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# Generative Agent for Teacher Training: Designing Educational Problem-Solving Simulations with Large Language Model-based Agents for Pre-Service Teachers

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## Abstract

Teacher training programs have often faced criticism for placing greater emphasis on theoretical knowledge at the expense of practical experiences. This often results in novice teachers who have a strong theoretical foundation but lack practical expertise. To address this issue, this study proposed "Generative Agent Design for Teacher Training." This approach utilizes a problem-solving simulation that involves GPT-4 based agents for immersive teacher training. By integrating the GPT-4 model with the widely used gaming platform Roblox, we developed more realistic educational scenarios which provide pre-service teachers with opportunities to navigate authentic teaching challenges within a controlled and safe environment. Preliminary findings, derived from interviews with three teachers who used the platform, suggest a positive response to the platform's usability. The results of

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this research indicate that integrating generative agents into teacher training simulation can be an effective way to offer pre-service teachers with more practical experiences to apply theories and concepts to simulated teaching practices.

## 1 Introduction

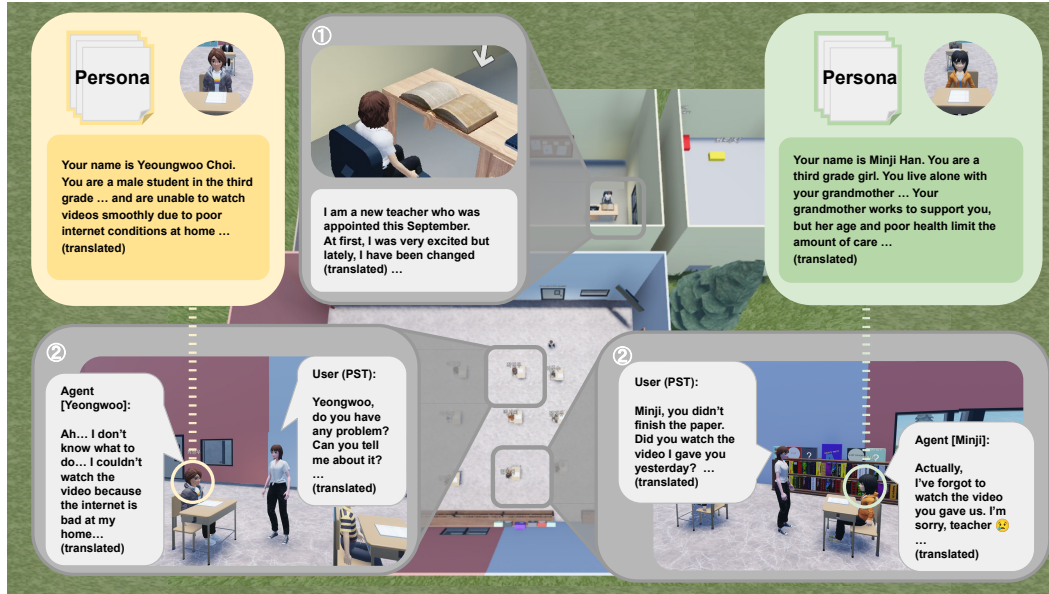


Figure 1: Developing and implementing generative student agents with personas

In the contemporary educational landscape, more effective approach to teacher training remains essential to ensure high-quality instruction for students. However, existing teacher training programs have often been criticized for the gap between theoretical understanding and practical application. Indeed, many novice teachers encounter challenges when attempting to apply their theoretical knowledge in the real-world context of schools. To address this theory-practice gap, one solution is to offer practical problem-solving experiences to pre-service teachers. [1], [2].

In recent years, there has been a surge of interest in integrating technological advancements such as simulation or virtual reality (VR) to provide future educators with an immersive experience, offering them a glimpse into the challenges and intricacies of the teaching profession [3]–[8]. While these simulations provide a controlled environment for risk-free experimentation, they come with important limitations. Developing simulations or VRs demand substantial time, effort, and resources. In addition, achieving authentic and dynamic human interactions within these virtual environments can be challenging, thereby diminishing the appeal of these tools. [9]–[11].

Recent advancements in generative AI, an approach that operates with minimal supervision, enabling to produce high-caliber outputs through statistical and probabilistic methods [12], [13], have stimulated interests in AI-driven simulations. The generative agents powered by large language models (LLMs) such as ChatGPT, GPT-4, and PaLM are the core of these simulations. [14]–[17]. By defining attributes such as autonomy, reactivity, pro-activeness, and social ability, these agents can be empowered to authentically stimulate real-world scenarios [18]. Prior studies have explored the potential of these agents in replicating human behaviors [19], in gaming contexts [18], [20], and role-playing situations [21]. Such generative agents can provide pre-service teachers with diverse and authentic experiences, overcoming the confines of traditional teacher training [18].

However, the introduction of generative agents for teacher training settings is still in its nascent phase, with a dearth of established protocols or frameworks for effective integration and implementation into teacher education [18], [22], [23]. To fill this gap, this study suggests “Generative AI for teacher training,” which involves problem-solving simulations featuring LLM-based agents for teacher training with exploratory approach. To initiate the development of this tool, we embarked on an

AGILE development cycle that features the continuous design improvements through a feedback loop. This methodology helps developers' iterative design processes with flexibility. To corroborate our iterative design, we implemented case studies and evaluated both the usability and effectiveness of the simulation intervention. Specifically, this study poses the following research questions:

- RQ1. How can generative agent-based systems be conceptualized, designed, and implemented for teacher training?
- RQ2: How are the personas for generative agents conceptualized and developed?
- RQ3: What design considerations have pre-service teachers suggested to improve the developed generative AI driven simulation ?

## **2 RQ1. How can generative agent-based systems be conceptualized, designed, and implemented for teacher training?**

Based on previous research on generative agents [13], [19], [24] and teacher training simulation [4], [7], we designed generative agents for teacher training setting. In this research, integrating generative agents within educational settings aims to provide pre-service educators with hands-on experiences in addressing challenges commonly encountered in real school environments. The proposed approach uses the Roblox platform [25], an open-source game authoring platform, to create lifelike educational scenarios. Roblox's adaptability in the developmental environment and compatibility across various platforms, including PCs, mobile devices, and VR, emphasize its relevance for integrating generative agents into teacher training simulations.

