Can generative AI mentor Pre-Service teachers? Exploring a chatbot led cognitive apprenticeship-based discourse (short paper)

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Abstract

This study examined the discourse between pre-service teachers (PSTs) and *TeachPal*, a Generative Artificial Intelligence (GenAI)-based chatbot designed to foster reflection and self-regulated learning within the Cognitive Apprenticeship Model framework. *TeachPal* was implemented in a simulation-based course combining in-class instruction and collaborative simulated scenario tasks. Using discourse analysis, we analyzed 60 chatbot-led interactions between *TeachPal* and 15 PSTs to characterize both PSTs' and *TeachPal*'s contributions to reflective dialogue. Results show that *TeachPal* successfully prompted PSTs to reflect on their instructional practices but struggled to sustain meaningful, non-repetitive discourse, limiting the depth of reflection and engagement. PSTs rarely initiated or elaborated on *TeachPal*'s feedback, while *TeachPal*'s responses were often generic or overly affirming. These findings reveal both the potential and current limitations of GenAI-based mentoring in teacher education and highlight the need for more structured, less repetitive PST-GenAI discourse to fully leverage its capacity for supporting reflective professional learning.

Keywords: Cognitive Apprenticeship Model, Discourse Analysis, Generative Artificial Intelligence, Pre-service teachers, Self-regulated learning.

Introduction and theoretical background

Supporting pre-service teachers (PSTs) in fostering their students' self-regulated learning (SRL), the active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behavior (Pintrich, 2000, p. 453), is a central challenge. This goal can be achieved through the Cognitive Apprenticeship Model (CAM), an

approach designed to support cognitive and metacognitive learning through guided experiences and externalization of thinking. CAM involves several stages: modeling, where an expert models a task; coaching, which serves to direct the trainee's attention to a previously unnoticed aspect of the task; scaffolding, where the expert provides help that enables the trainee to carry out the task; articulation, which involves prompting trainees to articulate their knowledge, reasoning, or problem-solving processes; reflection, in which trainees compare their problem-solving approaches with those of an expert; and exploration, which encourages trainees to engage in independent problem-solving (Collins et al., 1989, 1991; Dennen & Burner, 2008). However, the small facilitator-to-learner ratio required is a barrier to its large-scale implementation (Collins, 2006). Generative Artificial Intelligence (GenAI) may address this challenge by engaging PSTs in chatbot-led reflective discourse like that of a human mentor. The detect-diagnose-act framework, where AI receives data, diagnoses a learner's current state, and translates the diagnosis into meaningful pedagogical actions, captures the basic functioning of AI in education (Molenaar, 2022). This study examined the potential of *TeachPal*, a GenAI-based chatbot designed to trigger teachers' reflection on SRL instructional practices through personalized CAM-based feedback. *TeachPal* was implemented in a simulation-based course which alternated between human- and chatbot-led reflective discussions. We examined chatbot-led interactions between *TeachPal* and PSTs, and asked:

1. What characterizes PSTs' discourse with *TeachPal*?
2. What characterizes *TeachPal*'s discourse with the PSTs?

Methodology

The study took place in a course at a major university. The course introduced PSTs to SRL through simulation-based learning. PSTs completed collaborative simulated scenario tasks (CSTs) and engaged in CAM-based discussions in class, and then used *TeachPal*, a GenAI-based chatbot, as an at-home reflective coach. *TeachPal* provided scenario-specific feedback aligned with CAM stages, supporting PSTs' analysis and improvement of SRL-supportive instructional practices. Fifteen PSTs, all prepared to teach middle- or high-school science and who held at least a bachelor's degree in this field, participated in this study.

The PSTs' discussions with *TeachPal* (n=60) were analyzed based on the methodology described by Robertson et al. (2020). Each discussion was first divided into episodes according to CAM stages (Table 1).

