University of Hormozgan

Iranian Journal of Educational Research

Print ISSN: 1735 - 563X Online ISSN: 2980 - 874X

Homepage: http://ijer.hormozgan.ac.ir

Educational and Behavioral Research Center

Exploring the Impact of Reciprocal Teaching Methods on Problem-Solving Skills, Learning Speed, Metacognitive Knowledge, and Academic Self-Concept

Soghra Ebrahimi Ghavam[1] ✉, Mahshid Pourhosein[2], Mehdi Aslanzadeh[3]

1. Associate Professor Allameh Tabataba'i University, Tehran, Iran, s.ebrahimighavam@gmail.com
2. PhD Student in Human Resources and Organizational Behavior, Yazd University, Yazd, Iran
3. Associate Professor Allameh Tabataba'i University, Tehran, Iran

Article Info

Article type:

Research Article

Article history:

Received 26 May. 2024

Received in revised form 15 Oct. 2024

Accepted 2 Nov. 2024

Published online 01 Jun. 2025

Keywords:

Metacognitive Strategies,
Problem-Solving Skills,
Learning Speed,
Metacognitive Knowledge,
Academic Self-Efficacy

ABSTRACT

Objective: The present study investigated the effectiveness of the reciprocal teaching method on problem-solving skills, learning speed, metacognitive knowledge, and academic self-concept of seventh-grade female students in Tehran city.

Methods: This semi-experimental study was conducted on a sample of 20 seventh-grade female students in the 9th district of Tehran, selected through a multi-stage cluster sampling method. SPSS version 26 software was used for statistical data analysis, with variance analysis with repeated measurements applied.

Results: The test analysis results indicated the positive effect of metacognitive strategies (reciprocal teaching) on students' problem-solving skills, learning speed, metacognitive knowledge, and academic self-concept.

Conclusions: Based on these findings, students learn about behavioral, cognitive, and metacognitive strategies during the educational process, which improves their problem-solving skills, learning speed, metacognitive knowledge, and academic self-concept.

Cite this article: Ebrahimi Ghavam, S., Pourhosein, M. & Aslanzadeh, M. (2025). Exploring the impact of reciprocal teaching methods on problem-solving skills, learning speed, metacognitive knowledge, and academic self-concept. *Iranian Journal of Educational Research*, 4 (2), 1-16.

DOI: https://doi.org/10.22034/4.2.1

© The Author(s).

Publisher: University of Hormozgan.

DOI: https://doi.org/10.22034/4.2.1

[Downloaded from ijer.hormozgan.ac.ir on 2025-06-07]

Introduction

It is evident to educational scholars that school, as a social institution, profoundly influences an individual's social character formation. Through formal and informal education, students learn about lifestyle and interaction with others, demonstrating how to perform specific activities and the quality of collaboration or competition in these activities. Moreover, every country is responsible for preparing individuals for logical problem-solving and enhancing their everyday problem-solving beliefs through these educational avenues. Educational institutions, alongside formal education, endeavor to assist individuals in dealing with everyday issues and confronting life challenges, strengthening their belief in problem-solving abilities. Today, educators in all fields, from general domains to technology, assist students in acquiring high-level thinking skills and problem-solving abilities in all activities. These efforts also aid students in developing critical thinking skills and problem-solving abilities in natural activities and issues, placing them on a path of continuous learning and progress (Saif, 2017).

One of these skills is problem-solving. Problem-solving skills are essential for living in the present age. Problem-solving requires specific and purposeful strategies through which individuals define problems, decide on solutions, implement problem-solving strategies, and monitor them. Having problem-solving skills is fundamental in today's world, which is filled with challenges and various issues. This skill helps individuals intelligently and efficiently adopt effective strategies in complexities and when facing problems. Moreover, it enables individuals to make the best decisions in everyday life and professional and educational environments and respond to their challenges (MaryAnn & Rajni, 2011).

The speed of learning plays a crucial role in optimizing mental energy and enhancing learning productivity in the teaching and learning process. Learning speed indicates a set of practical solutions and techniques that can significantly increase the pace of grasping materials and allow learners and students to learn more in a shorter time. This means that improving learning speed makes learning faster and enhances understanding and focus in education and learning. Therefore, developing skills related to learning speed holds particular importance. These skills include strategies and techniques that improve the learning process and enhance an individual's performance in the teaching and learning process (Marquis et al., 2018).

