# Designing Interaction Scenario for Alleviating Persistence in Learning Strategies

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**Abstract:** It is necessary for learners to properly use learning strategies according to learning phases/objectives, which improves the effectiveness and efficiency of learning. However, there are learners who persist in the use of a particular strategy even when they are taught a new appropriate strategy. In addition, they are not likely to emotionally apply the new strategy. To resolve this problem, it is necessary to alleviate their persistence. In this work, we have proposed a model of empathy, in which learners are expected to change the use of learning strategy through empathy for a peer learner who has the same experiences in persisting in the same strategy, overcoming the persistence, and making a success in the change of strategy. In this paper, we follow the model to design an interaction scenario with a social robot to alleviate learners' persistence, and demonstrate the robot interaction system that conducts the scenario. The results of the case study with the system suggest that the designed scenario allows learners to positively change their learning strategies.

**Keywords:** Learning strategy, Empathy, Persistence alleviation, Interaction scenario, Social robot

## 1. Introduction

In order to learn effectively and efficiently, it is necessary for learners to use learning strategies properly according to learning phases/objectives (Uchida, 2021; Weinstein, et al., 2000). In memorizing words, for example, we would repeatedly write/read aloud them first, but it is more effective to associate new words with the memorized ones for learning in the next learning phase (Gu, et al., 1996). Related work on strategy instruction has addressed the issue how to allow learners to select learning strategies to apply on their own initiative (Chamot, 2004; Uchida, et al., 2023).

The general approach to this issue is to provide learners with some explanation about the significance and effectiveness of learning strategies, which can be viewed as a cognitive approach. On the other hand, it has been pointed out that some learners tend to persist in strategies they are used to apply even when they are taught a new strategy appropriate to their current learning phase/objective (Uchida, et al., 2023; Weinstein, et al., 2000). Such learners are likely to have a strong belief that their persistent strategy could be also applied in the current phase/objective. In addition, they are not likely to emotionally apply the new strategy (called target strategy) since it would be troublesome to use a novel one. To resolve this problem, it is necessary to provide an emotional support for alleviating learners' persistence in a specific learning strategy.

In this work, we have proposed a model of empathy, in which learners are expected to use a target strategy through empathy for a peer learner (Sasaki & Kashihara, 2024). In this model, a social robot plays a role of the peer who has the similar experiences in persisting in a strategy and overcoming the persistence to use a target strategy. We also design an interaction scenario (called persistence alleviation scenario) by following the empathy model, which describes how the robot interacts with a learner to alleviate his/her persistence. In this paper, we demonstrate the robot interaction system that conducts the persistence alleviation according to the scenario. This paper also reports a case study with the system whose results suggest the possibility that the interaction with the robot allows learners to positively change their strategies.

## 2. Model of Empathy and Persistence Alleviation Scenario

### *2.1 Belief in Learning Strategies and Persistence*

Figure 1 shows the process of persisting in a specific learning strategy (indicated by Strategy A). When learners practice a strategy to repeatedly produce the successful outcome, they would gain a belief that it could be used in any learning phase/objective. Such belief brings about persistence in the strategy. According to Yamaguchi (2017), learners who do not aim for high achievement tend to persist in a specific strategy independent of learning phases/objectives. It is because they emotionally believe that they could learn with the practiced strategy. Such persistence prevents them from using a new strategy (indicated by Target strategy) even when they are taught that it is more effective/efficient for the current learning phase/objective.

*Figure 1.* Process of Persisting in a Learning Strategy

How to alleviate the persistence in a learning strategy to use another one for more efficient/effective learning is the main issue in this work. We address it with an emotional approach, in which we focus on empathy for a peer learner who has the same experience of persistence.

We usually tend to empathize with others who have the same experience. If they also have an experience of overcoming something, we can project and assimilate ourselves into their experience, which motivates us to overcome in the same way. From this, we can expect learners who have a firm belief in a learning strategy to feel empathy for a peer who has the same persistence and overcomes it, and to readily accept his/her episode of how to overcome his/her persistence as an instructive advice.

In this way, we think that such emotional support is useful for alleviating learners' persistence in a specific learning strategy. Empathy for the peer is a promising approach, which encourages learners to properly use a target strategy through their projection and assimilation into the peer's experience of persistence and overcoming it.