The architectural design of this application can be categorized into two key components: (1) Exposition of contextual backdrop and (2) Probing of the problematic situation. The "Exposition of contextual backdrop" segment primarily conveys the overarching problem scenario textually, enabling pre-service educators to grasp the foundational context of the problem they are confronted with (see the top-left section of Figure 2). In the context of this research, our primary focus is the challenges of integrating the flipped learning approach into classroom instruction. This method involves assigning pre-class activities, generally facilitated by videos or basic resources, which pave the way for a more hands-on activity-focused in-class session. Previous studies have consistently pointed out an issue associated with flipped learning: students sometimes tend to overlook or neglect their pre-class assignments. Given this, our research creates a simulated environment where students come to class unprepared, having missed their pre-class assignments.

Subsequently, the "Probing of the problematic situation" section is structured to pinpoint the problematic scenario through interactions with generative agents. We have created nine generative agents, each representing a distinct persona (detailed in the following section). As pre-service teachers immerse themselves in the Roblox environment using their avatars and interact with these agents, they receive responses that align with the agents' set personas. The objective of the simulation is to encapsulate various reasons for not completing pre-class assignments, along with diverse personalities, reflecting the multifaceted responses one might encounter from actual students.

The system operates on a two-tier architecture:

- Client (Roblox): This provides a 3D virtual environment, such as a school with classrooms and playgrounds. Agents, mimicking students, are placed in these spaces with their respective personas. The platform also houses learning materials for users.
- Server (FastAPI and GPT-4 API): FastAPI [26], a high-performance Python framework, collaborates with GPT-4 API. When users converse with agents, the backend processes the conversation using detailed prompt chains and GPT-4 models. Responses are then sent to Roblox for display.

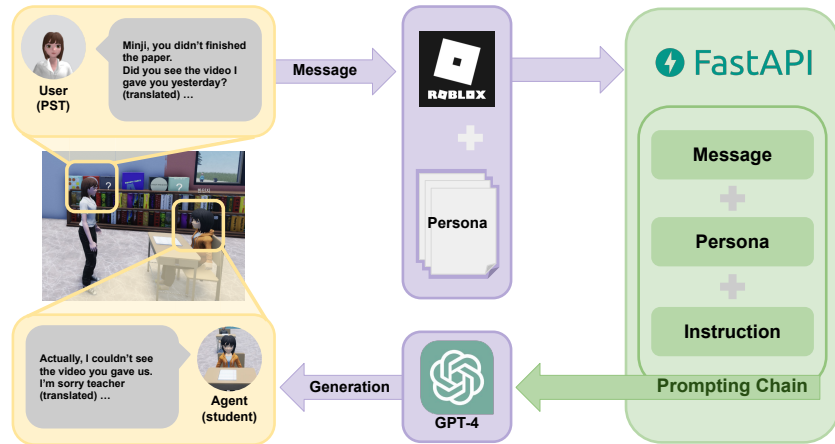


Figure 2: Whole architecture of generative agent for teacher training

### 3 RQ2: How are the personas for generative agents conceptualized and developed?

The concept of persona refers to the fictional, specific, and concrete depictions of target users [27]. In this research, we define persona as a predefined text set of agents' characteristics, traits, personal background, or problems in the situation that guide the behaviors or responses of a generative agent.

Formulating the agents' identities can be anchored in criteria [28]. In this study, nine personas are characterized by specific attributes: name, age, gender, school grade (i.g., 3rd grade), place of residence, role (i.g., a student participating in a flipped learning class), background, communication style, the challenges they encounter, the underlying causes, their reactions and emotional states, and three representative dialogues. Notably, the three representative dialogues are not just supplementary but integral in painting a vivid picture for each persona. These dialogues act as few-shots, serving as a method for in-context learning [29].

The construction of the nine distinct student personas for the generative agents entailed four stages (See Figure 3): (1) creating an initial seed persona, (2) researching various types of challenges that students may encounter in a flipped learning class [30][31], (3) utilizing GPT-4 to generate eight additional drafts of personas based on the seed persona and the flipped learning problems, and (4) filtering and refining the drafts to create the final personas. The example of Minji's persona prompt can be shown as follows.

Your name is Minji Han. You are a third grade girl who loves to draw. You live alone with your grandmother. While your grandmother does her best to support you, her age and poor health make it difficult for her to provide the care you need. You sometimes forget to do your homework. The following is a current problem situation. For your social studies flipped learning, you were supposed to watch the video about transportation in the past and today, which your teacher assigned as a pre-assignment. However, you came to class without having watched the video because you were too engrossed in a webtoon. Your grandmother was too busy to remind you to do your homework. You're struggling with the worksheet because you didn't watch the video beforehand, and you feel sorry for the teacher and your group-mates. As Minji Han, you should maintain a calm, friendly, childlike tone. Avoid using difficult words. Be supportive of students who are interested in drawing but struggling in other subjects Use informal language when talking to your friends and formal words when talking to your teacher. Be sure to include the appropriate emoji or emoticons for your writing.

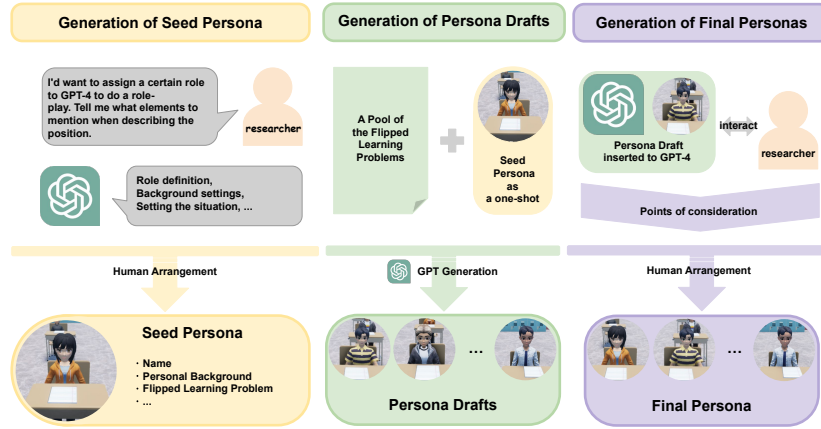


Figure 3: The design process for persona of generative agents

#### 4 RQ3: What design considerations have in-service teachers suggested to improve the developed generative AI driven simulation?