[Downloaded from ijer.hormozgan.ac.ir on 2025-06-07]

Another of these skills is metacognitive knowledge. This knowledge entails being aware of one's cognitive processes and optimal ways to utilize them to achieve desired goals. In other words, metacognition is an individual's awareness and understanding of their cognitive system or knowledge about knowledge. This knowledge helps individuals monitor their progress while acquiring knowledge about various issues and completing tasks. Additionally, it assists individuals in evaluating their efforts' outcomes and assessing their mastery level (Gelles, 2015). Good and colleagues (2016) believe that individuals must be self-aware for better performance in the information processing system.

Furthermore, in educational environments, one critical aspect receiving attention from educational practitioners is the improvement of students' academic self-concept. Some psychologists have stated that a critical determinant of understanding an individual's behavior is their educational attitude toward their academic self-concept (Franz et al., 2020; Dicke et al., 2018). In other words, maintaining and enhancing academic self-concept determines learners' overall motivation in the educational domain. When an individual's experience aligns with their perspective on their academic self-concept, the effects of this experience are observed in their behavior. However, when an individual's experience does not align with their academic self-concept, the effects of this experience may be unpleasant and lead to non-acceptance, anxiety, and even isolation, resulting in negative impacts on the formation of the individual's academic self-concept. Therefore, it can be said that the approach of peers, especially parents and educators, plays a significant role in shaping the academic self-concept of each student (Huang, 2011).

Considering the findings of some studies, improving these abilities in the teaching process is highly important (Eide et al., 2018; Hafenbrack, 2017), and there is a need to enhance these abilities through various educational interventions. In other words, using different teaching methods to improve problem-solving skills, learning speed, metacognitive knowledge, and academic self-concept is beneficial (Huang, 2011). The critical point here is that with an increased role of the student in the teaching process, there is a possibility that personal and educational abilities, including problem-solving skills, learning speed, metacognitive knowledge, and academic self-concept, may be enhanced better.

Cognitive strategies help us prepare new information for integration with previously learned information and store it in long-term memory. These strategies include repetitive activities, review,

[Downloaded from ijer.hormozgan.ac.ir on 2025-06-07]

semantic elaboration, and organization. Metacognitive strategies, on the other hand, help us monitor and guide cognitive strategies. These strategies can be divided into three categories: planning, monitoring, and organization (Luka, 2016). Metacognition refers to awareness of our learning and control over it. Just as cognitive strategies are learning strategies, metacognitive strategies are measures to monitor and guide cognitive strategies; thus, metacognition plays a fundamental role in successful learning (Malemir et al., 2023).

One type of metacognitive education is dual-domain instruction, which provides students with the foundations of cognitive and metacognitive strategies, enhancing their understanding and comprehension skills (Sagir, 2011). Dual-domain instruction is a method for acquiring metacognitive skills related to academic performance, which was introduced by Palinscar and Brown in 1984, and this method can help address students' group problems in any class and grade. This method teaches four strategies: questioning, summarizing, explaining, simplifying complex topics, and predicting future events. Dual-domain instruction is an educational activity that involves the best approach and dialogue between teachers and students, where both participants take on the role of teachers and address understanding and comprehension of topics through examination, summarization, prediction, and support (Habibi Kalibar et al., 2019).

According to some researchers, this method can improve students' metacognitive knowledge and self-perception by teaching their framework of four strategies (Caliskan & Sunbul, 2011). In other words, using metacognitive strategies in dual-domain instruction is such that it initially arouses students' interest in learning through simple activities or discussions on a topic. This method helps students navigate through interpreting materials and articulating their achievements to actively apply their new knowledge in different situations and evaluate their learning activities (Richard et al., 2014). Therefore, employing the dual-domain instructional model is expected to improve personal and educational skills such as problem-solving skills, learning speed, metacognitive knowledge, and academic self-perception.

Considering that metacognitive strategies (dual-domain instruction) require the use of specific behavioral, cognitive, and metacognitive strategies for focusing attention processes, they can help students learn and comprehend content better and potentially improve their academic self-perception (Assiari & Akhsan, 2019; Rizki & Lucia, 2017). Therefore, metacognitive strategies (dual-domain instruction) are expected to improve cognitive and psychological abilities, including

