

Social Robots and AI-Driven Learning: A Pilot Study on Student Engagement in Higher Education

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Abstract. *This pilot study explores how the Slovenian-speaking social robot AlphaMini, powered by ChatGPT, affects student engagement in higher education. Conducted with 22 students in a knowledge management class, the research used questionnaires and classroom observation to assess behavioral, emotional, and cognitive engagement. Students reported higher levels of emotional and behavioral engagement during the session with AlphaMini. Most students viewed the robot positively and recognized its potential for inclusive education. These findings suggest that localized social robots can motivate students and foster engagement in both higher and early learning environments.*

Keywords. artificial intelligence, social robot, chatGPT, student motivation, deduction

1 Introduction

The integration of Artificial Intelligence (AI) into education is reshaping teaching practices and creating new opportunities for active, personalized, and interactive learning. Among these emerging technologies, social robots powered by generative AI are gaining traction due to their ability to communicate in learners' native languages and simulate human-like interaction. Such robots are particularly promising for enhancing student engagement and motivation, which are key factors in successful learning (Hameed et al., 2023, Cai et al., 2024). One notable example is AlphaMini, a compact, humanoid robot equipped with speech recognition, facial detection, and the capacity for emotional expression. AlphaMini has been adapted to communicate in Slovenian, making it particularly valuable in contexts where localized tools are scarce. Social robots like AlphaMini and NAO are designed to foster natural, socially intelligent interaction through voice, gestures, facial expressions, and emotional cues. Although they are not physically human, their expressive features support the experience of social presence the sense of being in the company of another socially aware being which contributes to the development of emotional bonds and peer-like

relationships with students (Breazeal, 2003; Belpaeme et al., 2018). Prior research shows that social robots can function effectively as peer tutors, especially in language and STEM education (Kanda et al., 2011; Augello et al., 2020). Their consistent, non-judgmental, and emotionally responsive interactions offer advantages over traditional digital tools, which often lack a human or affective dimension (Hameed et al., 2023, Cai et al., 2024). In the Slovenian context, where few AI-based educational tools are tailored to the local language and culture, the presence of a Slovenian-speaking robot like AlphaMini represents a step toward more inclusive and equitable educational technologies (Nityashree et al., 2023). Social robots also align well with the goals of 21st-century education, supporting the development of collaboration, communication, critical thinking, and digital competence (Aberšek & Flogie, 2022). These capabilities are especially relevant when teaching abstract and cognitively demanding topics such as knowledge management, where verbal clarity, emotional engagement, and real-time interaction can aid comprehension. Despite the rising use of generative AI in classrooms particularly through tools like ChatGPT or Copilot there remains a notable lack of empirical research on the impact of such technologies when embodied in physical robots (Zhang & Aslan, 2021; Augello et al., 2020).

Most studies focus on chatbot-based tutoring systems, intelligent learning platforms, or writing assistants (Zawacki-Richter et al., 2019; Holmes et al., 2022), while only a few explore the pedagogical potential of embodied AI, especially in formal educational settings (Belpaeme et al., 2018; Mubin et al., 2013). The combination of a robot's physical presence with the linguistic capabilities of generative AI presents a unique learning experience. Unlike screen-based tools, social robots offer embodied, affective, and interactive communication, which can strengthen emotional and behavioral engagement. When paired with AI systems like ChatGPT, these robots are capable of dynamic, unscripted, and context-sensitive responses, making them highly suitable for exploratory learning and dialogue-rich environments (Hameed et al., 2023, Cai et al., 2024). Prior research

suggests that this blend of embodiment and intelligent language use contributes to deeper motivation, trust, and inclusivity in diverse learning contexts (Fridin, 2014; Kanda et al., 2011). This pilot study addresses the current research gap by examining how a Slovenian-speaking social robot integrated with generative AI affects university students' engagement when learning abstract topics such as knowledge management. The study was conducted with part-time students enrolled in management and logistics courses at the Faculty of Commercial and Business Sciences. To guide our investigation, we posed the following research questions (RQ) and hypotheses (H): RQ1: How does the presence of the AlphaMini social robot in the classroom affect student engagement across behavioral, emotional, and cognitive dimensions?

- H1a: The use of AlphaMini will significantly increase students' emotional engagement.
- H1b: The use of AlphaMini will significantly increase students' behavioral engagement.
- H1c: The use of AlphaMini will moderately increase students' cognitive engagement.

