Prompt Strategies in Lesson Plan Assessment: Insights fr

Pre-Service Teachers' Prompt Dataset

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Introduction

- Some studies indicate that how learners use GenAI reflects their critical thinking skills (Liu etal., 2024). Conversely, some research suggests that GenAI may foster poor learning behaviours and weaken critical evaluation (Lo et al., 2024; Zirar, 2023). Therefore, to investigate whether and how GenAI benefits learners, researchers need more detailed evidence to explore human-AI interaction process.

- In the human-AI interaction process, prompting serves as the bridge linking human inquiry and AI feedback. As a new 21st century skill, prompting facilitates precise communication of problems to an AI assistant by articulating the problems, their context, and the constraints of the desired solution (Federiakin et al., 2024).

- Prompt formulation requires users to self-aware of their task goals and convert their tasks into sub-tasks, verbalizing these as effective prompts followed by iterative output evaluation and adjustment (Tankelevitch et al., 2024). Through practice and learning, effective prompting skills can be acquired (Oppenlaender et al., 2024).

Research questions

While prior studies have explored how teachers and students use GenAI for content generation, less attention has been paid to how pre-service teachers prompt GenAI to support complex teaching tasks like lesson plan assessment. In the GenAI era, teacher need to develop AI literacy to know when and how to critically use AI tools in class (Ding et al., 2024). Moreover, most studies did not explore the human-AI interaction process and how users iterate their prompting strategies during complex task processing.

Using a dynamic process perspective, this study explored the cognitive process in GenAI-assisted lesson plan assessment task. On the one hand, this study contributes to understanding the human-AI interaction process from a dynamic perspective. On the other hand, the extracted prompting strategies from the human-AI interaction and the task design provide insights into pre-service teacher training in lesson plan design and assessment in the GenAI age.

- What prompt strategies do pre-service teachers use when assessing lesson plans with GenAI tools?

Methods

- **Participants:** Participants were 45 student teachers (third-year university students) in secondary school physics courses. They were required to assess their own lesson plans and their peers' lesson plans using a GenAI assistance tool.

- **Context**:

In this study, ERNIE driven GenAI, Wenxinyiyan (a popular local GenAI driven by local LLMs), was selected for the lesson plan revision task due to its unlimited access to file uploading in human-AI interaction without payment.

To support students efficiently and critically evaluating and modifying lesson plans, a simple lesson plan evaluation guide was provided, including tips on word construction in prompting and suggested attitudes towards generated output for assessment tasks. Students interacted with the GenAI in their mother language (Chinese).

Methods

- **Data collection:** Human-AI interaction screen recordings from these students were collected, and prompt datasets were manually extracted from the screen recordings.

- **Data analysis**:

Interpretive analysis was conducted as the qualitative method. Following the thematic analysis procedure proposed by (Braun & Clarke, 2006), prompting strategies were extracted and synthesized.

These prompts were analyzed using open coding to identify patterns in prompt strategies. Two coders independently reviewed the data, with one researcher coding 25% of the prompt data and another coding all of it. The code results achieved 90% consensus on thematic categories.

Moreover, several prompt strategies or patterns were used as references to analyze the prompts used by the participants and provide more practical implementations.

- **Data visualization**: To visualize the prompt interation process, a Sankey diagram of the 1st prompts, students' responses to the generated outputs, and the 2nd prompts was drawn.

Results

As shown in Figure 1, the most frequent prompting strategies used were Specific part (inquiry) (98), File+inquiry (67), Generated outputs (31), Prior prompting+new inquiry (24), Retry prior prompt (12). Some less frequently used but inspiring prompting strategies were GenAI recommended prompting, Ask GenAI self-reflection, Prior prompting+paragraphs, Combining prior-prompt, Search engine, and Another GenAI tool. More details of the prompting formation can be found in the section For Further Prompting.

