Investigating Conversational Patterns with Generative AI NPCs in Role-Play for Elementary Students' Social and Emotional Learning

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1. Abstract

The use of generative AI NPCs (Non Player Characters) in education provides new opportunities to advance Social and Emotional Learning (SEL) through interactive role-playing activities. This study examines the potential of AI-mediated interventions to foster social and emotional competencies by investigating the relationship between conversational patterns and learning outcomes. Thirty-one sixth-grade elementary school students participated in five role-play sessions based on real-life scenarios requiring SEL competencies such as self-awareness, self-management, social awareness, relationship skills, and responsible decision-making. In these sessions, students engaged in scenario-based dialogues with generative AI NPCs. Also, this study analyzed the conversational patterns between elementary school students and generative AI NPCs during role-playing-based SEL sessions. Thematic analysis of the dialogue logs revealed four distinct patterns: (1) off-context dialogue, where students deviated from the given scenarios; (2) minimal response and early termination, characterized by brief, factual replies with limited emotional engagement; (3) emotional empathy and communication, involving active expression and recognition of emotions; and (4) socio-emotional story expansion, where students extended the narrative with deeper social-emotional insights. These patterns illustrate varying levels of engagement with SEL competencies through AI-mediated role-play. By illuminating relationships between interaction patterns and SEL growth, this study contributes to the theoretical understanding of AI-mediated learning environments and offers practical insights for designing scalable, personalized interventions. Lastly, we underscore the theoretical, research, and applied implications of the proposed framework in investigating its applicability to diverse educational contexts.

Keywords

Game Analytics, Role-Play, Generative AI, NPC, Social and Emotional Learning

1. Introduction

In the contemporary educational landscape, the focus has shifted beyond the acquisition of academic knowledge to fostering holistic learning experiences that equip students with essential social and emotional skills (CoSN, 2023). Social-Emotional Learning (SEL) has emerged as a critical domain, particularly for elementary students, as it supports the development of self-awareness, the cultivation of healthy interpersonal relationships, and the ability to make responsible decisions (Niemi, 2020). Recognizing SEL as a foundation for lifelong personal and social growth, researchers and educators alike are exploring innovative methods to enhance its accessibility and effectiveness in diverse learning environments (Megis-Weinberg et al., 2021).

Role-playing has been recognized as one of the key instructional strategies in SEL (Lillard et al., 2013). It provides students with opportunities to practice social interactions in simulated scenarios, thereby enhancing their problem-solving skills in real-life contexts (Valdes, 2019). Traditional role-playing methods face significant challenges, including time and space constraints, as well as difficulties in providing consistent, personalized feedback. In SEL scenarios, human-to-human role-playing can also hinder students' ability to express themselves openly, potentially reducing the effectiveness of the learning experience.

This is where the integration of generative AI agents into SEL can play a transformative role. Recent advancements in generative AI technology have revolutionized educational environments by

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enabling natural language interactions and offering diverse simulation experiences (Borge et al., 2024). For example, according to the study, it's confirmed that generative AI agents in a simulated gaming environment can implement realistic human behavior (Park et al., 2024). These technologies facilitate empathetic and dynamic interactions, presenting new possibilities for role-playing activities in SEL.

This study aims to develop a role-playing learning model utilizing generative AI NPCs to support elementary students' SEL and to verify its effectiveness. By examining the impact of generative AI-based learning on students' social-emotional competencies, this research seeks to explore the potential of innovative learning designs. In addition, we analyzed the conversational logs between students and generative AI NPCs to derive patterns in the conversational, thereby gaining a deeper understanding. The research questions guiding this study are as follows.

RQ1: Does role-playing-based SEL with generative AI NPCs have a significant impact on enhancing elementary students' social-emotional competencies?
RQ2: How do the conversational patterns between elementary school students and generative AI NPCs manifest in role-playing-based SEL?

2. Methods

2.1. Participants

The study involved 31 sixth-grade students from an elementary school in Daegu, South Korea. Participants engaged in the learning activities using personal devices (Chromebooks) provided for educational purposes. The research was conducted following ethical guidelines and received approval from the Institutional Review Board (IRB) (Approval number: 0000-202409-0013-01).

2.2. Procedure

The educational program was developed through a systematic design process grounded in a review of existing educational practices and relevant literature. To ensure the program's quality and relevance, it was reviewed by two experts: one specializing in elementary education and the other in educational technology and SEL. Based on their feedback, the program was refined and finalized.

The finalized program incorporated an online learning environment specifically designed to support role-playing activities using generative AI. The OpenAI API was embedded into the platform, and customized NPCs were developed using the GPT-4o model to deliver tailored and interactive role-playing experiences. The program was structured around the CASEL framework for SEL (CASEL, n.d.), focusing on the five core competencies: self-awareness, self-management, social awareness, relationship skills, and responsible decision-making.

