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Comparison of the Effectiveness of Problem-Solving Techniques Training and Self-Regulation Skills Training on Academic Self-Efficacy among English as a Foreign Language Learners

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A B S T R A C T

Purpose: The present study aimed to compare the effectiveness of problem-solving techniques training and self-regulation skills training on the academic self-efficacy of English as a Foreign Language (EFL) learners.

Methods and Materials: This study employed a quasi-experimental design with a pretest–posttest–follow-up structure and a control group. The statistical population consisted of male EFL learners enrolled in language institutes in Mahabad during the 2024–2025 academic year, from which 60 participants were selected using purposive sampling and randomly assigned into two experimental groups and one control group (n = 20 per group). The first experimental group received problem-solving techniques training, and the second experimental group received self-regulation skills training, each delivered in eight weekly sessions lasting 90 minutes. The control group received no intervention. Academic self-efficacy was measured using the Jinks and Morgan Academic Self-Efficacy Questionnaire at three time points: pretest, posttest, and two-month follow-up. Data were analyzed using mixed repeated measures analysis of variance (ANOVA) with Greenhouse–Geisser correction and Bonferroni post hoc comparisons using SPSS-23 software.

Findings: The results of mixed repeated measures ANOVA indicated significant within-group effects of time for all academic self-efficacy components, including talent ($F = 10.79$, $p = 0.001$), effort ($F = 15.99$, $p = 0.001$), and context ($F = 30.40$, $p = 0.001$), indicating significant changes across measurement stages. Significant interaction effects between time and group were also observed for talent ($F = 5.64$, $p = 0.001$), effort ($F = 3.83$, $p = 0.020$), and context ($F = 13.41$, $p = 0.001$), indicating differential changes across groups. In addition, significant between-group differences were found for talent ($F = 3.16$, $p = 0.040$), effort ($F = 4.32$, $p = 0.020$), and context ($F = 12.37$, $p = 0.001$). Bonferroni post hoc comparisons showed that both intervention groups had significantly higher academic self-efficacy scores compared to the control group ($p < 0.05$). Furthermore, self-regulation skills training demonstrated a significantly greater effect on the effort component compared to problem-solving techniques training ($p = 0.040$).

Conclusion: Both problem-solving techniques training and self-regulation skills training were effective in significantly improving academic self-efficacy among EFL learners, with self-regulation training demonstrating relatively stronger effects on effort-related academic self-efficacy, and both interventions producing sustained improvements over time.

Keywords: *Academic self-efficacy, problem-solving techniques, self-regulation skills, English as a Foreign Language learners, quasi-experimental design, educational intervention*

1. Introduction

Academic success is widely recognized as a central indicator of educational effectiveness and individual development, particularly in the context of second and foreign language learning, where students must acquire complex linguistic, cognitive, and motivational competencies simultaneously. In contemporary educational systems, academic performance is not solely determined by intellectual ability but is significantly influenced by motivational and psychological constructs, among which academic self-efficacy has emerged as one of the most powerful predictors of learning outcomes. Academic self-efficacy refers to learners' beliefs about their capability to successfully perform academic tasks, regulate their learning processes, and overcome academic challenges. These beliefs influence students' effort, persistence, engagement, and resilience in academic contexts, thereby shaping both immediate performance and long-term educational trajectories. Empirical evidence has consistently demonstrated that students with higher academic self-efficacy are more motivated, demonstrate greater perseverance in the face of difficulties, and achieve higher levels of academic performance compared to students with lower self-efficacy beliefs (Ahmadi et al., 2023; Ahmed et al., 2023; Zhao et al., 2024). Furthermore, academic self-efficacy plays a crucial role in shaping students' learning engagement, academic vitality, and psychological well-being, serving as a protective factor against academic stress, disengagement, and performance decline (Mir Mahmoudi, 2025; Rad et al., 2025; Yang & Lian, 2025).