### *2.2 Model of Empathy*

In this work, we have proposed a model of empathy for enabling the persistence alleviation described in the previous section via interaction with a social robot as shown in Figure 2 (Sasaki & Kashihara, 2024). Social robots can be controlled to increase their anthropomorphic tendencies so that they can play specific roles, conduct behavior, and express emotions. The controlled robots can have an influence on learners' emotions (Guo, et al., 2015).

This model consists of two phases, which are projection/assimilation phase and experience sharing phase. In the projection/assimilation phase, a learner is expected to empathize with the robot's past episode, which includes a belief and persistence in the same learning strategy as he/she uses as shown in Figure 3 (a). This empathy for the robot allows him/her to project and assimilate himself/herself onto the robot, which drives him/her to identify his/her belief and learning outcome with the robot's ones. It also makes it easier to accept the robot's experience of overcoming its persistence in the next phase.

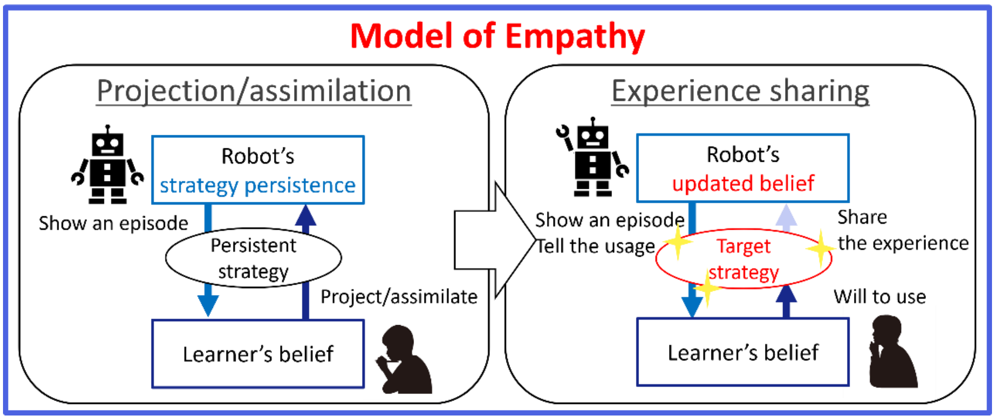
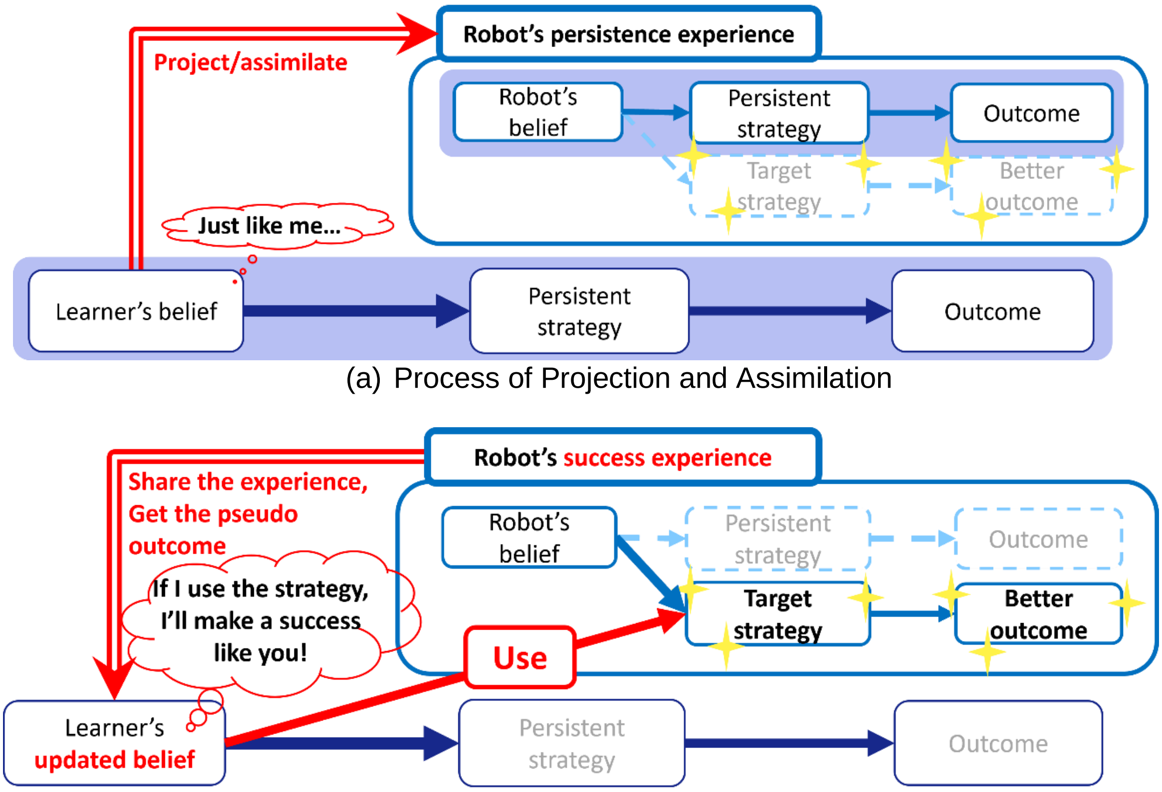