RQ2: How does prior experience with social robots influence students' engagement during the lesson?

- H2: Students with previous experience will report higher emotional engagement.
- H3: Students with prior experience will display greater behavioral engagement.
- H4: Students with prior experience will demonstrate stronger cognitive engagement.

The remainder of this paper is structured as follows. Section 2 outlines the methodology and instruments used in the pilot study. Section 3 presents the results, followed by a discussion in Section 4. The final section summarizes the main conclusions and offers implications for future educational use of AI and robotics.

2 Methodology

This study used a simple case study approach, combining a short classroom experiment with a questionnaire and basic observation of student reactions. The questionnaire comprised nine items designed to assess three dimensions of engagement: behavioral (e.g., "I participated more because of the robot"), emotional (e.g., "I felt comfortable and curious"), and cognitive (e.g., "I understood the topic better"). Each dimension included three items, rated on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). The questionnaire items were adapted from established engagement measurement tools, including the Student Engagement Instrument (Appleton et al., 2006) and similar studies on educational robotics (Belpaeme et al., 2018). An additional item inquired about prior experience with social robots (yes/no).

The goal was to find out how students respond when a social robot like AlphaMini is used in teaching. The study included 22 master's students from the Faculty of Management and Logistics. All students attended a live classroom session on knowledge management, where the robot AlphaMini presented key ideas in Slovenian, supported by ChatGPT. After the session, students filled out a short online questionnaire, where they shared how they felt during the lesson how focused they were, how much they participated, and whether they felt comfortable or motivated. We also observed the session and noted how students interacted with the robot for example, if they smiled, asked questions, or worked together in small groups.

The Table 1 below shows the basic information about the participants:

Table 1. Number and Percentage of Students by Field of Study

	N	%	M (SD)
Gender (total)	22	100	
Male	5	22.7	
Female	15	68.2	
Age			36.4 (10.3)
Field of study			
Business and Administrative Sciences, law, management	22	100	
Employment status (total)	22	100	
Employed	21	95.5	
Not (yet) employed	1	4.5	

Note: N = number of respondents, M = mean, SD = standard deviation.

Two respondents (9,1 %) opted not to answer the question regarding gender identity.

The questionnaire focused on three types of engagement: Behavioral (e.g., Did I participate more because of the robot?), Emotional (e.g., Did I feel comfortable and curious?), Cognitive (e.g., Did I understand the topic better?). Students answered on a scale from 1 (strongly disagree) to 5 (strongly agree). We also asked whether students had used a social robot before. This helped us compare if students with experience responded differently than those seeing the robot for the first time. During the lesson, we looked for visible signs of engagement, such as:

- Talking to the robot
- Paying attention
- Asking questions
- Smiling, laughing, or showing interest

These observations helped us better understand the answers from the questionnaire. For example, some

students who said they felt more motivated also showed more visible curiosity during the session.

3 Results

The results of the questionnaire show that students responded positively to the use of the social robot AlphaMini during the lesson. Due to the small sample size and exploratory nature of the pilot study, inferential statistical tests such as t-tests or ANOVA were not conducted. Instead, group means and Pearson correlations were used to identify patterns in the data. From Table 2 we see that all three types of engagement behavioral, emotional, and cognitive were rated fairly high on average. The correlation table shows how closely connected the three types of engagement were:

Table 2. Pearson Correlation Matrix Between Dimensions of Student Engagement

	1	2	3
1. Behavioral engagement	1	0.76**	0.47*
2. Emotional engagement		1	0.65**
3. Cognitive engagement			1

Note: **p < 0.01; * p < 0.05

The strongest relationship was between behavioral and emotional engagement ($r = 0.76$), which means that students who were more emotionally involved also tended to participate more actively in the lesson. There was also a moderate link between emotional and cognitive engagement ($r = 0.65$), suggesting that feeling comfortable and interested helped students focus and think more deeply. The weakest but still meaningful connection was between behavioral and cognitive engagement ($r = 0.47$). These results support RQ1, showing that the robot increased both emotional and behavioral involvement, with cognitive engagement also improving, though slightly less. To explore whether previous experience with social robots affected engagement (RQ2), we compared average scores between students who had already used a robot and those who had not.