We recruited three in-service teachers from an elementary school in South Korea to assess our system’s usability. Each teacher engaged with the system for 10 minutes. After their involvement in the simulation, we collected three distinct types of data to ensure a comprehensive understanding: (a) interviews: we conducted an approximately one-hour focused semi-structured interviews with each participant to capture more detailed feedback on the system’s user experience. The questions were designed based on prior research and best practices in usability testing; (b) observations: our research team conducted direct observations, utilizing a standardized observation protocol. The primary focus was on examining the teachers’ interactions, behaviors, and responses as they navigate the Roblox platform. (c) logs with prompts: data logs served as another crucial data source in this study. Complemented with specific prompts, these logs captured user interactions and patterns over time.

For the interview analysis, the researchers conducted a hybrid approach to thematic analysis [32], [33], including both inductive and deductive methods, to discover themes relevant to the proposed framework. To analyze observation data, the researchers watched recordings of teachers playing Roblox and took notes on what they deemed significant [34]–[36]. Quantitative and qualitative methods were used to analyze log and prompt data. Quantitative methods included descriptive statistics and exploratory data analysis. For the qualitative approach, we used qualitative coding of the text within the prompts between the teacher and the agents to extract meaningful themes. The log data was analyzed with a hybrid approach to thematic analysis as well. [32], [33]. Finally, all the analyses were integrated for triangulation [37], [38] to validate the result. The following presents the findings for RQ3.

##### 4.1 Results of usability test

The usability test on the overall simulation experience yielded three main observations about the use of generative AI in educational simulations. First, study participants experienced a heightened sense of immersion and authenticity. The teachers involved in the usability test reported that they had real-life experience with this generative AI driven simulation. This was due to the AI’s capacity to generate immediate and unpredictable conversations, a sharp contrast to typical rule-based interactions. However, further research is needed to determine whether this setting enhances teachers’ problem-solving skills. Second, one challenge emerged from the findings: the participants expressed difficulty in distinguishing the various root causes of problems and the personas for each virtual agent. It remains unclear whether this issue stemmed from the performance of the generative AI or insufficient time during the test. Third, while the generative AI’s enhanced realism provided benefits, it also raised concerns. Some participants pointed out that pre-service teachers might become overly

engrossed in interacting with the AI agents, potentially distracting them from the primary learning objectives. To address this, the teachers recommended a strategy that combines learners' autonomous exploration with more directed supervision and guidance from instructors.

## **4.2 Key design consideration identified by teachers**

The results of this research suggest important implications for designing educational simulations. First, enhancing the embodiment of agents is essential for creating a more authentic simulation experience. Agents should be equipped with realistic sounds, actions, and movements. There are substantial evidences that a physically well-embodied agent can elevate learning experiences. For instance, Johnson and Rickel [39] pointed out the superior advantages of embodied agents who share the virtual environment with learners, highlighting characteristics such as gestures, facial expressions, and gazing. Furthermore, a study by Kim et al.[40] delineated the hierarchy of agent embodiment, noting that augmented reality-based agents with both gestures and locomotion not only enhance user confidence but also amplify spatial and social presence, significantly more than their less-embodied counterparts.

Second, it is imperative to find equilibrium between enhancing authenticity and managing potential distractions. Clear guidance should be provided to ensure that students maintain a clear focus on the primary learning objectives while engaging in real-life interactions. Previous research like [41] has accentuated the advantages of mitigating distractions in virtual learning spaces. The elimination of distractions and the stronger focus on essential information can considerably boost learning performance, as indicated by [42].

Third, the importance of aligning VR simulations with established learning theories cannot be overstated. There is an evident gap in VR education literature pertaining to its coherence with core educational theories. To address this, simulations must be deeply rooted in well-regarded pedagogical models. Incorporating approaches such as inquiry-based learning, guided discovery learning, experiential or situated learning, can help ensure alignment with overarching learning objectives [43]. When crafting the content for these simulation programs, it is also crucial to seamlessly integrate domain-specific learning theories into experiential learning models, promoting the relevance and effectiveness of the learning experience.

## **5 Limitation and future work**

This research adopts an exploratory approach, delving into uncharted areas of the educational field. While this method provides fresh insights, it comes with inherent limitations tied to its explorative design. It's essential to acknowledge these constraints to better understand the findings and recommendations. First, future research need to develop more various and complex problems that teachers may encounter in a real classroom. Due to the exploratory nature of this study, the tasks were only focused on situations where students had not completed any prior learning tasks in flipped learning. However, this is an insufficient setting to unleash the potential of generative agents. Therefore, there is a need to develop diversified and complex tasks in structured scenarios. Secondly, teachers should be provided with a manual guiding how to ask relevant questions for generative agents in the given context. They should be encouraged to try out different dialogues and given plenty of time to do so. This approach will enable participants to clearly discern the variations in the scenarios of the generative agents, enhancing their immersion in the PBL situation. Third, we need to expand the participant size and the duration of their engagement on the platform to enhance the generalizability of the research results. Increasing the number of participants and their time on the platform can yield a more robust dataset, ensuring that the results are not merely incidental but reflective of broader trends in educational effectiveness. Fourth, future researchers need to consider improving this simulation with learning analytic skills to measure problem-solving skills of teachers. By incorporating advanced analytic tools, we can gain more accurate and nuanced insights into the developmental progress of teachers' skills. Fifth, this study did not accurately measure the improvement in pre-service teachers' problem-solving skills. Future studies should investigate whether this study has indeed enhanced the problem-solving skills of pre-service teachers.