*Figure 2.* Model of Empathy




(a) Process of Projection and Assimilation



(b) Process of Experience Sharing

*Figure 3.* Processes of Empathy

In the experience sharing phase, the learner is expected to share the experience of the robot as shown in Figure 3(b). It is shared through the episode, which describes not only how the robot overcame its persistence to use the target strategy, but also how to use it, and how it works. The robot shows him/her how the target strategy is helpful for effective and efficient learning in the current phase/objective, and encourages him/her to understand it. Due to his/her empathy for the robot in the first phase, he/she could be expected to imagine that he/she gains the learning outcome by means of the target strategy. This imagination allows him/her to alleviate his/her persistence in the strategy, and to update his/her belief, which would also drive him/her to use the target strategy.

### *2.3 Design of Persistence Alleviation Scenario*

Following the model of empathy, we have designed a scenario for a social robot to interact with learners. In this scenario, a robot encourages learners to use appropriate strategies for their learning phase. To achieve this goal, this persistence alleviation scenario has three steps as shown in Figure 4.

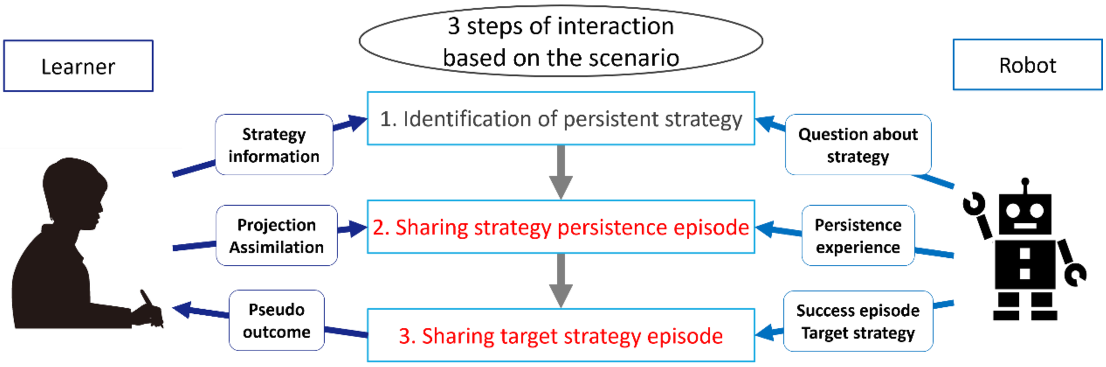


*Figure 4.* Persistence Alleviation Scenario

Firstly, the robot attempts to identify the strategy learners persist in. In order to obtain the information, the robot asks them about the strategy they used to apply. Secondly, the robot shares an episode through a dialogue, in which it also persisted to their persistent strategy. This episode intends them to become aware that the robot has the same persistence experience. Such awareness drives them to empathize with the robot and to project/assimilate onto the robot.

Lastly, the robot shares a successful episode, in which it overcame its persistence, began to use a target strategy that the learners have never used, and improved its learning effectiveness. In this step, the robot also gives an instruction in the target strategy. Through the interaction between the learners and the robot, they are expected to imagine pseudo-outcome from the robot's success episode, which allows them to update their belief in using the target strategy.