The program was implemented in a school setting over a two-week period. Students participated in a total of five sessions, each lasting 20 minutes. Following the completion of the program, students were asked to write reflective journals to capture their learning experiences. Additionally, individual interviews were conducted with a subset of students to gain deeper insights into their learning processes and experiences.

2.3. Data collection and analysis

To evaluate the program's effectiveness, diagnostic tools for social-emotional competence among Korean elementary school students (Woo & Lee, 2024) were used to measure changes at three time points: before the program, immediately after the program, and seven days after program completion. The diagnostic tool was designed to assess the social-emotional competence of Korean elementary school students, reflecting the context of the South Korean education system and the CASEL framework. It consists of 21 items rated on a 5-point Likert scale. The reliability of the tool, as measured by Cronbach's α, was .756 for recognizing and regulating emotions, .786 for self-management, .775 for empathy, .765 for building positive relationships, and .805 for responsible

decision-making, indicating satisfactory reliability for all sub-factors. The overall reliability was .918, confirming a high level of internal consistency across all items. In this study, the Cronbach's alpha coefficient at baseline was .862. An example item from the tool is, "I am aware of situations where I feel uncomfortable or upset."

Repeated measures ANOVA were conducted to evaluate changes in social-emotional competency scores across Pre, Post, and Follow-up phases, with significance set at $\alpha = .05$. Post-hoc pairwise comparisons using Bonferroni correction assessed specific differences between time points. Descriptive statistics, including means and standard deviations, were calculated for overall scores and each domain.

Domain-specific analyses were performed using individual repeated measures ANOVAs for self-awareness, self-management, social awareness, relationship skills, and responsible decision-making. All quantitative analyses were conducted using R.

The conversation logs between each student and the generative AI NPCs were collected during the role-playing sessions. Each dialogue was analyzed individually using a thematic analysis approach to identify recurring conversational patterns. Through this process, key themes and structures within the interactions were extracted, allowing for a deeper understanding of the nature of student-AI dialogues within the context of role-playing-based SEL.

3. Findings

3.1. RQ1: Analysis of Social-Emotional Competence

3.1.1. Overall impact of the role-playing-based SEL with generative AI NPCs

The repeated measures ANOVA revealed a significant main effect of time ($F = 735.53$, $p < .05$), indicating meaningful changes in students' overall social-emotional competency scores across Pre, Post, and Follow-up time points. Post-hoc analysis using Bonferroni correction showed a significant increase in scores from Pre ($M = 3.68$, $SD = 0.517$) to Post ($M = 4.01$, $SD = 0.500$; $p = 0.049$), while scores remained stable between Post and Follow-up ($M = 3.95$, $SD = 0.583$; $p = 1.000$). These findings suggest that the program had a substantial and immediate impact on students' social-emotional competencies, with the effects persisting over time.

Table 1

Summary of Overall Social-Emotional Competency Scores Across Pre, Post, and Follow-up

Time	Mean (M)	Standard Deviation (SD)	Pre vs. Time (p-value)	Post vs. Follow-up (p-value)
Pre	3.68	0.517	-	-
Post	4.01	0.500	0.049 (Yes)	-
Follow-up	3.95	0.583	0.141 (No)	1.000 (No)

3.1.2. Domain-Specific Results

The self-awareness scores increased significantly over time, with a main effect of time ($F = 451.91$, $p < .01$). Post-hoc analysis showed a significant improvement from Pre ($M = 3.68$, $SD = 0.793$) to Post ($M = 4.19$, $SD = 0.627$), and this improvement was sustained at Follow-up ($M = 4.12$, $SD = 0.615$). These results highlight the effectiveness of the program in enhancing students' ability to recognize and regulate their emotions.

Self-management scores improved from Pre (M = 3.35, SD = 0.777) to Post (M = 3.76, SD = 0.877) and slightly declined at Follow-up (M = 3.71, SD = 0.951). While the ANOVA revealed a moderate effect of time (F = 230.89, p = .072), the improvement did not reach statistical significance. This suggests that the program had a positive but limited effect on self-management.

Social awareness scores increased over time, with the highest scores observed at Post (M = 4.08, SD = 0.705) compared to Pre (M = 3.66, SD = 0.838). Scores slightly decreased at Follow-up (M = 3.85, SD = 0.818). While the ANOVA indicated a moderate effect (F = 334.57, p = .0585), the results were not statistically significant. These findings suggest some program influence, though further refinement of activities targeting empathy may enhance its impact.