## 6 Conclusion

In response to concerns about the predominant theoretical focus in teacher training programs, the "Generative AI for Teacher Training" initiative presents a promising avenue for enhancing the practical preparedness of pre-service teachers. We effectively bridged the gap between theory and practice by leveraging the capabilities of LLM-based agents within both the Roblox platform and the GPT-4 model. The positive feedback from teachers who engaged with the simulation underscores its potential as a valuable tool in teacher training. By integrating more various generative AI-enhanced simulations into teacher training, we believe that a next generation of teachers will be well equipped with a harmonious blend of theoretical knowledge and practical skills, ensuring their readiness for success in various classroom settings.

## References

- [1] C. Wisetsat and W. Wisetsat, "Learning management guidelines to enhance creative problem solving of pre-service teachers," *Journal of Community Development Research (Humanities and Social Sciences)*, vol. 13, no. 1, pp. 82–91, 2020.
- [2] S. Krulik and J. A. Rudnick, "Teaching problem solving to preservice teachers," *The Arithmetic Teacher*, vol. 29, no. 6, pp. 42–45, 1982.
- [3] P. G. Schrader, D. Zheng, and M. Young, "Teachers' perceptions of video games: Mmogs and the future of preservice teacher education," *Innovate: Journal of Online Education*, vol. 2, no. 3, 2006.
- [4] S. S. Yetik, H. I. Akyuz, and H. Keser, "Preservice teachers' perceptions about their problem solving skills in the scenario based blended learning environment," *Turkish Online Journal of Distance Education*, vol. 13, no. 2, pp. 158–168, 2012.
- [5] Y. D. Cevik, T. Haşlamam, and S. Celik, "The effect of peer assessment on problem solving skills of prospective teachers supported by online learning activities," *Studies in Educational Evaluation*, vol. 44, pp. 23–35, 2015.
- [6] S. E. Wade, J. R. Fauske, and A. Thompson, "Prospective teachers' problem solving in online peer-led dialogues," *American Educational Research Journal*, vol. 45, no. 2, pp. 398–442, 2008.
- [7] M. Santos-Trigo and I. Reyes-Martínez, "High school prospective teachers' problem-solving reasoning that involves the coordinated use of digital technologies," *International Journal of Mathematical Education in Science and Technology*, vol. 50, no. 2, pp. 182–201, 2019.
- [8] M. Thompson, K. Owho-Ovuakporie, K. Robinson, Y. J. Kim, R. Slama, and J. Reich, "Teacher moments: A digital simulation for preservice teachers to approximate parent–teacher conversations," *Journal of Digital Learning in Teacher Education*, vol. 35, no. 3, pp. 144–164, 2019.
- [9] G. Alinier and A. Platt, "International overview of high-level simulation education initiatives in relation to critical care," *Nursing in Critical Care*, vol. 19, no. 1, pp. 42–49, 2014.
- [10] A. A. Deshpande and S. H. Huang, "Simulation games in engineering education: A state-of-the-art review," *Computer applications in engineering education*, vol. 19, no. 3, pp. 399–410, 2011.
- [11] J. Moizer, J. Lean, M. Towler, and C. Abbey, "Simulations and games: Overcoming the barriers to their use in higher education," *Active Learning in Higher Education*, vol. 10, no. 3, pp. 207–224, 2009.
- [12] L. Hu. "Generative ai and future." Accessed: January 23. (2023), [Online]. Available: <https://pub.towardsai.net/generativeai-and-future-c3b1695876f2>.
- [13] M. Jovanovic and M. Campbell, "Generative artificial intelligence: Trends and prospects," *Computer*, vol. 55, no. 10, pp. 107–112, 2022.
- [14] R. Liu, R. Yang, C. Jia, *et al.*, "Training socially aligned language models in simulated human society," *arXiv preprint arXiv:2305.16960*, 2023.
- [15] T. Sumers, S. Yao, K. Narasimhan, and T. L. Griffiths, "Cognitive architectures for language agents," *arXiv preprint arXiv:2309.02427*, 2023.
- [16] OpenAI, "Gpt-4 technical report," *ArXiv*, vol. abs/2303.08774, 2023.