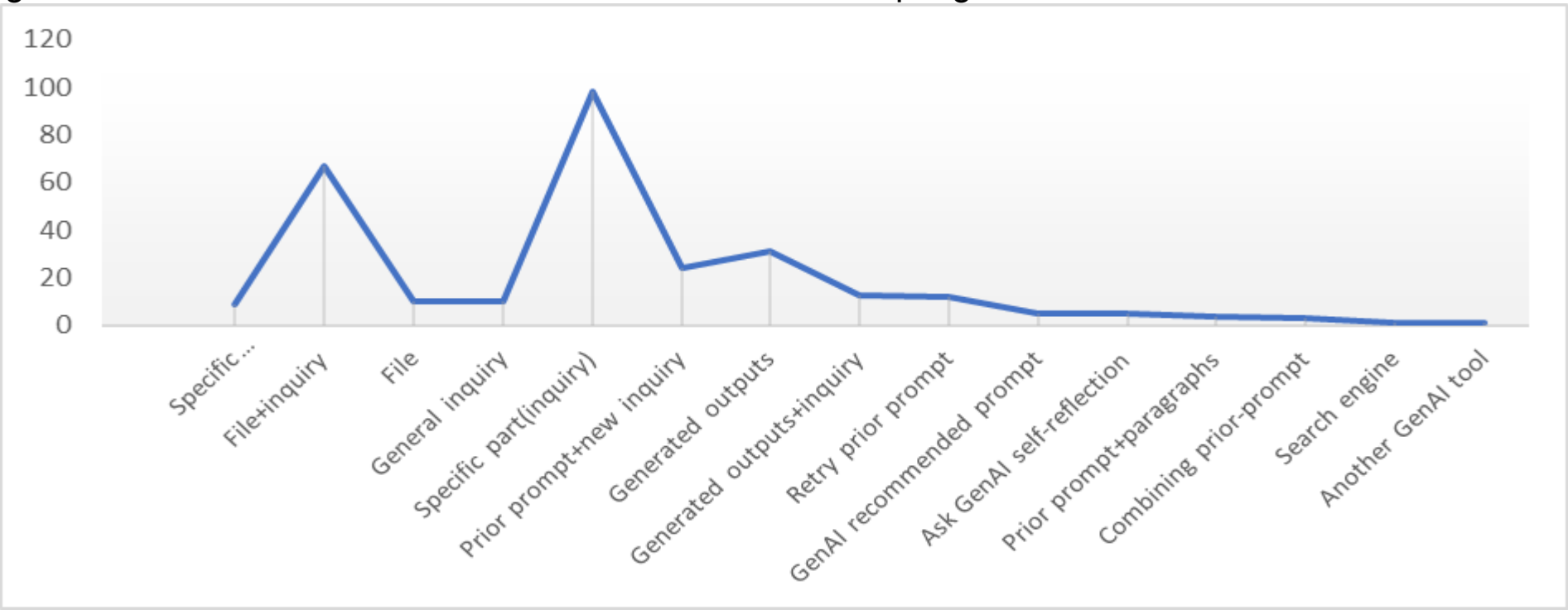

Figure 1. Frequently used prompting methods.

Note: the leftmost method is “Specific part(inquiry+paragraphs)”

Results

For 1st Prompting
At the starting point, most of participants initiated prompts in a combination form, including uploading lesson plan document through upload file button and providing a relatively general task requirement in the input, such as "Help me modify the lesson plan" or “Help me revise the lesson plan according to the teaching objectives”.

For Response to 1st Prompting
Two main approaches were found to deal with the generated output from the first prompt. One approach involved a new document, pasting all the generated output in it, and then comparing the generated outputs with their own lesson plans. The other approach involved directly comparing the generated output with the lesson plan and then take actions adoptively (either coping and enriching the pasted outputs or doing further prompting as shown in Figure 2).