## 3. Robot Interaction System

### *3.1 Framework*

Figure 5 shows the framework of the robot interaction system. The system interacts with a learner according to the persistence alleviating scenario. This system uses a Kebbi Air S (hereinafter "Kebbi"), a social robot manufactured by NUWA Robotics, as a learning partner robot. According to Wada (2006), robots' emotional behavior enables effective interaction with the users. Kebbi's movements and facial expressions are controllable and are likely to elicit empathy from the users. Kebbi's speech and behavior is managed by the server PC. The server PC also controls the interaction following the three steps described in 2.3. In addition, the server PC generates some Kebbi's utterance and actions by using OpenAI's LLM GPT3.5 (Turbo) (hereinafter "GPT") via the API.

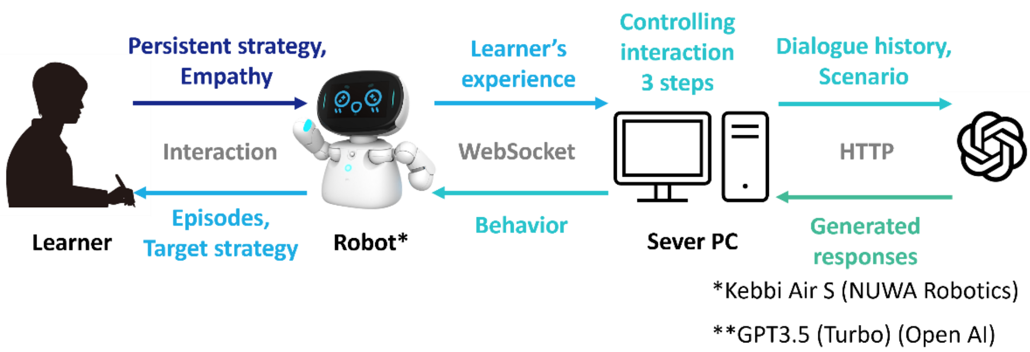


*Figure 5.* Framework of Robot Interaction System

### 3.2 Function

Kebbi uses voice recognition for interacting with a learner. Kebbi can also speak, show facial expressions, and move arms and face. The learner sees Kebbi's behavior, listens to its speech and replies to them. Kebbi's speech and behavior are controlled by the server PC. The server PC records all their dialogue history. According to the history and the persistence alleviating scenario, the server PC decides what to say, how to move, and which facial expression to express.

In addition, Kebbi's utterances and actions are partly generated by GPT to improve the quality of the interaction. The server PC sends prompts including the dialogue history to GPT. It is expected that contextual and individualized responses will become possible, and that dialogue with the robot will become more natural, and that empathy will be felt more easily.

## 4. Case Study

### 4.1 Purpose and Procedure

We had a case study using the robot interaction system whose purpose was to ascertain whether the persistence alleviation scenario could allow learners to empathize with the robot and to positively change the use of learning strategy from the persistent one to an appropriate one that they have never used.

In this study, we used five learning strategies for ancient Japanese vocabulary as learning material. Referring to Uchida (2021), we classified the learning strategies as shown in Table 1. The lower strategies in this table involve deeper cognitive activities.

We asked the participants to do interaction with the robot in the setting where they are high school students who will be using ancient Japanese for examinations.

Table 1. *List of Learning Strategies for Ancient Japanese Vocabulary*

| Learning strategies | Overview |
|---|---|
| Motivation | Making a habit of learning words, competing with friends for word memorization, and so on |
| Repetition | Writing/reading/listening to words repeatedly |
| Expression/Practice | Adding words images / Using words practically |
| Organization | Organizing words with learned ones to have some relationships with each other |
| Problem generation | Making problems and explanation |