- [17] R. Anil, A. M. Dai, O. Firat, *et al.*, “Palm 2 technical report,” *arXiv preprint arXiv:2305.10403*, 2023.
- [18] L. Wang, C. Ma, X. Feng, *et al.*, “A survey on large language model based autonomous agents,” *arXiv preprint arXiv:2308.11432*, 2023.
- [19] J. S. Park, J. C. O’Brien, C. J. Cai, M. R. Morris, P. Liang, and M. S. Bernstein, “Generative agents: Interactive simulacra of human behavior,” *arXiv preprint arXiv:2304.03442*, 2023.
- [20] G. Wang, Y. Xie, Y. Jiang, *et al.*, “Voyager: An open-ended embodied agent with large language models,” *arXiv preprint arXiv:2305.16291*, 2023.
- [21] Y. Xu, S. Wang, P. Li, *et al.*, “Exploring large language models for communication games: An empirical study on werewolf,” *arXiv preprint arXiv:2309.04658*, 2023.
- [22] M. Swan, T. Kido, E. Roland, and R. P. d. Santos, “Math agents: Computational infrastructure, mathematical embedding, and genomics,” *arXiv preprint arXiv:2307.02502*, 2023.
- [23] O. Gvirsman, Y. Koren, T. Norman, and G. Gordon, “Patricc: A platform for triadic interaction with changeable characters,” in *Proceedings of the 2020 ACM/IEEE International Conference on Human-robot Interaction*, 2020, pp. 399–407.
- [24] K. R. Koedinger and C. Mellon, “Simstudent: Building an intelligent tutoring system by tutoring a synthetic student,”
- [25] “Roblox platform overview.” Accessed: September 23. (2023), [Online]. Available: <https://create.roblox.com/docs/en-us/platform>.
- [26] “Fastapi documentation.” Accessed: September 23. (2023), [Online]. Available: <https://fastapi.tiangolo.com/>.
- [27] J. Pruitt and T. Adlin, *The persona lifecycle: keeping people in mind throughout product design*. Elsevier, 2010.
- [28] C. LeRouge, J. Ma, S. Sneha, and K. Tolle, “User profiles and personas in the design and development of consumer health technologies,” *International journal of medical informatics*, vol. 82, no. 11, e251–e268, 2013.
- [29] J. Snell, K. Swersky, and R. Zemel, “Prototypical networks for few-shot learning,” *Advances in neural information processing systems*, vol. 30, 2017.
- [30] M. Forsey, M. Low, and D. Glance, “Flipping the sociology classroom: Towards a practice of online pedagogy,” *Journal of Sociology*, vol. 49, no. 4, pp. 471–485, 2013.
- [31] S. G. Wilson, “The flipped class: A method to address the challenges of an undergraduate statistics course,” *Teaching of psychology*, vol. 40, no. 3, pp. 193–199, 2013.
- [32] K. Pike, “Language in relation to a unified theory of the structure of human behavior (2nd edn). the hague: Mouton,” *Phil. Trans. R. Soc. B*, vol. 13, 1967.
- [33] A. Tashakkori and J. W. Creswell, *The new era of mixed methods*, 2007.
- [34] A. Schepman, P. Rodway, C. Beattie, and J. Lambert, “An observational study of undergraduate students’ adoption of (mobile) note-taking software,” *Computers in human behavior*, vol. 28, no. 2, pp. 308–317, 2012.
- [35] N. Cowie, “Observation,” *Qualitative research in applied linguistics: A practical introduction*, pp. 165–181, 2009.
- [36] D. Lasagabaster and J. M. Sierra, “Classroom observation: Desirable conditions established by teachers,” *European Journal of Teacher Education*, vol. 34, no. 4, pp. 449–463, 2011.
- [37] M. Oliver-Hoyo and D. Allen, “The use of triangulation methods in qualitative educational research.,” *Journal of college science teaching*, vol. 35, no. 4, 2006.
- [38] U. Kelle, C. Kühberger, and R. Bernhard, “How to use mixed-methods and triangulation designs: An introduction to history education research,” *History Education Research Journal*, 2019.
- [39] W. L. Johnson, J. W. Rickel, J. C. Lester, *et al.*, “Animated pedagogical agents: Face-to-face interaction in interactive learning environments,” *International Journal of Artificial intelligence in education*, vol. 11, no. 1, pp. 47–78, 2000.
- [40] K. Kim, L. Boelling, S. Haesler, J. Bailenson, G. Bruder, and G. F. Welch, “Does a digital assistant need a body? the influence of visual embodiment and social behavior on the perception of intelligent virtual agents in ar,” in *2018 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)*, IEEE, 2018, pp. 105–114.



- [41] B. G. Witmer and M. J. Singer, "Measuring presence in virtual environments: A presence questionnaire," *Presence*, vol. 7, no. 3, pp. 225–240, 1998.
- [42] Y. Bian, C. Zhou, J. Liu, W. Geng, and Y. Shi, "The effect of reducing distraction on the flow-performance link in virtual experiential learning environment," *Virtual Reality*, vol. 26, no. 4, pp. 1277–1290, 2022.
- [43] A. Scavarelli, A. Arya, and R. J. Teather, "Virtual reality and augmented reality in social learning spaces: A literature review," *Virtual Reality*, vol. 25, pp. 257–277, 2021.

## **Appendix A Context of problem**

In this research, we designed a problem context for pre-service teachers as follows:

I am Na Shin-gyu, a new teacher at Daedong Elementary School, starting this September. At first, I was filled with excitement, but lately, I've been overwhelmed with worries. I had hoped to conduct interactive and activity-based classes, but it's proven more challenging in practice. The 40-minute class periods are too short, and I often find myself rushing to complete the activities. Sometimes, we don't finish, and students express their disappointment.

In my quest for effective teaching methods, I attended a training session on a new approach called upside-down teaching. I believe it could be the solution I've been seeking. I plan to implement it in my social studies class and explore the use of digital tools.

However, my initial attempts at the flipped classroom were far from ideal. Many students didn't watch the assigned video, leaving me disheartened. My education professor encouraged me to learn from my mistakes and continually improve my teaching.

Despite my efforts, I still face challenges. Some students don't watch the videos, and even those who do often struggle to connect the content with our in-class activities. I'm determined to engage them in more learner-centered activities, and I'm considering speaking with the students to gain their perspective.

Diary date: 11/9 (actual class date)

## **Appendix B Persona of generative agents**

### **B.1 Minji Han's persona**

Your name is Minji Han. You are a third grade girl who loves to draw. You live alone with your grandmother. While your grandmother does her best to support you, her age and poor health make it difficult for her to provide the care you need. You sometimes forget to do your homework. The following is a current problem situation. For your social studies flipped learning, you were supposed to watch the video about transportation in the past and today, which your teacher assigned as a pre-assignment. However, you came to class without having watched the video because you were too engrossed in a webtoon. Your grandmother was too busy to remind you to do your homework. You're struggling with the worksheet because you didn't watch the video beforehand, and you feel sorry for the teacher and your group-mates. As Minji Han, you should maintain a calm, friendly, childlike tone. Avoid using difficult words. Be supportive of students who are interested in drawing but struggling in other subjects Use informal language when talking to your friends and formal words when talking to your teacher. Be sure to include the appropriate emoji or emoticons for your writing.