[Downloaded from ijer.hormozgan.ac.ir on 2025-06-07]

problem-solving skills, learning speed, metacognitive knowledge, and academic self-perception. The movement to use metacognitive strategies has been underway in most societies for years. It has sparked numerous studies, making dual-domain instruction and its impact on various cognitive, emotional, and ethical aspects of individuals one of the vast research areas in many of these societies. Despite this widespread use, unfortunately, there has not been enough attention to this issue in our country, and the number of studies conducted in this area is negligible compared to other societies; significantly fewer studies in educational psychology have addressed this issue. This is while many educational experts acknowledge that students' problem-solving skills, learning speed, metacognitive knowledge, and academic self-perception are not at a desirable level (Kordneghabi & Dortaj, 2017; Izadi & Mohammazadeh, 2007). Therefore, the present study aims to fill this research gap by investigating the effectiveness of cognitive strategies (dual-domain instruction) on problem-solving skills, learning speed, metacognitive knowledge, and academic self-perception of seventh-grade female students in Tehran.

Material and Methods

The research is applied as it examines the effectiveness of metacognitive strategies (dual-domain instruction) on problem-solving skills, learning speed, metacognitive knowledge, and academic self-perception of seventh-grade female students in Tehran. In terms of methodology, it is a semi-experimental study that utilizes a pretest-posttest design with a control group. The study population consists of seventh-grade girls from District 9, selected randomly from among the 22 educational districts in Tehran. Participants were chosen from two schools that were matched in terms of demographic characteristics and the number of students. A total of 20 students were selected using a multi-stage cluster sampling method, and through random assignment, they were divided into experimental and control groups.

In the pretest phase, both experimental and control groups completed researcher-made questionnaires that measured problem-solving skills, learning speed, metacognitive knowledge, and academic self-perception. During the academic year of 2022-23, the experimental group underwent a three-month intervention consisting of 18 sessions of 50 minutes each, using a dual-domain instructional package based on the Palinscar and Brown teaching method (1984), while

[Downloaded from ijer.hormozgan.ac.ir on 2025-06-07]

the control group received no intervention. Following the intervention, participants from both groups completed the same questionnaires again as a post-test.

The reliability of the research instruments was assessed using Cronbach's alpha to ensure adequate internal consistency for each tool:

Problem-Solving Skills Questionnaire: The Cronbach's alpha for this questionnaire was 0.87, indicating high internal consistency for measuring problem-solving skills.

Learning Speed Questionnaire: This questionnaire achieved a Cronbach's alpha of 0.85, suggesting reliable measurement of students' learning speed.

Metacognitive Knowledge Questionnaire: With a Cronbach's alpha of 0.82, this tool demonstrated strong internal consistency for evaluating metacognitive knowledge.

Academic Self-Concept Questionnaire: The reliability for this questionnaire was 0.88, reflecting high internal consistency for assessing academic self-concept.

These Cronbach's alpha values confirm that the research instruments had strong internal consistency, ensuring reliable measurement of the targeted constructs within the study sample. Content validity was also verified through expert evaluations. Statistical analysis was performed using SPSS version 26, and repeated-measures analysis of variance was used to analyze the results.

Table 1. Content of Dual-Domain Instruction Sessions Using the Palincsar and Brown Teaching Method (1984)

Number of sessions	Session content
Session 1	In this session, after the concept of reciprocal teaching was introduced, the objectives and benefits of reciprocal teaching sessions were explained to the students.
Session 2	At the beginning of this session, the students were provided with a brief explanation of the four reciprocal teaching strategies. Then, the first strategy, the prediction strategy, was taught to the students. In this strategy, after reading the first sentence of the text, the following sentence is predicted, and the accuracy of the prediction is determined after reading the second sentence.
Session 3	In this session, the question-generation strategy was also taught to the students. In teaching this strategy, after reading each paragraph, all the questions related to that paragraph are asked, and in the end, general questions are selected from among these questions.
Session 4	In this session, a brief review of the two previous strategies was conducted within 45 minutes.
Session 5	The participants were taught the explanation strategy (answering questions). In this strategy, the teacher reads a text and then asks the students to identify whether they have encountered any ambiguous points and, if they have, how they would understandably clarify them.
Session 6	In this session, the three strategies above were reviewed.
Session 7	The final summarization strategy was taught to the students within 45 minutes of this session. Four rules were used to summarize each paragraph: eliminating minor details, eliminating redundant phrases, substituting headings for lists of terms, and substituting headings for lists of actions and events.
Session 8	In this session, self-testing and question-posing were introduced, contributing to a better understanding of the content.