Relationship skills scores showed a slight increase overtime from Pre (M = 3.49, SD = 0.706) to Post (M = 3.77, SD = 0.655) and were maintained at Follow-up (M = 3.74, SD = 0.669). However, the ANOVA results were not significant (F = 413.27, p = .108), indicating no substantial effect of the program on this domain.

Scores in responsible decision-making remained relatively stable across time points, with Pre (M = 4.20, SD = 0.498), Post (M = 4.20, SD = 0.530), and Follow-up (M = 4.29, SD = 0.496). The ANOVA revealed no significant effects (F = 1059.74, p = .3653), suggesting that the program did not notably influence this domain.

3.2. RQ2: Conversational Patterns between Students and Generative AI NPCs

The thematic analysis of the conversation logs identified four distinct conversational patterns exhibited by elementary school students during role-playing-based SEL sessions with generative AI NPCs.

Some students initiated dialogues that diverged from the given role-playing scenarios. Rather than responding within the context of the presented problem, these students introduced unrelated topics, leading the conversation away from the intended SEL learning objectives. This pattern suggests instances where engagement with the learning task was diluted by external or imaginative themes introduced by the students.

Another recurring pattern involved students providing brief, factual responses to the AI NPCs without elaboration or emotional engagement. These students often answered in short sentences and aimed to conclude the conversation as quickly as possible, showing limited demonstration of social-emotional competencies such as empathy, perspective-taking, or self-expression.

Many students engaged in emotionally focused dialogue, expressing their own feelings or responding empathetically to the emotions conveyed by the AI NPCs. These interactions were characterized by efforts to recognize, validate, and discuss emotions, aligning closely with the intended SEL goals of fostering emotional awareness and interpersonal communication skills.

Some students not only responded appropriately to the presented scenarios but also actively expanded the storyline by proposing additional social-emotional dimensions. They elaborated on character motivations, imagined alternative outcomes, or introduced new relational dynamics, thereby demonstrating higher-order social-emotional competencies such as complex empathy, perspective-taking, and collaborative problem-solving. These four patterns illustrate a spectrum of student engagement with the role-playing tasks, ranging from limited cognitive participation to deeply social-emotional and creative interaction.

4. Conclusion

This study empirically confirmed that role-playing-based SEL utilizing generative AI NPCs has a significant positive impact on improving elementary school students' social and emotional competencies. Additionally, students exhibited diverse conversational patterns, suggesting the importance of prompts in role-playing-based SEL utilizing generative AI NPCs.

The program demonstrated significant overall improvements in social-emotional competencies across time points. The repeated measures ANOVA revealed a significant main effect of time, with scores increasing from Pre to Post and stabilizing at Follow-up. Specifically, self-awareness showed

the strongest improvement, with a statistically significant and sustained effect, underscoring the program's ability to enhance students' emotional recognition and regulation skills. While self-management and empathy showed moderate improvements, these effects were less pronounced and did not reach statistical significance. Relationship skills and responsible decision-making exhibited limited changes, suggesting a need for additional targeted interventions to address these domains effectively. The findings highlight the potential of incorporating generative AI technologies into SEL models in elementary education. Specifically, the study demonstrated dynamic interactions between students and Generative AI NPCs can maximize learner engagement and performance, suggesting a new paradigm for SEL through AI-driven methods.

However, the findings also revealed variability in the retention of effects across different domains of social-emotional competencies. While the intervention demonstrated a significant immediate impact across all areas, the sustainability of these effects varied, with some domains exhibiting limited retention over time. This discrepancy may be attributed to the relatively short duration of the program. In general, representative social-emotional learning programs are developed and implemented as long-term education of 10 sessions or more (Ex, Merrel et al., 2007; Kusché & Greenberg, 2011) and it can be understood that social-emotional learning can be expected to be highly effective when long-term intervention is carried out. On the other hand, this study evaluated the results of a five-session program, which may not have provided enough time to strengthen and internalize all the targeted competencies. This limitation highlights the need for future research to explore the long-term effects of generative AI-supported SEL interventions conducted over a longer period of time. Further investigation into how these programs affect the transfer of social-emotional competencies to real-life situations, such as interpersonal and problem-solving situations, will also provide valuable insights. Addressing these aspects will not only improve our understanding of the role of generative AI in SEL but also help us design more effective and sustainable educational programs.

In conclusion, this study demonstrated that role-playing with generative AI NPCs is an effective approach to enhancing elementary students' social-emotional competencies. Furthermore, it lays the groundwork for future research into AI-supported SEL interventions.

Declaration on Generative AI

During the preparation of this work, the authors used GPT-4o in order to: Grammar, writing and spelling check. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the publication’s content.

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