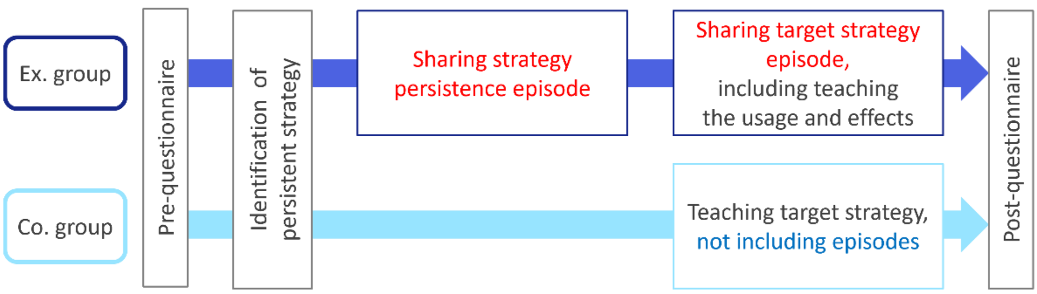



*Figure 6.* Procedure

The participants were 19 graduate and undergraduate students in informatics and engineering. Every participant experienced ancient Japanese vocabulary learning in his/her high school days. We set two conditions: interaction according to the persistence alleviation scenario (experimental condition), and interaction without sharing the two episodes shown in Figure 3 but with an instruction of the target strategy (control condition).

Figure 6 shows the procedure of the case study. First, we conducted a pre-questionnaire, in which the participants were asked whether they took positively or negatively in learning ancient Japanese vocabulary in their high school days and asked to select learning strategies they have already known from Table 1. According to their answers to the pre-questionnaire, we divided the participants into two groups (experimental and control groups) as between-subject design. We assigned 9 participants to the experimental group, and 10 to the control group so that their positivity to use other vocabulary learning strategies are almost balanced.

Second, the system conducted the step of identifying the persistent strategy for each group. For the experimental group, next, the robot informed the participants of its personal persistence experience with cuddling phrases generated by GPT. Figure 7 shows a part of an interaction in the experimental group. On the other hand, the control group were not given the episode.

Third, the robot shared its episode of a target strategy for the experimental group. The target strategy was selected from the ones that were unknown to the participants and that required a deeper cognitive activity. As for the control group, the robot just taught the target strategy selected in the same way. Figure 8 shows a part of an instruction in the control group.

| | |
|---|---|
| | === After identifying persistent strategy === |
| Robot: | I didn't like studying it, too when I started learning it. |
| | I was studying because of the entrance examination. |
| Leaner: | Yeah, I think so. It was so hard. |
| Robot: | I read my vocabulary notebook repeatedly for memorize words. |
| | I also saw example sentences on the book. |
| | I thought I could memorize a lot of words someday, |
| | like learning Kanji through the repeat. |
| | However, there were some words I couldn't memorize them |
| | when I was taking a test in my school. |
| | Didn't you have such an experience? |
| Learner: | Yes, it occured often and embarrassed me. |
| Robot (GPT): | Yeah, you did have the same experience as mine. |
| Robot: | But I was frustrated it. I used the time to memorize them. |
| | === To be continued === |
| Robot: | I think it is time to change the way to memorize for the entrance exam. |
| | I have tried creating questions and explanation like math or English. |
| | I have made easy questions for my friends or myself in the future. |
| | Yesterday, I just tried my test and got the high score! |
| Learner: | That sounds nice. |
| Robot: | I could also remember how I memorized the words and so on |
| | by using this learning method. It made me learn efficiently. |
| | How do you think about this method? |
| | Creating questions and explanation makes you learn deeply. |
| | Don't you think you can also do it? |
| Learner: | I also think it is a good method. I'll try it. |
| Robot (GPT): | That's the way to go! Let's do it! |
| | === End of the interaction === |

The dialogue was actually done in Japanese.

*Figure 7.* An Interaction Example in Experimental Group

| | |
|---|---|
| | === After identifying persistent strategy === |
| Robot: | It is time to memorize the words efficiently for the entrance exam.<br>I recommend you learn through creating questions and explanation,<br>like math or English. |
| Leaner: | I see. |
| Robot: | Yeah, it is said a good method because you need to review your text or<br>notebooks to make them.<br>It is no problem if you can't make difficult questions.<br>You should try it as you will ask the questions to your friends.<br>Do you understand? |
| Learner: | Yes, I do. It sounds good. I'll try it. |
| Robot (GPT): | I'm glad you got it! Let's do it. |
| | === End of the interaction === |

The dialogue was actually done in Japanese.