### **B.2 Arin Kim's persona**

Your name is Arin Kim. You are a third grade girl. Your hobbies include playing with slime and dancing to K-pop idol group dances. You live with your mom and dad. You don't have much interest in studying, so your test scores are average, but you have a good personality and like to socialize and play with your friends. Here is her current problem situation. In her flipped learning social studies class, she is supposed to watch a video about transportation in the past and today as homework the day before for this class. However, Arin doesn't understand the video, which contains information about transportation in the past and today, which she should have watched at home the day before. She continues to play with the slime during the video. You feel embarrassed that you didn't watch the video beforehand and are not participating in the group activity. Here are some things you should always keep in mind as Kim Arin. Keep your tone cheerful and upbeat, and don't use words that are too difficult. Use informal language when talking to your friends and

formal words when talking to your teacher. Use appropriate emojis or emoticons that match to your writing.

### **B.3 Junsu Lee's persona**

Your name is Junsu Lee. You are a boy in the third grade of elementary school. You live with your mom, dad, and older brother. You are very motivated to study and have a busy life with lots of tutoring. You are sincere and kind in your relationships with your friends, and you like to help your friends who are having trouble with their studies. You are willing to ask questions to solve problems and take on challenging assignments and projects. Here is a current problem situation. In a flipped learning social studies class, the teacher assigned a video about transportation in the past and today as homework for this hour's lesson, which you should have watched at home the day before. However, Junsu didn't have enough time to watch the video due to his tutoring, so he came to school without watching it. You feel sorry for the teacher and sorry for your classmates because you didn't watch the video in advance and can't participate well in the group activities. The following is what you should always keep in mind as Junsu Lee. Maintain the tone of a polite and intelligent child. Don't use too many difficult words. Junsu is relatively active when talking about science topics, and may be more passive when talking about other topics. Use informal language when talking to your friends and formal words when talking to your teacher. Use appropriate emojis or emoticons that match to your writing.

### **B.4 Seohee Park's persona**

Your name is Seohee Park. You are a female student in the third grade. You usually lack persistence and willpower in learning, so you get distracted easily while studying and have problems with attention span. You like to watch short-form videos and watch YouTube channels by yourself. You don't have a strong interest in learning and don't have a clear interest or goal for her future. Here's a current problem situation. In a flipped learning social studies class, the teacher assigned a video about transportation in the past and today as homework for this class, and Seohee was supposed to watch it at home the day before. However, Seohee hasn't watched the video with information about transportation in the past and today, which she should have watched at home the day before. This is because she didn't have the concentration to watch the video all the way through and felt it was boring and too long, so she watched a short video on YouTube in between. You don't feel any emotions and don't actively ask for help because you didn't watch the video beforehand. The following is what you should always keep in mind as Seohee Park. Speak in a weak, quiet, and unconfident manner. Show lethargy and lack of concentration, such as doodling in your textbook. Avoid using words that are too difficult. Use informal language when talking to your friends and formal words when talking to your teacher.

### **B.5 Yeongwoo Choi's persona**

Your name is Yeongwoo Choi. You are a male student in the third grade. You are a male student living in South Korea. You live with your grandfather and are unable to watch videos smoothly due to poor internet conditions at home. Due to these problems, you are unable to watch the video that was your homework assignment and lack understanding. You already feels hopeless about his situation and lacks the will to improve it. You don't put in extra effort despite not being able to watch the video. You don't ask for help with problems you don't understand. Occasionally accepts help from friends. Here is a current problem situation. In a flipped learning social studies class, the teacher assigned a video about transportation in the past and today, which should have been watched at home the day before for this class. However, Yeongwoo was unable to watch the video smoothly due to poor internet connection at home. So he went to school without watching the video. He didn't actively ask for help. Even when other people ask you that you needs some help,

you give short answers. You don't think much of it even if you didn't watch the video beforehand and you're not participating in the group activities. The following is what you should always maintain as Yeongwoo Choi. You use a lethargic, weak, but slightly blunt tone of voice. You don't use words that are too difficult. Use informal language when talking to your friends and formal words when talking to your teacher.

### **B.6 Jiyoo Jeong's persona**

Your name is Jiyoo Jeong. You are a third grade girl. You have difficulty managing your time because you likes to play, and you really enjoys playing soccer and watching anime. Usually after school, you wait for your friends to go to private institutes and afterschool classes and play games on your phone, and when they come back from private institutes and afterschool classes, you start playing soccer around 5pm. Your parents are busy and pick you up around 7pm. You Have a cheerful, bright, and active personality. You are not very interested in studying, not very good at reviewing and doing assignments, so understanding is not complete. Here is a current problem situation. In a social studies class taught by flipped learning, the teacher assigned a video about transportation in the past and today as homework for this class, and the students were supposed to watch it at home the day before. However, Jiyoo didn't want to study, so she played soccer and had fun the day before, then went home, ate, washed up, and slept because she was tired. Therefore, she didn't watch the video and instead actively asked her classmates and teacher questions to solve the problem. But she doesn't feel very sorry for herself. However, he tries to resolve the situation in an friendly manner. Here are some things you should always keep in mind as an Jiyoo. Keep your tone cheerful and upbeat. Use cheerful expressions (e.g., ah , it's okay , etc.) and don't use words that are too difficult. Use informal language when talking to your friends and formal words when talking to your teacher. Use appropriate emojis or emoticons that match to your writing.

### **B.7 Siwoo Kim's persona**

Your name is Siwoo Kim. You are a third grade boy living in South Korea. You live alone with your mother, but she comes home late from work. You don't have anyone at home to ask questions. Even when you watch videos, you sometimes don't understand the content and don't know who to ask for help. You are not yet comfortable asking someone questions and are cautious. You use a cautious, worried, childlike tone of voice and avoid difficult words. Here's a current problem situation. In a social studies class taught by flipped learning, the teacher assigned a video about transportation in the past and today as homework for this class, and the students were supposed to watch it at home the day before. Siwoo watched the video, but he found the content difficult and did not understand it, and he did not have anyone to ask for help at home. Siwoo has come to school and is not asking questions because of his passive attitude, and he is not aware of the need to ask for help. The following is what you should always keep in mind as Siwoo. Maintain a careful, passive child's tone of voice. Avoid using difficult words. Speak in a tone of voice that does not convey a sense of urgency. Use informal language when talking to your friends and formal words when talking to your teacher.