[Downloaded from ijer.hormozgan.ac.ir on 2025-06-07]

Session 9	After reviewing the students ' assignments, the five-step method for increasing students' understanding was applied in this session.
Session 10	After reviewing the assignments in this session, a 17-item scale was used to assess students' reading comprehension and study methods.
Session 11	After reviewing the assignments, the discussion about study methods continued, focusing on additional study or "finding important information again."
Session 12	Another study method, the SQ4R method, or the after-reading strategy, was taught in this session.
Session 13	After reviewing the assignments, the discussion about improving reading speed was continued.
Session 14	After reviewing the assignments and answering their questions, the discussion about speed-reading methods continued, and exercises were practiced.
Session 15	In this session, the effectiveness of exercises related to correct eye movement and reducing eye fixation time was reported, and the discussion about phrase-reading exercises continued.
Session 16	After reviewing the students' assignments and explaining their homework, this session reiterates essential points to consider when using the speed-reading method.
Session 17	In this session, questions about how to set goals, pose questions about the material, and summarize the points to consider when reviewing the material to understand better were addressed.
Session 18	After reviewing the students' assignments, problem-solving strategies were mentioned, and to attract the student's interest, a mathematical problem from the book 83 Mathematical Activities for Teenagers was presented.

Results

Demographic Description: The average age of the participants in the study was 13.58 ± 0.6, and the average GPA of these students was 14.12 ± 0.9. Indicators Description: Descriptive indices on problem-solving skills are presented in Table 2.

Table 2. Average and Standard Deviation of Problem-Solving Skills (n=40)

Variable	Stage	Group	Mean	SD
Problem-solving skills	Pre-test	Experiment	11.1	0.65
		Control	11.1	0.52
	Post-test	Experiment	12.8	0.57
		Control	11.9	0.60

The results in Table 2 indicate the average scores for problem-solving skills of participants in the experimental and control groups during the pre-test and post-test stages. The results for the experimental group show that the average scores increased from 11.1 in the pre-test to 12.8 in the post-test. Also, the average scores for the control group did not show a significant change in the two test phases. Descriptive indices on learning speed are provided in Table 3.

Table 3. Mean and standard deviation of learning speed (n=40)

Variable	Stage	Group	Mean	SD
Learning speed	Pre-test	Experiment	18.1	0.89
		Control	17.2	0.75
	Post-test	Experiment	6	0.90
		Control	16.9	0.86

[Downloaded from ijer.hormozgan.ac.ir on 2025-06-07]

The results in Table 3 indicate the average learning speed scores of participants in the experimental and control groups during the pre-test and post-test stages. The results for the experimental group show that the average scores decreased from 18.1 in the pre-test to 6 in the post-test. Also, the average scores for the control group did not show a significant change in the two test phases. Descriptive indices on metacognitive knowledge are provided in Table 4.

Table 4. Mean and standard deviation of metacognitive knowledge (n=40)

Variable	Stage	Group	Mean	SD
Metacognitive knowledge	Pre-test	Experiment	27.1	1.09
		Control	26.5	1.12
	Post-test	Experiment	30	0.99
		Control	26.8	1.01

The results in Table 4 indicate the average scores for metacognitive knowledge of participants in the experimental and control groups during the pre-test and post-test stages. The results for the experimental group show that the average scores increased from 27.1 in the pre-test to 30 in the post-test. Also, the average scores for the control group did not show a significant change in the two test phases. Descriptive indices on academic self-concept are provided in Table 5.

Table 5. Mean and standard deviation of academic self-concept (n=40)

Variable	Stage	Group	Mean	SD
Academic self-concept	Pre-test	Experiment	102.1	3.04
		Control	99.2	2.89
	Post-test	Experiment	124	2.90
		Control	100.1	3.02

The results presented in Table 5 indicate the average scores for academic self-concept of the participants in the experimental and control groups during the pre-test and post-test stages. The results for the experimental group show that the average scores increased from 102.1 in the pre-test to 124 in the post-test. Also, the average scores for the control group did not show a significant change in the two test phases.

To test the interaction effect between the participant (group) and the within-participant factor (time) on the measures obtained from problem-solving skills, learning speed, metacognitive knowledge, and academic self-concept, a simple mixed analysis of variance (ANOVA) was utilized. Before employing this method, the assumption of sphericity was tested to determine the homogeneity of variances and the similarity in the magnitude of correlation coefficients between

[Downloaded from ijer.hormozgan.ac.ir on 2025-06-07]

pairs of within-participant levels (Table 6). The sphericity assumption was verified using Mauchly's test for sphericity, confirming the homogeneity of error variances (Table 7).