From a theoretical perspective, academic self-efficacy is closely associated with students' academic self-concept, motivation, and learning behaviors. Research has demonstrated reciprocal relationships between academic self-efficacy and academic achievement, indicating that higher self-efficacy promotes improved performance, which in turn reinforces learners' confidence in their academic abilities (Marsh et al., 2024; Wu et al., 2021). In addition, academic self-efficacy is strongly associated with learning engagement, self-assessment practices, and perseverance, highlighting its central role in regulating academic behavior and performance (Riaz et al., 2022; Yang et al., 2023). Students with strong academic self-efficacy are more likely to engage actively in learning tasks, adopt effective cognitive strategies, and persist in challenging academic situations, whereas students with low self-efficacy are more prone to academic procrastination, anxiety, and disengagement (Desai et al., 2021; Goroshit & Hen, 2021; Scheunemann et al., 2021). Moreover, academic self-efficacy has been identified as a key determinant of academic motivation, academic engagement, and persistence in educational settings, further underscoring its importance as a foundational component of academic success (Affuso et al., 2023; Sutherland et al., 2023; Wild & Grassinger, 2023).

In recent years, educational researchers have increasingly emphasized the importance of developing instructional interventions that enhance academic self-efficacy by strengthening students' cognitive and self-regulatory competencies. Among these competencies, problem-solving skills have been recognized as a critical component of effective learning. Problem-solving involves the ability to identify problems, generate solutions, evaluate alternatives, and implement appropriate strategies, all of which require higher-order cognitive processing. Students who possess strong problem-solving skills are better able to navigate academic challenges, regulate their cognitive processes, and achieve academic success. Research has demonstrated that problem-solving instruction enhances learners' academic self-efficacy by promoting cognitive flexibility, analytical reasoning, and confidence in their ability to overcome academic obstacles (Fitriana & Waswa, 2024; Rahmah et al., 2022; Rahman et al., 2024). Furthermore, problem-solving training has been shown to improve students' learning outcomes, academic performance, and motivation by enabling them to engage actively in learning tasks and apply knowledge effectively in novel situations (Abda & Pambudi, 2024; Sari et al., 2021; Yapatang & Polyiem, 2022).

Problem-based learning and problem-solving training approaches also contribute to students' academic self-efficacy by fostering active engagement, collaboration, and critical thinking. These approaches encourage learners to participate actively in the learning process, construct

Iranian Journal of Educational Sociology
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knowledge through meaningful experiences, and develop confidence in their problem-solving abilities. Studies have shown that structured problem-solving interventions significantly improve students' academic performance, cognitive skills, and self-efficacy beliefs by enhancing their ability to manage academic challenges effectively (Almulla & Al-Rahmi, 2023; Andrini, 2024; Pimdee et al., 2024). Similarly, innovative instructional strategies that emphasize problem-solving and interactive learning environments have been found to enhance students' cognitive competence and academic confidence by promoting active learning and meaningful engagement (Aslan, 2021; Daryanes et al., 2023; Riyadi et al., 2021). In addition, problem-solving interventions have been shown to reduce academic procrastination and improve students' self-regulatory behaviors by strengthening their ability to manage academic tasks effectively (Realfan et al., 2025).

In addition to problem-solving skills, self-regulation has emerged as another critical determinant of academic self-efficacy and academic success. Self-regulation refers to learners' ability to plan, monitor, and evaluate their learning processes in order to achieve academic goals. Self-regulated learners actively control their cognitive, motivational, and behavioral processes, enabling them to optimize their learning outcomes and academic performance. Research has demonstrated that self-regulation skills are strongly associated with academic self-efficacy, academic achievement, and learning engagement, as students who effectively regulate their learning processes are more confident in their ability to succeed academically (Johnson et al., 2021; Mahmud & German, 2021; Zheng & Sun, 2024). Furthermore, self-regulation training has been shown to improve academic performance, motivation, and learning strategies by enhancing learners' ability to manage their learning processes effectively (Karlen et al., 2023; Lee et al., 2023; Theobald, 2021).

Self-regulated learning interventions have also been found to enhance academic self-efficacy by promoting goal setting, self-monitoring, and strategic learning behaviors. These interventions enable students to develop greater control over their learning processes, thereby increasing their confidence in their academic abilities. Studies have shown that students who receive self-regulation training demonstrate higher levels of academic self-efficacy, improved learning performance, and greater persistence in academic tasks compared to students who do not receive such training (Abtokhi et al., 2021; Edwards et al., 2021; Hwang & Oh, 2021). Moreover, self-regulation has been identified as a critical factor in reducing academic anxiety, improving academic engagement, and enhancing overall academic performance, highlighting its importance in educational interventions aimed at improving student outcomes (Delima & Cahyawati, 2021; Zheng & Sun, 2024).