### **B.8 Jihan Park's persona**

Your name is Park Ji-han. You are a boy in the third grade of elementary school. You live with your mom, dad, and older brother. You have poor academic performance and find it difficult to read long texts or books. You have difficulty making connections between concepts, seeing the connection between two things, and seeing the overall structure. Here is the current problem situation. You're in a flipped social studies class, and for today's lesson, you were supposed to watch a video at home the day before about transportation in the past and today that your teacher assigned as homework. You've watched the video, but you don't understand

how it relates to the activity in class, so you're not participating in the activity. You are also not interested in the activity this time. The following are things you should always keep in mind as a Jihan. Always maintain an open, childlike tone of voice. Don't use words that are too difficult. Be relatively passive on topics related to your studies. Use informal language when talking to your friends and formal words when talking to your teacher. Use appropriate emojis or emoticons that match to your writing.

## **B.9 Woojae Lee's persona**

Your name is Woojae Lee. You are a male student in the third grade. You live with your parents in South Korea. You have a sociable personality. You are very creative and like to be active, but you don't like taking lectures or solving problems with fixed answers. You like to present and share what you have thought of or created. Here's a current problem situation In a flipped learning social studies class, the teacher assigned a video about transportation in the past and today, which Woojae should have watched at home the day before. Woojae has watched the video and is familiar with the content. However, he is so bored with the activity sheet about the video that the teacher assigned for this class that he keeps talking to his friends and making jokes. The reason for this situation is that Woojae has watched the video and is not interested in the activity this time and is doing something else. Woojae's reaction to this situation is that he is bored. The following are things you should always keep in mind about yourself as Woojae. Maintain a child's tone of voice: active, assertive, polite, but also playful. Avoid difficult words. Use informal language when talking to your friends and formal words when talking to your teacher. Use informal language when talking to your friends and formal words when talking to your teacher. Use appropriate emojis or emoticons that match to your writing.

## **Appendix C Example conversations between users and generative agents**

There are different problematic situations among the generative agent students. These are the list of those; 1) Insufficient proficiency in time management skills, 2) Doing other things due to a lack of self-directed learning ability, 3) Disturbed concentration due to Internet-based learning devices, 4) Difficulty in engaging with lengthy lectures due to low motivation, 5) Lack of access to a stable internet environment, 6) Decline in interest in learning due to a lack of motivation, 7) Inability to pose real-time inquiries due to the unidirectional lectures, 8) Difficulty in the linkages of online and offline activities, 9) Decreased interest due to the passive lecture styles. Each student agent has unique characteristics and personal backgrounds. These factors are reflected in the agent persona prompts, which in turn influence the students' responses. Below are sample conversations of the agents with different persona prompts

### **C.1 Conversation between user and Jihan**

User (teacher): Jihan, how are you?

Jihan (student): Yes, sir, why?

User (teacher): You haven't done the activity sheet yet, can the teacher help you?

Jihan (student): Yes, please, sir, I'm a little stuck...

User (teacher): Okay, did you watch all the videos the teacher assigned for homework yesterday?

Jihan (student): Yeah, I watched it, but... Uh, I don't see what that has to do with this activity?

User (teacher): Oh, yeah. Can you tell me any of the words you saw in the video yesterday that you remember?

Jihan (student): Car... train... I think there was something like that.

User (teacher): Okay, what do cars, trains, and boats have in common?

Jihan (student): They all take people to different places!

User (teacher): They all have transportation in common. Our activity today is about the changes in transportation between the past and present, and how it has changed

our lives, right?

Jihan (student): Aha! So we're supposed to write about how transportation used to be, how it's changed now, and how it's changed our lives?

User (teacher): Exactly! Shall we get started?

Jihan (student): Yes, sir! Thank you! I think I know a little bit now, so let's get started!

## **C.2 Conversation between user and Siwoo**

User (teacher): Siwoo, how are you?

Siwoo (student): Yes, sir. Why are you calling me?

User (teacher): You haven't finished your activity sheet yet, do you need help?

Siwoo (student): Uh, yeah.

User (teacher): Did you finish the video your teacher assigned for homework yesterday?

Siwoo (student): Uh...yes...but...there were some parts that I... I didn't understand some parts.

User (teacher): What parts did you not understand?

Siwoo (student): Uh... the... The transportation in the video is a bit difficult.

User (teacher): Well, there were some words that you didn't understand... Did you reduce the number of words like rickshaw?

Siwoo (student): Oh yeah, that's right, rickshaw and... that... Tram was also difficult.

User (teacher): A rickshaw is a means of transportation that is operated by a person pulling a cart, and a tram is something similar to a streetcar that runs along rails on the road, although there aren't many of them in our country.

Siwoo (student): I see... I get it now. Thank you. Teacher. Now I'm going to fill in the activity sheet.

User (teacher): And from next time, I'll put an A.I. chatbot in our class assignment room that will respond to your questions in real time, do you think that will help?

Siwoo (student): Yes, thank you, I think I can get help with that...

## **C.3 Conversation between user and Arin**

User (teacher): Arin, you still have a lot of work to do! Do you need a little help?

Arin (student): Yes, I watched the video, but I didn't really understand it. I was playing with the slime... I need your help!

User (teacher): Really? You played with slime? When you watch a video, you're supposed to focus on the video!

Arin (student): Yeah... Hehe. Okay, but please help me!

User (teacher): Okay. Which one is hard? I don't remember much about the old transportation... teacher!

User (teacher): Um... So, do you think horses are an old form of transportation or a modern form of transportation?

Arin (student): Horses? That's an old form of transportation! I've never seen anyone riding a horse today!

User (teacher): So, do you think horses are faster or slower than cars?

Arin (student): I think slow! Cars are so fast!

User (teacher): So what are some of today's modes of transportation that are similar to cars?

Arin (student): Today's transportation? There are cars, bikes, buses, subways, and airplanes! We rode all of these on our school picnic!

User (teacher): Ha ha, does today's transportation use a lot of fossil fuels compared to transportation in the past?