Table 1. Discussion Episodes

CAM Episode / Teaching model	**Definition**
Phase 1: Coaching	*TeachPal* evaluates the PST's instructional practices based on Opp4SRL, rates the levels of the different practices PSTs used, and draws their attention to how they can better leverage opportunities for SRL.
Phase 2: Scaffolding	*TeachPal* suggests that PSTs use higher-level instructional practices that promote SRL, tailored to the specific scenario.
Phase 3: Modeling	*TeachPal* conducts a renewed simulation of the situation in which the PST participated, using SRL-supporting instructional practices at a higher-level than those used by the PST. *TeachPal* conducts a reflection on the simulated scenario.

CAM Episode / Teaching model	**Definition**
Phase 4: Reflection	*TeachPal* asks the PST to reflect and compare the two simulated scenarios - the scenario in which the PST participated versus the simulated scenario conducted by *TeachPal*.
Phase 5: Articulation	*TeachPal* encourages the PST to externalize and express their thoughts and feelings about how they handled the situation, as well as the instructional practices they employed.
Phase 6a: Exploration	*TeachPal* assists the PST in exploring the instructional practices implemented to promote SRL in the scenario and encourages the PST to think about what could have been done differently and how.
Phase 6b: Exploration	*TeachPal* encourages the PST to propose additional scenarios where there are opportunities to leverage similar aspects as in the simulated scenario.

We decided to analyze only episodes 4-6b due to a lack of PST talk-turns in episodes 1-3, possibly due to their focus. Thus, episodes 4-6b were coded with the goal of identifying patterns in PSTs' engagement with *TeachPal* (Table 2).

Table 2. Pre-Service Teacher Talk-Turns Coding Scheme

Codes & definition (Robertson et al., 2020)	**Adaptation to the current study**	**Examples**
Acknowledge: Teacher statement that acknowledges what was previously said (e.g., that makes sense, yeah, that might be really helpful).	*Acknowledge_PST (**Ack**)*: PST statement that acknowledges what *TeachPal* previously said.	Harel: ***Right, I totally agree***
Clarify teacher: Request for more information relative to what was said in the previous turn or turns.	*Clarify_PST* (**Clfy)**: Request for more information / clarification relative to what was said in the previous turn or turns.	Ronen: ***Can you provide suggestions*** *for sentences the teacher can use to help with the cognitive strategies?*
Elicit teacher: Question or statement that requests new information about lesson content, teaching actions, or student behaviors.	*Elicit_PST* (**Elct):** Question or statement that requests new information about lesson content, teaching actions, or student behaviors not addressed previously / might open new discussion.	Inbal: *I can connect to my field of biology. Many children have difficulty understanding microscopic concepts that cannot be seen. I encourage them to watch videos and simulations.* ***What solution could there be here?***
Embrace: Teacher makes proactive statements related to the suggestion for instruction, regarding intentions for subsequent	*Embrace (**Emb**)*: PST makes proactive statements related to the suggestion for an instructional practice regarding intentions for	Doron: ***Your feedback helped me identify strengths and weaknesses.***

Codes & definition (Robertson et al., 2020)	**Adaptation to the current study**	**Examples**
instruction (e.g., Sounds like a good idea. I'll try it...). May include plan for uptake.	subsequent instruction (e.g., Sounds like a good idea. I'll try it…). May include plan for uptake	
Explain: Teacher statement in which they explain what they will do and why or justify what they have done	*Explain_action* (**Exp Can)**: PST explains and justifies what she did and why OR what *TeachPal* did in the simulation *Explain_context* (**Exp Ctx**): PST suggests an alternative scenario where SRL opportunities could be leveraged	Dvir: ***I suggested that she divide the task into smaller tasks that she needs to complete within half an hour to an hour and see if she manages to complete them and send them to me on time.*** Ido: ***A student who struggles with a mathematical issue they need to understand of a problem in physics. The student might not know how to allocate time to the issue or how deep to delve in it.***
Intention: Teacher makes a new statement about an instructional action or plan for the first time.	*Intention* (**Int)**: PST makes a statement or explains about an instructional practice they plan to implement	Nasreen: ***I will give*** *her a table listing all the terms and their definitions.*
Observe Teacher: Teacher notices and names the student's actions (often not linked back to a previous idea).	*Observe_PST_student* (**Obs Stu)**: PST notices and names student action or behavior in relation to learning *Observe_PST_pedagogy* (**Obs Pdg)**: PST notices and names the instructional practice	Amit: *I think I was surprised that* ***the student took the initiative and knew exactly what strategies he needed*** Doron: *This supports SRL* ***monitoring and reflection*** *aspects*
Reflection: Teacher reflects on teaching actions, e.g., what could they have done differently, what went well.	*Reflection_PST* **(Refl)**: PST reflects on instructional practices, e.g., would have done differently, went well	Ayala: ***I think I allowed room for his feelings, but I think I should have given more space to his sense of frustration and tried to understand more deeply where it comes from. Perhaps I should have given him better tools to recognize that he is stuck****. We talked about the duration and the feelings, but there are certainly other tools through which he could realize that he is stuck*
NA	*Triggering_ending*: PST triggers episode ending	Inbal: **We already answered that**