In the context of English as a Foreign Language (EFL) learning, academic self-efficacy is particularly important because language learning requires sustained effort, cognitive flexibility, and persistence in the face of complex linguistic challenges. Students with high academic self-efficacy are more likely to engage actively in language learning activities, demonstrate greater persistence in overcoming linguistic difficulties, and achieve higher levels of language proficiency. Research has shown that academic self-efficacy is strongly associated with language learning motivation, academic engagement, and language achievement, emphasizing its critical role in successful language acquisition (He, 2024; Zhao et al., 2024). In addition, technological advancements and modern instructional approaches, including artificial intelligence–supported learning environments, have further highlighted the importance of cognitive and self-regulatory skills in promoting academic self-efficacy and academic success (Bukhari, 2025).

Despite the extensive evidence supporting the effectiveness of problem-solving training and self-regulation training in enhancing academic self-efficacy, relatively few studies have directly compared the effectiveness of these two intervention approaches within the same research framework, particularly among English language learners. Although both interventions target cognitive and motivational processes, they differ in their theoretical foundations and mechanisms of action. Problem-solving training focuses primarily on developing cognitive competence and analytical reasoning skills, whereas self-regulation training emphasizes the development of metacognitive and self-management skills. Understanding the comparative effectiveness of these interventions is essential for identifying the most effective strategies for enhancing academic self-efficacy and improving educational outcomes among language learners.

Given the critical role of academic self-efficacy in determining students' academic success, motivation, and learning engagement, and considering the demonstrated effectiveness of both problem-solving training and self-regulation training in enhancing cognitive and motivational competencies, there is a clear need to examine and compare the effectiveness of these interventions in improving

Iranian Journal of Educational Sociology
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academic self-efficacy among English language learners. Therefore, the present study was conducted to compare the effectiveness of problem-solving techniques training and self-regulation skills training on the academic self-efficacy of English language learners.

2. Methods and Materials

2.1. Study Design and Participants

The present study employed a quasi-experimental design using a pretest–posttest–follow-up format with two experimental groups and one control group. This design was selected to evaluate the causal effects of two structured educational interventions—problem-solving techniques training and self-regulation skills training—on the academic self-efficacy of English as a Foreign Language (EFL) learners while controlling for baseline differences and assessing the stability of intervention effects over time. The statistical population consisted of all male English language learners enrolled in language institutes in Mahabad during the 2024–2025 academic year. From this population, 60 participants were selected using purposive sampling based on inclusion criteria such as enrollment in English language learning courses, willingness to participate in intervention sessions, and absence of concurrent psychological or educational interventions targeting self-efficacy or learning skills. After selection, participants were randomly assigned to three groups, including the problem-solving techniques training group (n = 20), the self-regulation skills training group (n = 20), and the control group (n = 20), ensuring equivalence in group size and reducing selection bias. Random assignment enhanced internal validity and ensured that observed differences could be attributed to intervention effects rather than preexisting individual differences. The experimental groups received structured educational interventions, while the control group received no intervention during the study period. Measurements were conducted at three time points: pretest (before intervention), posttest (immediately after completion of the intervention), and follow-up (two months after intervention completion) to assess both immediate and sustained effects of the interventions. The quasi-experimental framework with repeated measures allowed for examination of within-group changes over time and between-group differences in intervention outcomes, thereby providing robust evidence regarding intervention effectiveness.

2.2. Data Collection

The primary data collection instrument used in this study was the Academic Self-Efficacy Questionnaire developed by Jinks and Morgan (1999), which is a standardized psychometric instrument designed to assess students' beliefs in their academic capabilities. This questionnaire consists of 30 items organized into three subscales measuring academic talent (items 1–10), academic effort (items 21–30), and academic context (items 11–20). Each item is rated on a four-point Likert scale ranging from strongly disagree (score of 1) to strongly agree (score of 4), allowing for quantitative measurement of perceived academic competence and self-beliefs related to academic functioning. Several items, specifically items 4, 5, 15, 16, 19, 20, 22, and 23, are reverse scored to control for response bias and ensure accurate representation of academic self-efficacy. Total scores range from 30 to 120, with higher scores indicating stronger academic self-efficacy. Scores between 30 and 52 indicate low academic self-efficacy, scores between 52 and 75 indicate moderate academic self-efficacy, and scores above 75 indicate high academic self-efficacy. The questionnaire has demonstrated strong psychometric properties, with an overall reliability coefficient of 0.82 and subscale reliability coefficients of 0.78 for talent, 0.66 for effort, and 0.80 for context. Previous validation studies conducted in Iran have reported Cronbach's alpha coefficients of 0.81, confirming the instrument's reliability in educational settings. In the present study, internal consistency reliability was calculated using Cronbach's alpha and yielded a coefficient of 0.73, indicating acceptable reliability for research purposes. The Academic Self-Efficacy Questionnaire was administered at three time points (pretest, posttest, and follow-up) to evaluate changes in academic self-efficacy across intervention phases and to measure both short-term and long-term intervention effects.