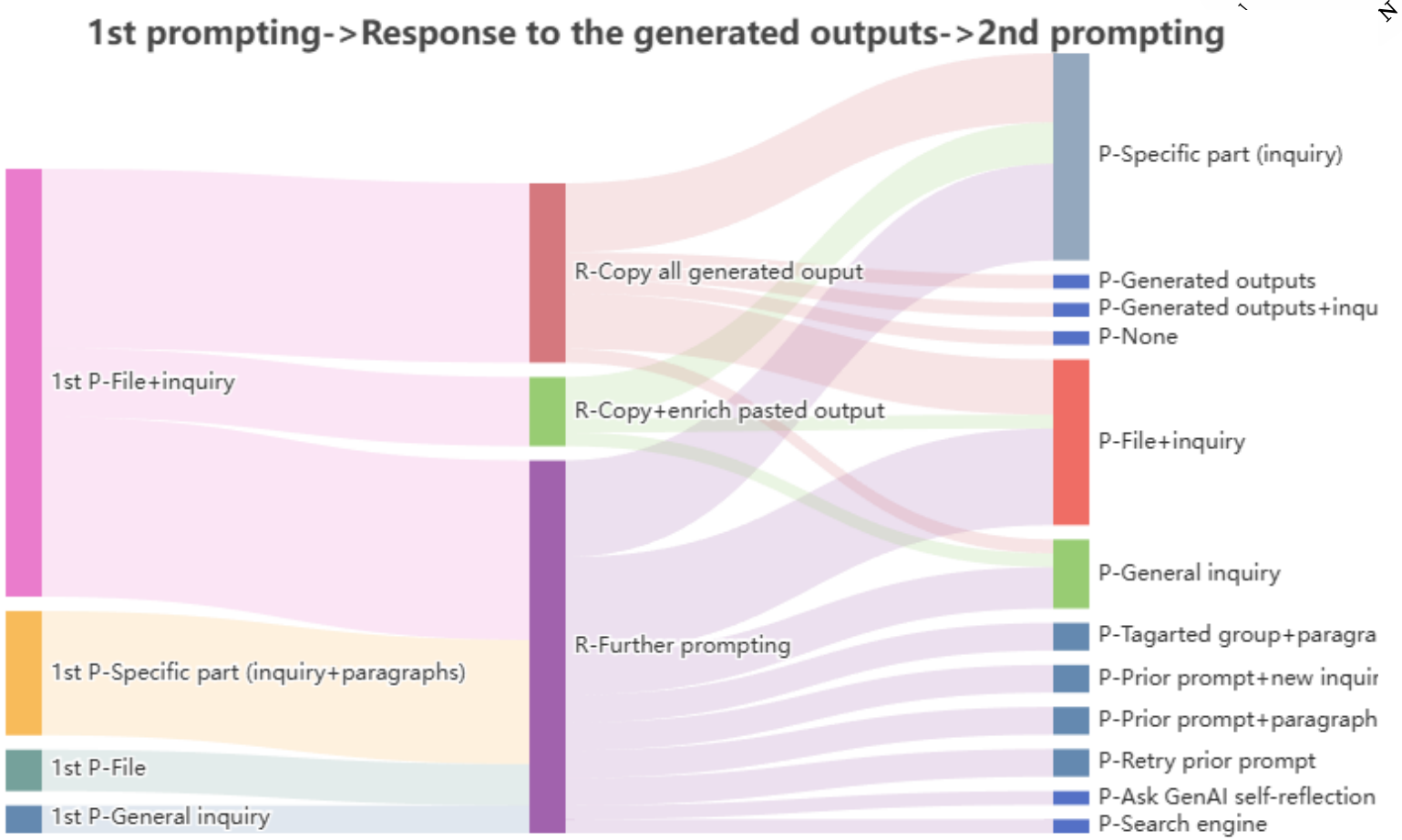

Figure 2. Sankey diagram of prompt strategy decision process workflow.
Note: “P-” = Prompt, “R-”= Response to the outputs generated from prior prompts.

Results

When participants were stuck or unsatisfied the generated outputs, they took a few different approaches. 10 prompting forming methods were synthesized in Table 1.

Prompting forming	Description	Features	Prompt examples shown in this study
"Special part" +inquiry /paragraphs	Divide task A into task (a_1, a_2, … a_n): depart lesson plans into different sections and ask AI to modify them one by one	List details of knowledge points	Participant 43 used the prompt template "Three points of […] in the teaching of molecular thermal motion in high school physics should be specific" to provide extra content of teaching objectives.
		List each section in different prompts	Participant 29 used the prompt template "Write a […] for the secondary school lesson "Temperature"" to generate different details about teaching objectives, student situation analysis, teaching process.
Ask GenAI self-reflection	Pointing the gaps between the generated outputs and expected outputs	Modify degree	"Why did I ask you to change the teaching process, but you changed the whole lesson plan?" (Participant 43)
		Targeted student groups	"The double pendulum is not suitable for teaching high school students. Please change to a specific case of complex system capacity conservation analysis." (Participant 45)
		Use of personal pronouns	"Don't use "I" to describe something, just keep the details." (Participant 45)
Search engine	Search engine as additional data source and then copy the searched result in prompt to specify detailed desired generated outputs.	Pedagogical knowledge	"The four dimensions of physics teaching objectives." (Participant 5)
		Domain knowledge	"Differentiation" (Participant 4).
Another GenAI tool	Using the same prompt to generate outputs in another AI tools and compare the results		"Help me refine the teaching plan to make its structure complete. The teaching objectives should be written based on the core literacy of high school physics." (Participant 28)
Prior prompt+new inquiry	Copy prior prompts and add new inquiry to construct new prompt		"Help me revise the teaching plan and change the teaching objectives to the four dimensions: 'Physical Concepts,' 'Scientific Thinking,' 'Scientific Inquiry,' and 'Scientific Attitude and Responsibility.'" (Participant 5)
Combining prior-prompt	Combing prior prompts to form new prompts		"Please expand the teaching process section, emphasizing a student-centered approach and focusing on cultivating students' scientific thinking." (Participant 3)
Generated outputs+new inquiry	Copy the generated outputs based on prior prompts and add new inquiry forming new prompt		"Please generate an image based on the above text." (Participant 2)
Generated outputs	Copy the generated outputs based on prior prompts to form new prompt		"Tell some interesting timekeeping stories or riddles." (participant 6)
Retry prior prompting	Participant primarily used the "retry" button or copy prior prompt to generate iterative outputs		"Please provide a classroom introduction to work and power for first-year high school students, accompanied by an image." (Participant 2)
Using GenAI recommended prompting	Try recommended prompts to get ideas	Teaching activities	"When introducing a new lesson, what historical or cultural background can the teacher introduce?" (Participant 27)
		Application scenarios of domain knowledge	"Why do astronauts lie flat when the rocket takes off?" (Participant 37)