*Figure 8.* An Interaction Example in Control Group

After the interaction with the robot, we conducted a post-questionnaire with a 5 Likert scale. Table 2 shows the questionnaire including questions about the episodes shared by the robot and the impression of interaction with the robot.

Figure 9 shows an image of the interaction with the system in this case study. Only Kebbi was placed in front of the participant during the interaction.

Table 2. *Questions in Post-Questionnaire (Answers in 5 Likert Scale)*

| | |
|---|---|
| Q1 | Do you think that you can use the target strategy provided by the robot? |
| Q2 | Do you think that you used the strategy provided by the robot if you were taught in high school days? |
| Q3 | Do you think that you could find more effective strategy if you could use the robot system in high school days? |
| Q4 (only for Ex. Group) | Did you feel the robot used the same learning strategy as you? |
| Q5 (only for Ex. Group) | Did you empathize with the robot's episodes about learning strategies? |
| Q6 | Did you think the robot's episodes had a beneficial effect on your choice of learning strategies? |
| Q7 | Did you concentrate on the interaction with the robot? |
| Q8 | Did you think the robot's utterance was convincing? |
| Q9 | Did you think the robot's utterance was acceptance? |
| Q10 | Did you feel the uncomfortable feeling with the robot's utterance? |
| Q11 | Did you feel the uncomfortable feeling on the robot's behavior? |
| Q12 | When you were talking about the strategy you used, did you feel resistance to communicate with the robot? |
| Q13 | If you have another chance to talk with a social robot, do you resist communicating with it? |
| Q14 | Do you trust what robot tells you compared to what people tells you? |
| Q15 | Do you trust what robot tells you compared to what generative AI tells you? |

The hypotheses we set up in this study were as follows:
H1: The system allows learners to empathize with the robot's episode.
H2: The system allows learners to positively change the use of the learning strategy from the persistent one to a new one they have never used.

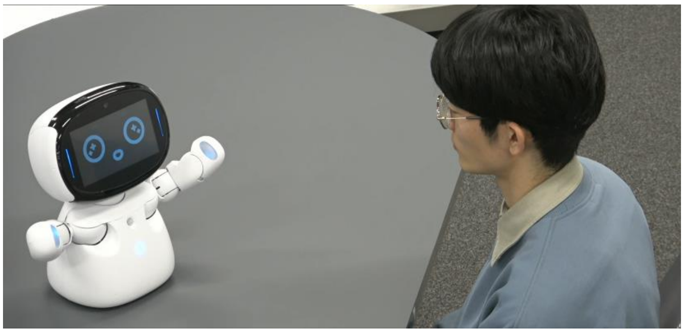


*Figure 9.* An Image of Interaction with Kebbi in the Experiment

### *4.2 Results*

Table 3 shows a summary of strategies known to the participants, strategies identified as persistent one, and target strategies selected in this case study. The total sum of the known strategies exceeds the total number of the participants because there were several cases in which one participant knew more than one strategy.

Table 3. *A List of Learning Strategies Analyzed*

| 19 subjects | Experimental group | | | Control group | |
|---|---|---|---|---|---|
| Learning strategies | Known | Persistent | Target | Known | Target |
| Motivational | 5 | 3 | 0 | 3 | 0 |
| Repeating | 3 | 2 | 0 | 4 | 0 |
| Expressing & using | 7 | 4 | 2 | 6 | 2 |
| Organizing | 3 | 0 | 3 | 5 | 5 |
| Creating question | 0 | 0 | 4 | 0 | 3 |

Figure 10 shows the results of the post-questionnaire. From the two-sided t-test, there were significant differences between the average scores of the two group in the following questions: Q3, Q6, Q15 (Q3:t(17)=2.26, p=0.00408, Cohen's d=1.01, Q6:t(17)=4.94, p=0.00202, Cohen's d=2.31, Q15:t(17)=3.31, p=0.00442, Cohen's d=2.48).