Table 6. Mauchly's Test of Sphericity Results

Variable	Mauchly's W	Chi-Square	DF	P
Problem-solving skills	0.946	1.85	2	0.619
Learning speed	0.981	1.69	2	0.721
Metacognitive knowledge	0.909	1.32	2	0.702
Academic self-concept	0.923	2.10	2	0.689

Table 6 indicates that the assumption of sphericity, as tested by Mauchly's test, holds for within-subject effects. Therefore, the results of this test provide evidence for the homogeneity of variances and equality of covariance coefficients for within-subject effects.

Table 7. Levene's test for homogeneity of variances

Variable	DF1	DF2	F	P
Problem-solving skills	1	38	0.06	0.718
Learning speed	1	38	0.07	0.809
Metacognitive knowledge	1	38	0.05	0.812
Academic self-concept	1	38	0.08	0.792

Table 7 presents the results of the Levene's test. The results of this test also empirically support the homogeneity of error variances for the variables of problem-solving skills, learning speed, metacognitive knowledge, and academic self-perception. Since the examination of Mauchly's test results for the variables of problem-solving skills, learning speed, metacognitive knowledge, and academic self-perception indicate the significance of this test, the Greenhouse-Geisser correction was applied.

Table 8. Summary of the results of repeated measures analysis of variance

Variables	Source	SS	DF	MS	F	P	Effect size
Problem-solving skills	Time	212/545	2	16.21	42.23	1.001	0.51
	Time * Group	145/321	2	11.42	41.19	0.001	0.52
	Group	485/231	1	492.132	38.30	0.001	0.48
Learning speed	Time	198/324	2	20.34	51.09	0.003	0.32
	Time * Group	119/043	2	16.56	50.15	0.003	0.36
	Group	512/014	1	517.712	53.66	0.004	0.29
Metacognitive knowledge	Time	320/934	2	24.19	26.21	0.002	0.43
	Time * Group	228/390	2	18.56	25.92	0.002	0.41
	Group	597/812	1	601.165	26.87	0.001	0.40
Academic self-concept	Time	202/198	2	19.43	30.16	0.004	0.62
	Time * Group	197/564	2	10.72	31.11	0.004	0.60
	Group	428/105	1	432.891	30.21	0.003	0.59

[Downloaded from ijer.hormozgan.ac.ir on 2025-06-07]

As seen in Table 8, the factor of time and the interaction between time and group are significant in the variables of problem-solving skills, learning speed, metacognitive knowledge, and academic self-concept. In other words, changes over time within at least one of the groups have been different in these four variables. Also, the group variable is significant in all four variables. In the first section, the mixed analysis of variance statistical method results shows that the main within-group factor effect on all variables is statistically significant. Furthermore, this section shows the results regarding the interaction effect of within-group and between-group factors, and the main between-group factor effect on all variables is statistically significant.

Finally, the results of the Bonferroni post hoc test, aimed at determining the statistical significance of pairwise comparisons of within-group factor levels, indicate that in the comparisons based on problem-solving skills, learning speed, metacognitive knowledge, and academic self-concept scores, the difference between the average scores of participants in the pre-test stage and their average scores in the post-test stage is statistically significant.

Table 9. Bonferroni post hoc test for pairwise comparisons of research variable mean scores.

Variable	Comparison of Scores	Mean difference	Standard error	Sig.
Problem-solving skills	Pre-test – Post-test	1.7	1.41	0.001
Learning speed	Pre-test – Post-test	12.1	0.976	0.001
Metacognitive knowledge	Pre-test – Post-test	2.9	0.989	0.271
Academic self-concept	Pre-test – Post-test	21.9	1.02	0.05

Discussion

The current research results demonstrate reciprocal teaching's effectiveness in enhancing problem-solving skills, learning speed, metacognitive knowledge, and academic self-perception. Regarding the effectiveness of reciprocal teaching in improving problem-solving skills, this finding aligns with previous research (Yen, 2015; Luzal, 2012; Malmir et al., 2023; Nikouyan et al., 2022). Explaining the findings of this research regarding the effectiveness of reciprocal teaching intervention in students' problem-solving skills, it can be noted that many students suffer from a lack of interest, self-confidence, and personal control in problem-solving due to repeated failures (Luzal, 2012). Implementing incentive programs and corrective feedback leads to successful learning experiences and increases learners' motivation. Consequently, it fosters self-confidence and personal control in problem-solving among students. Additionally, educators in the field of reciprocal teaching believe that this method can aid students in better learning and achieving a

[Downloaded from ijer.hormozgan.ac.ir on 2025-06-07]

deeper and more accurate understanding. Through reciprocal teaching, students can be taught four strategies or techniques (questioning, summarizing, explaining, and clarifying complex points and predicting future events) (Rezaei & Kermanizadeh, 2015; Mariska et al., 2018). Therefore, learners seem capable of increasing their confidence in solving various life problems and maintaining personal control over the problem-solving process through these four strategies.