Results

The prompting patterns identified in this study were compared with existing prompting strategies or patterns to link the concrete prompt examples with abstract prompting strategies or patterns. As shown in Table 2, to some degree, the selected prompting strategies or patterns could be used to categorize prompt examples within the prompt structure.

Prompting features	Items	Prompt examples shown in this study
Prompt components (Eager & Brunton, 2023)	Verb, focus, context, focus and condition, alignment, constraints and limitations	Verb: “polish”, “perfect”, “add”, “generate”, “how to guide…to understand…” (Participant 2)
CLEAR Framework (Lo, 2023)	Concise, logical, explicit, adaptive, reflective	Reflective: “Can the modified teaching process reflect the characteristics of physical modeling?” (Participant 39)
TELeR (Santu & Feng, 2023)	Turn, expression, level of details, role	Level of detials (level 3): ” I am a high school physics teacher. Please help me revise my lesson plan. It is required to meet the high school physics curriculum standards. The teaching objectives should be based on core literacy. The teaching methods should use experimental methods, lectures, intuitive demonstrations, group discussions, and group exploration methods. The course content should be practical, interesting, and exploratory.” (Participant 17)
Assign AI roles in learning (Mollick & Mollick, 2023)	Mentor, tutor, coach, teammate, student, simulator, tool	Tutor: “Based on the uploaded high school physics lesson plan file, provide a brief overview of the lesson plan, and make some suggestions for revisions to this lesson plan file from the perspective of an excellent teacher” (Participant 24)

Discussions

- The findings show that pre-service teachers are capable of using a range of prompting strategies to improve GenAI's feedback quality. These strategies mirror metacognitive skills such as monitoring output quality and adjusting inputs. This suggests that prompt engineering can serve as a bridge between human pedagogical judgment and AI affordances. Integrating prompt training into teacher education could empower novice educators to use GenAI tools more effectively and responsibly.

- For prompt engineering strategies in human-AI collaboration, our findings demonstrate both alignments and differences with previous studies:

Human-human interaction phenomena in human-AI interaction: As found in the article by (Zamfirescu-Pereira et al., 2023), our results also detected behaviour expectations drawn from human-human interaction phenomena in human-AI interaction. Participants 17 seemed to believe that LLM-driven AI can understand the difference of display channels without detailed descriptive explanation, resulting in prompts like "Display blackboard design in the form of pictures".

Unlike the challenges of struggling getting started (a design-stage barrier) mentioned in the study by by (Zamfirescu-Pereira et al., 2023), students in our study formed their 1st prompts using diverse strategies. This might be related to the their prior knowledge of the tasks and the interface design and interaction modes provided by GenAI tools.

Conclusion and Impications

- scaffolded prompting by providing templates or guided interactions tailored to educational contexts.

To effectively utilize GenAI in complex problems solving process, prompt formulation, prompt iteration, output evaluation, workflow understanding, workflow adapting need to be considered (Tankelevitch et al., 2024). Therefore, task decomposition and self-awareness are recommended to be supported in GenAI-assisted complex problem solving. Moreover, task design in GenAI-assisted contexts is recommended to provide **domain knowledge points or objective evaluation criteria**.

- teacher training programs should consider including prompt engineering as part of AI literacy education.

For this context, **GenAI tools with diverse interface design and interaction modes** are suggested to be employed. This would increase exploration opportunities and motivation for non-AI expert users, esp. beginners. Additionally, **multiple roles** can be assigned to GenAI to explore complex tasks from different perspectives (Mollick & Mollick, 2023). This would enrich the diverse generated outputs, providing idea pools for users to synthesize information targeting goals. Furthermore, according to the prompt examples in this study, utilizing **private datasets** would customize the generated output from LLMs, such as lesson plan examples, stored historical lesson plans, and national curriculum standards.

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