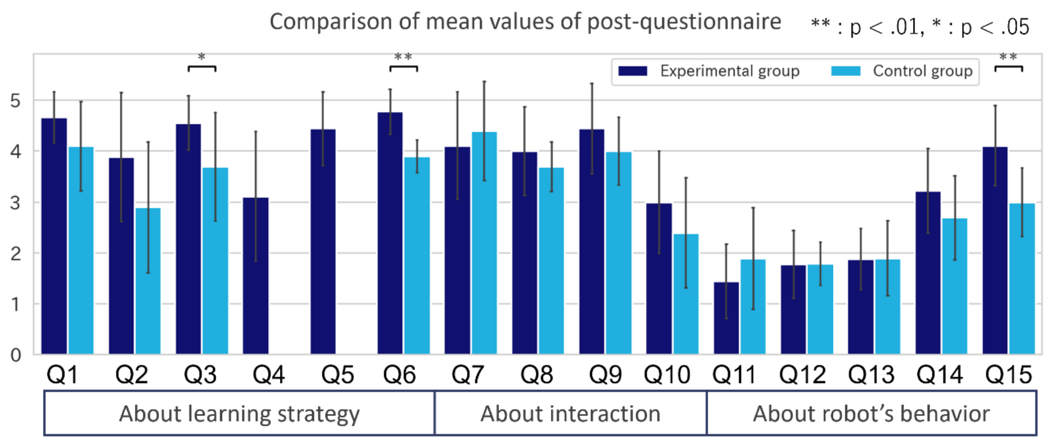



*Figure 10.* Results of Post-Questionnaire (Average scores)

Figure 11 shows the comparison of the same questions about the impression of social robots in the pre and post questionnaires in each group. From the two-sided t-test, there was a tendency of significant difference in the experimental group between the average scores in the question about trust in robot compared to generative AI ($t(7)=1.89$, $p=0.0955$, Cohen's $d=0.667$).

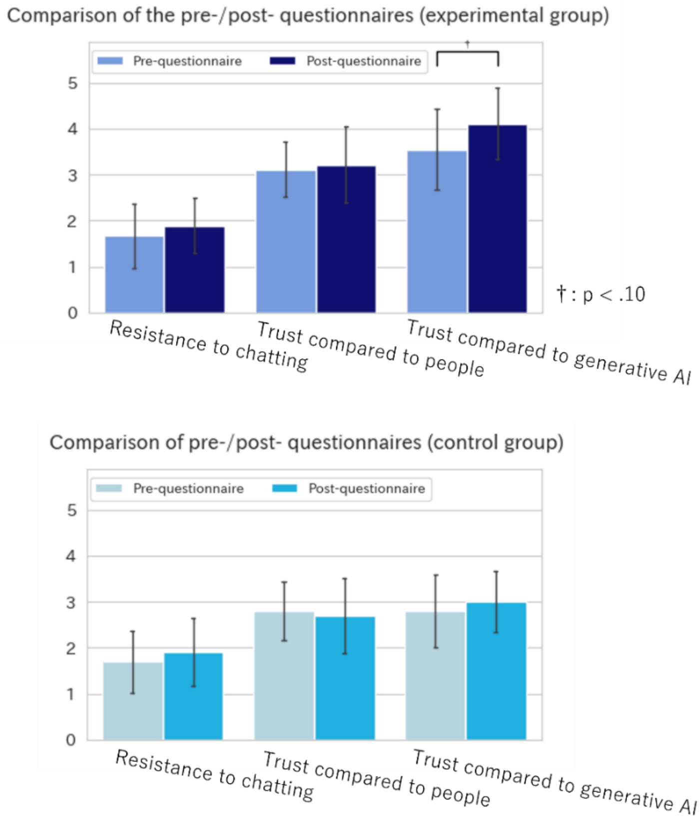



*Figure 11.* Comparison of Pre- and Post-Questionnaires

### *4.3 Discussion*

Firstly, let us discuss about the hypothesis H1. As for Q4 of the post-questionnaire, the experimental group did not so strongly feel that the robot was using the same learning strategies as themselves as shown in Figure10. But the average score of Q5 was high. This suggests that the participants in the experimental group empathize with the robot's episode, which includes persistent and target strategies. We accordingly think H1 is supported. As shown in Figure 11, furthermore, the trust in robot in the experimental group increased compared to the one in generative AI after interacting with the robot. We think this increase has a positive influence on the participants' empathy for the robot. In other words, the trust in robot promotes empathy for the robot's episode about the persistent learning strategy.