2.3. Intervention

The intervention protocol consisted of two structured educational training programs implemented separately for each experimental group over eight weekly sessions, with each session lasting 90 minutes. The first experimental group received problem-solving techniques training based on the structured educational framework developed by Sullivan, Lackey, and Graff, which focuses on developing cognitive and behavioral strategies for identifying, analyzing, and resolving academic and real-life problems. This intervention included training in problem identification,

Iranian Journal of Educational Sociology
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generation of alternative solutions, evaluation of consequences, decision-making, and implementation of selected solutions. Participants were encouraged to engage actively in problem-solving exercises, group discussions, and practical assignments to strengthen cognitive flexibility and analytical thinking skills. The second experimental group received self-regulation skills training based on Zimmerman's self-regulation model, which emphasizes three core phases: forethought, performance, and self-reflection. This intervention focused on developing goal-setting skills, strategic planning, self-monitoring, self-evaluation, and adaptive regulation of learning behaviors. Participants were trained to set realistic academic goals, monitor their progress, regulate their learning strategies, and evaluate their performance outcomes systematically. Both interventions were implemented in group format to facilitate peer interaction and collaborative learning. One week after the pretest assessment, participants in the experimental groups began the training programs, and training continued for eight consecutive weeks. The control group did not receive any intervention during this period. One week after completion of the training sessions, the posttest was administered to all groups, and the follow-up assessment was conducted two months later to evaluate the durability of intervention effects.

2.4. Data Analysis

Data analysis was conducted using SPSS software version 23 in two stages, including descriptive and inferential statistical analyses. Descriptive statistics, including means and standard deviations, were calculated to summarize academic self-efficacy scores across groups and measurement stages. Inferential analysis was performed using mixed repeated measures analysis of variance (mixed ANOVA), which allowed simultaneous examination of within-group changes over time (pretest, posttest, and follow-up) and between-group differences (problem-solving training group, self-regulation training group, and control group). The significance level for all statistical tests was set at $p < 0.05$. This comprehensive statistical approach enabled precise evaluation of intervention effectiveness, group differences, and sustainability of intervention effects over time.

3. Findings and Results

In this section, the descriptive and inferential findings related to academic self-efficacy and its components (talent, effort, and context) across the pretest, posttest, and follow-up stages in the problem-solving techniques training group, self-regulation training group, and control group are presented.

Table 1

Mean and standard deviation of academic self-efficacy components by measurement stage and group

Group	Component	Statistic	Pretest	Posttest	Follow-up
Problem-Solving Techniques Training	Talent	Mean	19.40	26.34	24.82
		Standard Deviation	4.33	4.22	5.26
Self-Regulation Training	Talent	Mean	19.85	23.80	22.50
		Standard Deviation	6.17	4.07	5.44
Control	Talent	Mean	19.50	18.85	18.70
		Standard Deviation	4.54	6.73	6.51
Problem-Solving Techniques Training	Effort	Mean	17.32	23.22	23.71
		Standard Deviation	4.31	4.42	5.26
Self-Regulation Training	Effort	Mean	17.23	24.34	23.81
		Standard Deviation	5.22	4.41	5.91
Control	Effort	Mean	18.16	17.51	18.65
		Standard Deviation	4.76	5.51	5.58
Problem-Solving Techniques Training	Context	Mean	17.26	22.00	22.40
		Standard Deviation	3.63	3.89	3.15
Self-Regulation Training	Context	Mean	17.22	21.60	22.20
		Standard Deviation	3.42	3.41	3.04
Control	Context	Mean	17.32	16.60	16.20
		Standard Deviation	3.22	2.96	2.78