In conclusion, reciprocal teaching has significantly improved students' problem-solving skills, learning speed, metacognitive knowledge, and academic self-perception. This method provides students with active learning experiences and equips them with essential skills for facing real-world challenges. Through collaborative learning and problem-solving, students enhance various cognitive abilities and develop a stronger sense of academic self-perception. The strategies taught in reciprocal teaching empower learners to navigate different aspects of problem-solving and maintain personal control over the learning process. Thus, reciprocal teaching emerges as a promising approach to enhance students' overall academic performance and self-perception, preparing them for success in various academic and real-life contexts.

In the realm of the effectiveness of reciprocal teaching in increasing learning speed, this finding is consistent with previous research (Santrouk, 2014; Saif, 2017; Franz et al., 2020; Dick et al., 2018; Cheng & Shu, 2015; Abdo & Soumarmou, 2013; Nikouyan et al., 2022). In summary, it can be said that the reciprocal teaching intervention program has been influential in students' learning speed. In explaining the findings of this research regarding the effectiveness of reciprocal teaching intervention in students' learning speed, it can be stated that this method, due to its nature of education accompanied by small, regular steps and with extensive practice and repetition, enables students to become proficient in increasing learning speed. Since it aligns with many stages of problem-solving in various subjects, the effectiveness of this educational method is evident in increasing learning speed and problem-solving skills in students.

A critical element in the reciprocal teaching approach is scaffolding, which means supporting a novice individual through verbal guidance for modeling and describing cognitive processes. This method is initially teacher-directed and gradually becomes self-initiated to monitor, review, and predict internal cognitive processing; explicit speech becomes internal thinking and decodes by the reader through the text and decoding textual phenomena. Therefore, it is expected that the set of teachings that students receive in reciprocal teaching will improve their problem-solving skills

[Downloaded from ijer.hormozgan.ac.ir on 2025-06-07]

and learning speed, and students who become proficient in learning speed and problem-solving skills will improve their academic self-perception.

In the realm of the effectiveness of reciprocal teaching in increasing metacognitive knowledge, this finding is consistent with previous research (Bong, 2020; Asari & Akhsan, 2019; Rizki & Lucia, 2017; Yen, 2015; Nikouyan et al., 2020). In summary, it can be said that the reciprocal teaching intervention program has been influential in the variable of students' metacognitive knowledge. In explaining the findings of reciprocal teaching in students' metacognitive knowledge, it can be stated that reciprocal teaching increases awareness of performance during education and other cognitive actions of the individual.

Moreover, reciprocal teaching enables individuals to consider all cognitive actions involved in a cognitive activity from beginning to end. It directs their learning process in a way that enhances the efficiency of their mental processes regarding time and available resources. In other words, in this educational method, students can improve various dimensions of metacognition (awareness, cognitive strategies, planning, and self-monitoring). Reciprocal teaching strengthens cognitive processes through direct interactions between the teacher and students. This direct interaction allows students to actively engage in problem-solving, critical thinking, and extensive question-and-answer sessions, which is highly effective in enhancing metacognitive knowledge. Reciprocal teaching allows students to experience concepts in a practical and applied manner. These practical experiences can help improve their metacognitive knowledge as they can improve connections between different concepts and gain a deeper understanding of the content. Reciprocal teaching can strengthen students' memory through active interactions and direct feedback from the teacher, allowing students to correct their mistakes and progress in the learning process, which also promotes improving their metacognitive knowledge.

In the realm of the effectiveness of dual-sided education on increasing academic self-perception, this finding is consistent with the results of studies by Badrkeshan and Motallebzadeh (2023), Mofarreja et al. (2023), Franz et al. (2020), Dick et al. (2018), Cheng and Shuo (2015), Abdo and Soumarmo (2013), Nikouyan et al. (2020), and Moharamzadeh Fat'hi (2019). In summary, it can be said that the dual-sided education intervention program has effectively influenced the variable of students' academic self-perception. In explaining the findings of this research regarding the effectiveness of dual-sided education intervention in students' academic self-perception, it can be

[Downloaded from ijer.hormozgan.ac.ir on 2025-06-07]

said that dual-sided education provides an opportunity for students to participate actively in the learning process.

