate type of display based on the nature of the categorical data and the purpose of the analysis. Students should also be able to accurately interpret and analyze these displays, recognizing trends, outliers, and proportions within the data. Additionally, they should have the ability to critique poorly designed displays and explain why certain graphical choices may misrepresent or obscure the data. This will demonstrate a mastery of both creating and comprehending graphical representations of categorical data for effective communication and analysis.

Later, in a course for secondary PSTs, ChatGPT was used as a thinking partner while designing questions that align with the National Research Council's (2001) strands of proficiency. Specifically, PSTs made a first attempt without the assistance of ChatGPT, then during a meeting to discuss their progress, ChatGPT's brain was picked for ideas for different types of questions or better wording of previously created questions. For example, a common request was "what are three questions that focus on (specific NRC strand) with this standard: (specific state standard)." The prompt for multiple examples was intentional to show PSTs that they could request several to simultaneously consider.

Reflections

The lesson design experiences are still being refined. Anecdotally, in the class that taught their lesson, their lesson plans and microteaching of those lessons were stronger than in previous semesters. Instead of having one segment of the lesson that was their motivation for doing the lesson, the PSTs had more interconnected sequences of learning experiences. Lee et al. (2016) also noted improved quality when PSTs modified lesson plans suggesting that PSTs experience more success when modifying

content as opposed to designing content. The secondary PSTs who discussed the different types of lesson plans were critical of the time expectations, underdeveloped-ness of lesson plans, and the overly formulaic nature of the lesson structure, but were grateful for the exposure to various ways of teaching one standard and not having to start from scratch.

The real-time use of ChatGPT created opportunities for more tailored learning experiences. In the middle grades class, discussion comparing goals included delight at overlapping ideas, inquiry related to content, and distinctions between the two types of goals. Reflecting on the real-time editing of assessment questions with secondary PSTs, the process was less formulaic as there was no specific set of prompts used. However, the PSTs communicated appreciation for the ways ChatGPT could aid with question refinement – both in terms of content and wording. The real-time use of ChatGPT, while imperfect, was important for PSTs to consider how to interact with AI for similar queries on their own.

Discussion

The positive experiences working with ChatGPT hinge on its capacity to create tailored examples in response to specific, detailed prompts. PSTs, who might struggle with designing an inquiry lesson on certain standards, can now not only prompt ChatGPT for ideas, but also a plan to enact such a lesson. This new ability raises the question of how to support PSTs to be content modifiers. The known possible factual errors that ChatGPT may generate necessitates that PSTs rely on their pedagogical content knowledge to filter AI-created lesson plans for accuracy related to content (Trust et al., 2023). NCTM's AI position statement also suggests teachers need even deeper knowledge of math instruction and assessment (NCTM, 2024). In conclusion, the examples shared in this paper utilized ChatGPT to generate products that were not put into action without modification, but to have discussions to refine understandings of definitions, refine rough draft ideas, and consider lesson design from examples. While there is positive potential, concerns remain about how to support PSTs' use of AI as professionals.

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