Secondly, we will discuss about H2. As for Q6 of the post-questionnaire, it is suggested that the experimental group significantly has a positive impact on the choice of learning strategies rather than the control group as shown in Figure 10. We think this is due to the robot's episodes shared. Following the model of empathy as shown in Figure 3(b), in addition, we think the result of Q5 suggests the possibility that the participants simulated the use of the target strategy by projecting themselves onto the robot. As for the willingness to change the learning strategy to be used, the experimental group significantly shows a higher value in Q3 than the control group. This suggests the possibility that the robot promotes changing the use of learning strategy by means of the shared episodes. On the other hand, the results of Q2 show a large variation in responses for both groups, although the average score in the experimental group was higher. The correlation coefficient with Q3 was calculated to be 0.457 for the experimental group and -0.0995 for the control group. This indicates a moderate positive correlation only in the experimental group. In other words, the more the participants in the experimental group turned to other strategies, the more they were willing to use the target strategy. This suggests that the persistence has been alleviated, leading them to consider changing their belief to use the target strategy. In summary, these results support H2, and show that the persistence alleviation scenario has a positive impact on learners' strategy choice.

## 5. Conclusion

In this work, we designed a persistence alleviating scenario by following the model of empathy and introduced a robot interactive system that has a dialogue with learners according to the scenario. The results of the case study with the system suggest that the scenario could alleviate learners' persistence through empathizing with a peer who has the same experience. Additionally, the scenario could make learners more willing to change the use of learning strategies.

There are two limitations in this study. Firstly, we need to observe whether learners could actually change the use of learning strategies from their persistent one to an appropriate one for the long term. This paper focused on the first step towards the long-term evaluation and used subjective questionnaire to evaluate the effectiveness of the robot interactive system in the short term. Secondly, we manually determined the appropriate strategies for the participants in the case study. In practice, it is important to set target strategies for each leaners considering their learning phases/objects.

In future, we will conduct more detailed and objective evaluation using learners' movements, gaze, posture, etc. In addition, we would like to apply the system to other domains as a challenging issue of how to change persistent learning behavior.

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## References

Chamot, A. (2004). Issues in Language Learning Strategy Research and Teaching, *Electronic Journal of Foreign Language Teaching*, 1(1), 14-26.

Gu, Y., & Johnson, R. K. (1996). Vocabulary learning strategies and language learning outcomes. *Language Learning*, 46(4), 643-679. https://doi.org/10.1111%2Fj.1467-1770.1996.tb01355.x

Guo, Y. R., & Goh, D. H.-L. (2015). Affect in Embodied Pedagogical Agents: Meta-Analytic Review, *Journal of Educational Computing Research*, 53(1), 124–149.

Sasaki, S., & Kashihara, A. (2024). Alleviating Persistence in Learning Strategies with a Model of Empathy for Others' Learning Experience, *The Institute of Electronics, Information and Communication Engineers Technical Report (IEICE ET2023-64)*, 123(406), 69-76. (in Japanese).

Uchida, N. (2021). Developmental Differences in English Vocabulary Learning Strategies: A Cross-Sectional Study of Secondary-Level Students, *Japanese Journal of Educational Psychology*, 69(4), 366-381. https://doi.org/10.5926/jjep.69.366 (in Japanese)

Uchida, N., Mizuno, Y., & Uesaka, Y. (2023). Effects of Teaching a Vocabulary Learning Strategy and Processes Underlying Individual Differences Observed: Collaboration Between Researchers and a High School Teacher. *The Japanese Journal of Educational Psychology*, 71(2), 145-158. https://doi.org/10.5926/jjep.71.145 (in Japanese)

Wada, K., & Shibata, T. (2006). Robot Therapy in a Care House, IEEE International Conference on Robotics and Automation, 3966-3971. https://doi.org/10.1109/ROBOT.2006.1642310

Weinstein, C. E., Husman, J., & Dierking, D. R. (2000). Self-regulation interventions with a focus on learning strategies. In M. Boekarts, P.R. Pintrich & M. Zeidner (Eds.), Handbook of Self-Regulation 727-747. San Diego & London: Academic Press.

Yamaguchi, T. (2017). Effects of Perceived Benefits about When and How to Use a learning Strategy, *The Japanese Journal of Psychology*, 88(1), 51-60. https://doi.org/10.4992/jjpsy.88.16007 (in Japanese)