They cultivate various skills through discussions, collaboration, and solving real problems. These interactions can improve academic self-perception because students feel actively engaged in learning and enhance their abilities. Dual-sided education often provides opportunities for successful experiences in the academic environment. When students participate in group activities and achieve common goals, this experience of success can boost their self-confidence and self-perception. Collaboration in dual-sided education allows students to enhance their communication skills. Effective communication with classmates and teachers can foster stronger social connections among students and facilitate improvements in their self-perception. In dual-sided education, students are confronted with real-world problems and seek creative solutions. This process facilitates the development of critical thinking skills and problem-solving, thereby enhancing academic self-perception.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by the ethics committee of Allameh Tabataba'i University. The patients/participants provided their written informed consent to participate in this study.

Author contributions

E.GH, M.P and M.A contributed to the study conception and design, material preparation, data collection and analysis. All authors contributed to the article and approved the submitted version.

Funding

The authors did (not) receive support from any organization for the submitted work.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

[Downloaded from ijer.hormozgan.ac.ir on 2025-06-07]

References

Abdu, Q., & Sumarmo, U. (2013). Improving Mathematical Communication Ability and Self-concept Learning of Junior High Students by Using Reciprocal Teaching. *Journal on Mathematics Education*, 4(1), 59-74.

Asyari, M., & Ikhsan, M. (2019). The Effectiveness of Inquiry Learning Model in Improving Prospective Teachers' Metacognition Knowledge and Awareness. *International Journal of Instruction*, 12(2), 455-470.

Badakhshani, S., & Motallebzadeh, K. (2023). The Impact of Reflective Reciprocal Teaching on Iranian Intermediate EFL Learners' Academic Self-Concept. *Scientific Quarterly Journal of Language Horizons*, Alzahra University, 7(3), 147-155.

Bong, J. (2020). *Qualitative Exploration of Designing Online Reciprocal Teaching for Scaffolding Metacognitive Strategy Use for College Students*. The Florida State University, ProQuest Dissertations Publishing. 27743067.

Caliskan, M., & Sunbul, M. (2011). The Effects of Learning Strategies Instruction on Metacognitive Knowledge, Using Metacognitive Skills and Academic Achievement (Primary Education Sixth Grade Turkish Course Sample. *Educational Sciences: Theory and Practice*, 11(1), 148-153.

Ching, H., & Shu, C. (2015). Effects of Online Reciprocal Teaching on Reading Strategies, Comprehension, Self-Efficacy, and Self-concept. *Journal of Educational Computing Research*, 52(3), 381–407.

Dicke, T., Marsh, H. W., Parker, P. D., Pekrun, R., Guo, J., & Televantou, I. (2018). Effects of school-average achievement on individual self-concept and achievement: Unmasking phantom effects masquerading as true compositional effects. *Journal of Educational Psychology*, 110(8), 1112–1126. https://doi.org/10.1037/edu0000259.

Eide, R., Jenison, D., Mickelson, K., & Northrup, L. (2018). *Engineering Fundamentals and Problem Solving*. Iowa State University Digital Press.

Franz, R., Gerda, H., Josef, K., & Alexander, S. (2020). On the Impact of Learning Cycle Teaching on Austrian High School Students' Emotions, Academic Self-Concept, Engagement, and Achievement. *Journal of Research in Science Education*, https://doi.org/10.1007/s11165-020-09918-w.

Gelles, D. (2015). *Mindful work: How meditation is changing business from the inside out*. Boston: Eamon Dolan.

[Downloaded from ijer.hormozgan.ac.ir on 2025-06-07]

Good, D. J., Lyddy, C. J., Glomb, T. M., Bono, J. E., Brown, K. W., Duffy, M. K., Baer, R. A., Brewer, J. A., & Lazar, S. W. (2016). Contemplating mindfulness at work: An integrative review. *Journal of Management*, 42(2), 114–142.

Habibi Kalibar, R., Farid, A., & Bahadori Khirvoshahi, J. (2019). The Effect of Badi'ah Paradigm and Seven-Stage Learning Cycle Pattern on Improving Students' Creative Thinking. *Teaching Research Quarterly*, 7(1), 168-183.

Hafenbrack, A. C. (2017). Mindfulness meditation as an on-the-spot workplace intervention. *Journal of Business Research*, 75, 118–129.