Episodes 4-6b were also coded to identify patterns in *TeachPal*'s discourse and engagement with PSTs (Table 3).

Table 3. *TeachPal* Talk-Turns Coding Scheme

Codes & definition (Robertson et al., 2020)	**Adaptation to the current study**	**Examples**
Acknowledge: Coach statement that acknowledges what was previously said (e.g., That makes sense, yeah; That might be really helpful)	*Acknowledge_TeachPal* (**Ack):** *TeachPal* statement that acknowledges what was previously said.	*TeachPal*: ***It sounds like there might be an opportunity*** (Rotem)
Affirm: Coach affirms an action or statement made by the teacher, e.g., 'Keep doing that.', 'So I think you're doing fine.'	*Affirm (***Afrm)**: *TeachPal* affirms an action or statement made by the PST, e.g., 'Keep doing that.', 'So I think you're doing fine.'.	*TeachPal*: ***That sounds like a solid approach!*** (Ori)
Clarify coach: Request for more information relative to what was said in the previous turn or turns. Coach may restate or reword the teacher's comment.	*Clarify_TeachPal* (**Clfy)**: *TeachPal* asks the teacher to clarify: Requests for more information relative to what was said in the previous turn or turns. *TeachPal* may restate or reword the PST's comment.	*TeachPal*: ***What are your thoughts on how these aspects of SRL were addressed in both approaches?*** (Inbal)
Intro: Coach suggests an instructional action or plan for the first time during the coaching session.	*Declarative_suggestion* (**Dec Sugst)**: *TeachPal* suggests an instructional practice during an episode.	*TeachPal*: ***Monitoring and control are indeed crucial aspects of self-regulated learning (SRL)*** (Amit)
Elicit coach: Question or statement that requests new information about lesson content, teaching actions, or student behaviors.	*Elicit_TeachPal* (**Elct)**: *TeachPal* questions or requests new information about lesson content, teaching actions, or student behaviors.	*TeachPal*: ***In reflections on the simulation****, conducted with your student, can you share your thoughts on the specific strategies you employed to address the student's challenges and enhance her self-regulated learning (SRL) skills?* (Shahr)
Observe coach: Coach notices and names the teacher's action	*Observe_TeachPal (***Obs)**: *TeachPal* notices and names the PST's instructional practices.	*TeachPal*: ***On the other hand, your solution*** *offers a more concrete plan for implementation, which*