Table 3. Mean Differences in Engagement Based on Prior Experience with a Social Robot

	Experience with Social Robot	
	Yes	No
Variables	M (SD)	M (SD)
Behavioral engagement	4.1 (0.5)	3.58 (0.7)

Emotional engagement	3.54 (0.3)	3.43 (0.5)
Cognitive engagement	3.42 (0.7)	3.2 (0.7)

Note: M = Mean, SD = Standard Deviation

From Table 3 we see that students who had prior experience with social robots reported higher scores across all three areas: The biggest difference was in behavioral engagement, suggesting that familiarity helped students feel more confident and active in the session. Emotional engagement was also higher, although the difference was smaller. Cognitive engagement followed a similar trend. These findings support H2, H3, and H4, showing that previous exposure to social robots may increase comfort, interest, and participation. Most students responded positively to AlphaMini. Students with robot experience were more engaged overall. The strong link between emotional and behavioral engagement suggests that students need to feel safe and interested before they are ready to participate actively. Even students with no prior experience rated their engagement relatively high, which shows that AlphaMini was well accepted even as a novelty. These results suggest an association between the presence of AlphaMini and increased emotional and behavioral engagement.

4 Discussion

The aim of this pilot study was to explore how the use of a Slovenian-speaking social robot, AlphaMini, impacts student engagement during a university-level session on knowledge management. The results show that students generally responded positively to the robot-led session, especially in terms of emotional and behavioral engagement. One of the most important findings is the strong connection between emotional and behavioral engagement. Students who felt comfortable, curious, or emotionally supported by the robot also participated more actively in the lesson. This supports earlier research that emphasizes the importance of social presence and emotional safety in learning (Belpaeme et al., 2018; Fridin, 2014). Social robots, especially when speaking in the learners' native language, seem to lower barriers to participation and encourage students to be more open and responsive. The results also showed a moderate improvement in cognitive engagement, meaning that the robot helped students think more about the topic and possibly understand it better. However, this effect was not as strong as for emotional and behavioral aspects. This may be because cognitive engagement depends not only on how the material is presented, but also on content difficulty, prior knowledge, and learning habits. Still, the increase suggests that even complex topics like knowledge management can benefit from

more engaging delivery formats. When comparing students with and without prior experience with social robots, the results clearly show that familiarity helps. Students who had interacted with a robot before were more engaged on all levels.

This suggests that as social robots become more common in classrooms, students may respond to them even more positively over time. It also shows the importance of gradual introduction and training, especially in higher education, where such technologies are still relatively new. Classroom observations further confirmed the questionnaire results. Many students laughed, asked questions, and made positive comments about the robot. A few mentioned that such robots would be especially helpful for children, or in settings where students are shy, anxious, or need more emotional support.

5 Conclusions

This pilot study shows that a Slovenian-speaking social robot supported by generative AI can positively influence student engagement in higher education, particularly in lessons involving abstract or theoretical topics. The strongest impact was seen in emotional and behavioral engagement, with moderate gains in cognitive engagement. Students appreciated the robot's gestures, natural speech, and supportive presence. Due to the non-experimental design and small sample size, we cannot make causal claims regarding the effect of the robot on engagement. Those with previous robot experience showed higher overall engagement in our pilot study, suggesting that familiarity and continued exposure play a key role in acceptance and motivation. Although this was a small-scale study, the results are promising. A potential limitation of this study is also the novelty effect, as students' engagement may have been temporarily elevated by the introduction of the robot (Kennedy et al., 2023). Furthermore, the small sample size and lack of statistical testing limit the generalizability of our findings. Our findings align with previous research suggesting social robots can support engagement in a variety of educational settings (Belpaeme et al., 2018; Augello et al., 2020).

While our study was limited to a university context, future research could explore these applications in primary and inclusive education. Their ability to combine emotional intelligence with structured content delivery makes them a valuable complement to traditional teaching methods. Future studies could include a larger number of participants, test the effects over a longer period, and compare robot-led teaching with traditional instruction. Additional research could also explore learning outcomes, not just engagement, to better understand how social robots impact actual knowledge acquisition. In conclusion, the combination of social robotics and generative AI when adapted to the local language and context offers a promising

direction for more inclusive, engaging, and emotionally aware education. Future research should employ longitudinal designs and larger samples to better assess the sustained impact of social robots in education.

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