Heppner, P. (1988). *The Problem-Solving Inventory: Manual*. Palo Alto, CA: Consulting Psychologist Press.

Huang, C. (2011). Self-concept and academic achievement: A meta-analysis of longitudinal relations. *Journal of School Psychology*, 49(5), 505–528.

Izadi, S., & Mohammadzadeh Admlai, M. (2007). Investigating the Relationship between Learning Styles, Personality Traits, and Academic Performance of Students. *Journal of Behavioral Sciences*, 14(27), 15-29.

Kardanoghabi, R., & Dartaaj, F. (2017). *Theories of Education: Models, Strategies, Methods, and Techniques*. Tehran: Allameh Tabataba'i University Press.

Liu, W.C., & Wang, C.K.J. (2005). Academic self-concept: A cross-sectional study of grade and gender differences in a Singapore Secondary School. *Asia Pacific Education Review*, 6(1), 20-27.

Luca, A., Lupu, L.M., & Herghiligiu, I.V. (2016). Organizational Knowledge Acquisition - Strategic Objective of Organization. *Proceedings of CBU International Conference on Innovations in Science and Education*, 23-25.

Luzale, D. (2012). The Effect of Reciprocal Peer Tutoring and Non-Reciprocal Peer Tutoring on the Performance of Students in College Physics. *Journal of Research in Education*, 87(1), 34–49.

Mafarja, N., Zulnaidi, H., & Mohd Fadzi, H. (2023). Effect of reciprocal teaching strategy on physics students' academic self-concept. *International Journal of Evaluation and Research in Education*, 12(2), 1023-1034.

Mahramzadeh Fattahi, M. (2019). The Effect of Reciprocal Teaching and Structured Teaching on Learning Outcomes in Education. *First National Conference on Humanities and Development*.

Malmir, A., Maleki, M., Rastegar, Z., & Farahani, Z. (2023). Investigating the Effect of Metacognitive Strategies (Dual-sided Teaching Method) on Reading Comprehension and Problem-Solving of

[Downloaded from ijer.hormozgan.ac.ir on 2025-06-07]

Elementary Students. *First International Conference on Psychology, Social Sciences, Educational Sciences, and Philosophy*.

Mariska, O., Roel, v., Amos, J. S., & Peter J. (2018). Effects of reciprocal teaching on reading comprehension of low-achieving adolescents. The importance of specific teacher skills. *Journal of Research in Reading*, 41(1), https://doi.org/10.1111/1467-9817.12082.

MaryAnn, D., & Rajni, S. (2011). A Programmatic Approach to Teaming and Thematic Instruction. *University of North Carolina Wilmington*.

Nikouyan, T., Ghazanfari, A., Cherami, M., & Sharifi, T. (2021). Comparing the Effectiveness of Reciprocal Teaching and Thinking Cycle on Metacognitive Knowledge and Academic Self-Perception of Fifth-Grade Female Students in Shiraz. *Journal of Educational Science and Evaluation*, 13(52), 187-203.

Nikouyan, T., Ghazanfari, A., Cherami, M., & Sharifi, T. (2022). Investigating the Effectiveness of Reciprocal Teaching, Direct Explanation on Learning Speed, and Problem-Solving Skills. *Iranian Journal of Political Sociology*, 5(11), 3005-3021.

Rezaei, A., & Kermanizadeh, R. (2015). The Effect of Reciprocal Teaching on Improving Reading Comprehension and Learning Disabilities. *Journal of Learning Disabilities*, 4(4), 49-46.

Richard, R., Deegan, B. F., & Klena, J. C. (2014). The learning styles of orthopedic residents, faculty, and applicants at an academic program. *J Surg Educ*, 71, 110–118.

Rizki, M., & Lucia, M. (2017). Reciprocal Teaching with Buddy to Improve Metacognitive Strategies of a High School Student with Reading Comprehension Difficulties. *Proceedings of the 1st International Conference on Intervention and Applied Psychology (ICIAP 2017)*.

Sagir, S. U. (2011). Research on problem-solving skills of teacher candidates. *E-Journal of New World Science Academy*, 6, 2482–2494.

Saif, A. A. (2017). *Psychology of Modern Education*. Tehran: Douran Publishing.

Yen, J. H. (2015). The effects of reciprocal teaching (RT) on junior college students' metacognitive awareness and reading comprehension. *International Journal of Teaching and Education*, 3(4), 15–32.

[Downloaded from ijer.hormozgan.ac.ir on 2025-06-07]