Codes & definition (Robertson et al., 2020)	**Adaptation to the current study**	**Examples**
(often not linked back to a previous idea).		*also supports the goal-setting aspect of SRL* (Inbal)
Reconstructive recap: Coach summarizes the conversation - not presenting a new suggestion for instruction - rather only a recap of what was previously discussed. (Usually closes out the conversation but not always).	*Reconstructive_Recap* (**Rcap)**: *TeachPal* summarizes the episode - not presenting a new suggestion for instructional practice - rather only a recap of what was previously discussed (Usually closes out the episode but not always).	*TeachPal*: ***Overall, both approaches demonstrate a commitment to supporting students' self-regulated learning by addressing their concerns and involving them in the decision-making process. Each approach has its strengths, with the simulation focusing more on student involvement and your solution emphasizing practical implementation. By combining elements of both approaches, teachers can effectively support students in becoming more self-regulated learners.*** (Inbal)
Coach explains, expands, builds on, or makes a connection related to a suggestion or intention provided earlier in the coaching session.	*TeachPal* explains, expands, builds on, or makes a connection related to a suggestion or intention about an instructional practice provided earlier in the coaching session.	
Expand_Declarative: Coach provides further information about the instructional suggestion	*Expand_Declarative* (**Exp Dec)**: *TeachPal* provides further information about the instructional suggestion	*TeachPal*: *By involving the student in planning ahead and setting goals,* ***you encouraged her to take an active role in her learning process. This aligns with SRL principles by fostering metacognitive awareness and strategic planning. Additionally, addressing the activation of prior knowledge through the topic selection helps scaffold her understanding and build connections between new and existing information, which is crucial for effective learning****.* (Doron)

Codes & definition (Robertson et al., 2020)	**Adaptation to the current study**	**Examples**
Expand_Procedural: Coach provides further information about how the teacher can implement the instructional suggestion	*Expand_Procedural* **(Exp Pro)**: *TeachPal* provides further information about how the teacher can implement the instructional suggestion	*TeachPal*: ***You could discuss examples from different contexts, such as sports, business, or personal projects, where goal-setting and planning are essential for success. Then, you can draw parallels with the student's academic tasks and experiments, emphasizing how setting clear objectives and breaking down tasks into manageable steps can lead to better outcomes.*** (Rotem)
Expand_Conditional: Coach provides further information about why or when an instructional suggestion should be used.	*Expand_Conditional* (**Exp Cond)**: *TeachPal* provides further information about why or when an instructional suggestion should be used.	*TeachPal*: *Implementing these adjustments based on observed behaviors and patterns can indeed support the student in improving their task performance.* ***By tailoring their time management strategies to address specific challenges and capitalize on their strengths, the student is more likely to experience greater success in completing their tasks efficiently and effectively****. It's important to continue monitoring their progress and remaining open to further refinements as needed to ensure ongoing improvement.* (Ayala)

Results

PSTs' Discourse with *TeachPal*

Table 4 presents code frequencies for PSTs' talk-turns during the Discussion Episodes in all four sessions for each PST. Percentages are calculated from the total number of PSTs' talk-turns.

Table 4. Analysis of Pre-Service Teachers' Talk-Turns

	Ack (%)	Emb (%)	Exp Ctx (%)	Clfy (%)	Elct (%)	Trg End (%)	Refl (%)	Obs Pdg (%)	Obs Stu (%)	Exp Acn (%)	Int (%)
Amit	2	6	0	2	6	6	3	17	14	29	9
Ayala	0	0	2	0	0	0	11	8	6	32	13
Doron	0	4	1	0	0	0	9	18	18	38	16
Dvir	0	0	2	0	0	2	2	2	7	36	27
Harel	2	2	4	0	1	3	7	8	19	22	19
Ido	0	2	5	2	1	2	5	5	19	35	16
Inbal	3	6	4	4	3	10	8	6	18	21	23
Limor	0	0	0	0	3	0	18	16	5	42	8
Nasreen	0	0	3	0	2	6	2	6	19	39	2
Nadav	1	0	1	3	4	1	9	5	13	25	21
Ori	0	0	1	0	0	7	3	4	19	27	35
Orna	0	0	6	0	2	15	6	6	10	27	10
Ronen	0	6	3	1	3	4	15	7	13	19	28
Rotem	2	0	2	2	2	0	13	8	2	41	13
Shahar	0	0	3	0	0	3	12	12	0	41	9

Low-frequency codes included *Acknowledge_PST* and *Embrace*, indicating limited uptake of *TeachPal's* feedback, *Explain_Context, which* suggests alternative scenarios, and *Clarify_PST* and *Elicit_PST,* which indicate proactive requests for guidance. In contrast, *Reflection_PST* appeared relatively often, though unevenly across PSTs. *Observe_PST_Pedagogy* and *Observe_PST_Student* were also common but varied across PSTs. Finally, *Explain_Action* and *Intention*, reflecting PSTs' explanations and justifications of SRL-supportive practices, were frequent and consistent.