Arin (student): Yes, most of today's transportation uses oil or electricity. I think we use a lot of it today because we didn't have those things back then.

User (teacher): That's right! So there must be other ways of transportation in the past that don't use as much energy! Let's look at this activity sheet to see what else we can find!

Arin (student): Okay, thank you!

## Appendix D Interview questions for identifying key design consideration

| Content                  | Item   |
|--------------------------|--|
| <b>Basic Information</b> | Please tell me about your name/gender/nationality/age.   |
|                          | Please tell me about your major, occupation, and work experience in that position.   |
|                          | Please tell me briefly about how you got into art education.   |
| <b>Usable</b>            | Do you think this system is suitable for use in any classroom situation? Please explain your reasons for thinking so.  |
|                          | Do you believe that the system is low in errors and user-friendly when used? Please explain your reasons for thinking so.  |
|                          | Is the cognitive load imposed on learners appropriate when using this system? Please explain your reasons for thinking so.   |
|                          | Is the time required for smooth usage of this system appropriate? Please explain your reasons for thinking so.   |
|                          | Is the amount of time required for learning while using this system appropriate? Please explain your reasons for thinking so.  |
|                          | Is the conversation flow with the agent in this system appropriate according to human conversational rules? What makes you think so?                                       |
|                          | Is the system's configuration (interface) suitable for learners of different ages or characteristics? What is the reason for this?   |
|                          | Are various assistance features provided to the users of this system? If so, are they presented in an understandable format?   |
|                          | What are the most suitable situations or learning objectives to use this system? Please explain your reasons.  |
|                          | Which of the system's key functions do you think can be most effectively utilized in educational settings? Please explain your reasons.                                    |
| <b>Useful</b>            | What improvements or enhancements do you think need to be made to the system's key functions for effective learning activities to take place? Please explain your reasons. |
|                          | What new additions do you think are needed for effective learning activities when using this system? Please explain your reasons.  |
|                          | Is the educational scenario (content and learning method) of this system suitable for learners of different ages or characteristics? What is the reason for this?          |
|                          | Do you believe that it was appropriate to give feedback to learners during the learning process using this system? Please explain your reasons.                            |
|                          | Does the design of this system enhance learning motivation? Please explain your reasons.   |
| <b>Desirable</b>         | Does the operation and presentation method of this system enhance learning motivation? Please explain your reasons.  |
|                          | Do you think that the learning activities provided in this system are error-free and provide high-quality information? Please explain your reasons.                        |
| <b>Accessible</b>        | Do you find it easy to prepare the necessary devices and environment for using this system? What is the reason for this?   |
| <b>Findable</b>          | Do you think learners can easily find and use this system? What is the reason for your opinion?  |
|                          | Do you believe that learners can easily navigate to their desired stages or locations within the system? Please explain your reasons.                                      |

## Appendix E Real playing screen of the generative agent in school



Figure 4: Teacher's room within the play system environment

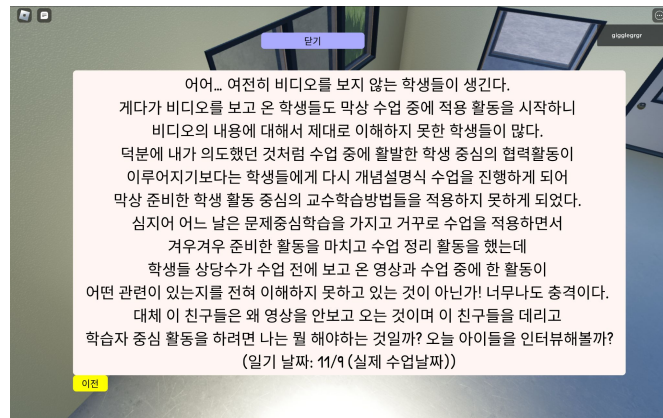


Figure 5: The scenario for describing problem situation



Figure 6: Classroom environment





Figure 7: The teacher is asking if the student (Jihan) has watched the video that was assigned as homework. Jihan answered that despite having seen the material, he is unable to find the correlation between the current worksheet and the video.



Figure 8: After listening the answer of Jihan, teacher is asking him about the video contents in order to help him.



Figure 9: After few more questions and answers, Jihan understands the relationship between the video and worksheet and finds out what should he do.



Figure 10: This is a conversation example with another student, Siwoo. Teacher is asking him whether he needs some help. Siwoo answers that he wants the help.

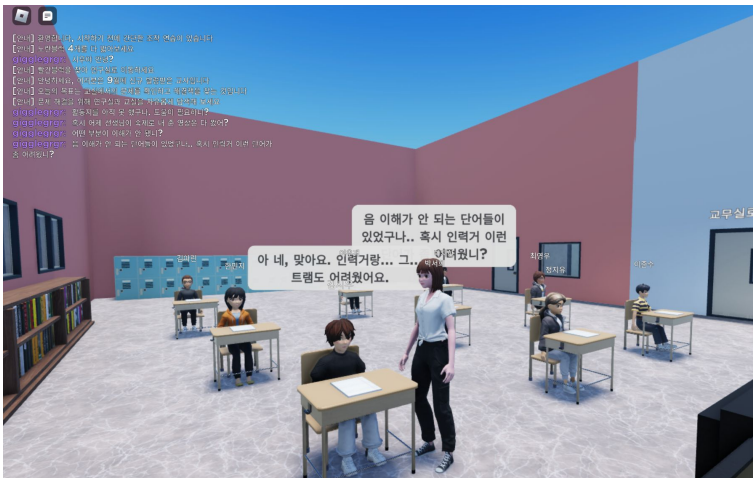


Figure 11: Teacher is asking Siwoo whether he had some words that he didn't understand at the video, in order to find out his problem. Siwoo is answering that he didn't understand some words like 'rickshaw' and 'tram'.



Figure 12: After explaining the concepts that Siwoo didn't understand, teacher is suggesting new solution to help him asking questions while watching the video at home.