TeachPal's Discourse with PSTs

Table 5 presents code frequencies for *TeachPal* talk-turns during the Discussion Episodes in all four sessions for each PST. Percentages are calculated from the total number of *TeachPal* talk-turns

Table 5. Analysis of *TeachPal* Talk-Turns

	Obs (%)	Rcap (%)	Ack (%)	Afrm (%)	Dec Sugst (%)	Exp Dec (%)	Exp Con (%)	Exp Pro (%)	Clfy (%)	Elct (%)
Amit	9	14	33	9	27	27	36	8	23	48
Ayala	0	13	8	0	13	6	31	4	23	50
Doron	1	1	41	0	12	22	21	0	51	44
Dvir	2	2	40	5	14	21	21	0	26	49
Harel	4	13	41	4	9	34	29	3	37	38
Ido	5	6	43	10	30	34	43	5	41	40
Inbal	3	11	32	29	23	30	42	22	31	52
Limor	2	0	10	0	2	5	0	0	50	48
Nasreen	0	11	48	2	8	30	25	0	39	31
Nadav	7	4	25	5	20	24	36	4	49	23
Ori	0	4	19	15	13	1	30	0	59	30
Orna	2	13	26	0	7	20	15	0	35	37
Ronen	0	2	5	1	1	1	2	0	37	59
Rotem	0	3	35	16	21	24	43	11	52	30
Shahar	3	9	21	6	6	24	15	9	21	48

Low-frequency codes included *Observe_TeachPal*, reflecting TeachPal's explicit noticing and naming of PSTs' instructional practices, and *Reconstructive_Recap*, indicating that the summary of discussion episodes was rare and inconsistent. In contrast, *Acknowledge_TeachPal* and *Affirm* were the most frequent talk moves. *Declarative_suggestion*, *Expand_Declarative* and *Expand_Conditional* appeared often but unevenly, whereas *Expand_Procedural* was infrequent. Finally, *Clarify_TeachPal* and *Elicit_TeachPal*, which prompted PSTs' reflection, were frequent and consistent across discussions.

Discussion

PSTs seldom reacted to *TeachPal's* suggestions and showed limited willingness to embrace them. They did not proactively seek guidance from *TeachPal* regarding learning strategies, and only rarely provided alternative scenarios for applying SRL as prompted or meaningfully reflected on their own scenarios. Reflection is a crucial component in improving teachers' instructional practices and has a major role in the CAM (Collins et al., 1991; Dennen & Burner, 2008), making this a highly positive result. The analysis of *TeachPal*'s talk-turns further illuminates this issue.

TeachPal triggered PSTs to reflect on their actions and articulate their thinking and provided numerous strategies, demonstrating the potential of GenAI tools to support personal learning by analyzing learner data and generating tailored feedback (Giannakos et al., 2024; Trust et al., 2023). However, *TeachPal* offered little guidance on how to implement these strategies. These results demonstrate that *TeachPal*'s actions were aligned with its goal to provide feedback and support

teachers in reflecting on their practices and that they addressed the different types of knowledge associated with effective strategy instruction (Schraw, 1998). Regarding *TeachPal*'s effectiveness in supporting PSTs' reflection, articulation, and exploration, *TeachPal* did not consistently address PSTs' instructional practices, but rather provided more generic explanations, contradicting the CAM rationale of providing specific, individualized feedback (Collins et al., 1991; Dennen & Burner, 2008); *TeachPal* often continued somewhat repetitive discussions, a known GenAI pitfall (Buschek et al., 2021), which may have reduced PSTs' engagement.

On the one hand, our results highlight the potential of the GenAI-based CAM approach to enhance PSTs' engagement and reflection but concurrently suggest that the effectiveness of integrating GenAI was limited due to the discourse characteristics. We therefore suggest that more attention should be given to the structuring of effective PST-GenAI discourse so that it is less repetitive tailored to PSTs' need to fully exploit its potential (Trust et al., 2023).

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