As shown in Table 1, the mean scores of academic self-efficacy components increased substantially from pretest to posttest in both experimental groups, whereas no meaningful increase was observed in the control group. In the problem-

Iranian Journal of Educational Sociology
E-ISSN: 2645-3460

solving techniques training group, the mean talent score increased from 19.40 at pretest to 26.34 at posttest and remained relatively stable at 24.82 during follow-up. Similarly, the effort component increased from 17.32 at pretest to 23.22 at posttest and further increased slightly to 23.71 at follow-up. The context component also increased from 17.26 at pretest to 22.00 at posttest and remained stable at 22.40 during follow-up. In the self-regulation training group, comparable improvements were observed across all components. Talent increased from 19.85 at pretest to 23.80 at posttest and remained relatively stable at 22.50 at follow-up. Effort increased from 17.23 at pretest to 24.34 at posttest and remained at 23.81 during follow-up. Context increased from 17.22 at pretest to 21.60 at posttest and increased slightly to 22.20 at follow-up. In contrast, the control group showed minimal changes or slight decreases across all components over time. These descriptive findings suggest that both problem-solving techniques training and self-regulation skills training were associated with improvements in academic self-efficacy and its components, whereas no meaningful improvement occurred in the absence of intervention.

Prior to conducting the main inferential analyses, the statistical assumptions underlying mixed repeated measures analysis of variance were examined to ensure the validity and accuracy of the results. The normality of score distributions for academic self-efficacy and its components across the problem-solving techniques training group, self-regulation training group, and control group was assessed using the Shapiro–Wilk test. The obtained significance values were greater than 0.05 ($p = 0.35$ for both experimental groups and $p = 0.23$ for the control group), indicating that the null hypothesis of normality was not rejected and that the distribution of academic self-efficacy scores did not significantly deviate from normality. Therefore, the assumption of normal distribution was satisfied, allowing the use of parametric statistical tests. The homogeneity of variances across groups was evaluated using Levene's test, and the results showed non-significant values for all components, including talent ($F = 2.02$, $p = 0.12$), effort ($F = 0.32$, $p = 0.51$), and context ($F = 0.11$, $p = 0.79$), indicating that the assumption of equal variances across groups was met. In contrast, the assumption of sphericity, which refers to the equality of variances of the differences between repeated measurements, was examined using Mauchly's test of sphericity. The results indicated significant values for all components, including talent ($W = 0.52$, $p = 0.001$), effort ($W = 0.46$, $p = 0.001$), and context ($W = 0.51$, $p = 0.001$), demonstrating that the assumption of sphericity was violated. Consequently, to correct for this violation and prevent inflation of Type I error, the Greenhouse–Geisser correction was applied in the mixed repeated measures ANOVA. Overall, the assumptions of normality and homogeneity of variances were satisfied, and appropriate statistical corrections were applied to address the violation of sphericity, ensuring the robustness and validity of the inferential analysis.

To examine the statistical significance of these differences, mixed repeated measures analysis of variance with Greenhouse–Geisser correction was conducted.

Table 2

Mixed repeated measures analysis of variance of academic self-efficacy components using Greenhouse–Geisser correction

Component	Source	Sum of Squares	df	Mean Square	F	Significance	Eta Squared
Talent	Within Groups (Time Effect)	294.08	1.42	206.74	10.79	0.001	0.16
	Interaction (Time × Group)	307.26	2.85	108.00	5.64	0.001	0.17
	Between Groups	378.88	2.00	189.44	3.16	0.040	0.11
Effort	Within Groups (Time Effect)	433.14	1.26	344.00	15.99	0.001	0.22
	Interaction (Time × Group)	207.29	2.52	82.31	3.83	0.020	0.12
	Between Groups	434.18	2.00	217.09	4.32	0.020	0.13
Context	Within Groups (Time Effect)	357.21	1.39	257.11	30.40	0.001	0.35
	Interaction (Time × Group)	315.09	2.78	113.40	13.41	0.001	0.32
	Between Groups	544.81	2.00	272.41	12.37	0.001	0.30

The results presented in Table 2 indicate that the within-group effect of time was statistically significant for all academic self-efficacy components, including talent ($F = 10.79$, $p = 0.001$), effort ($F = 15.99$, $p = 0.001$), and context ($F = 30.40$, $p = 0.001$), indicating that academic self-efficacy scores changed significantly across the pretest, posttest, and follow-up stages. Furthermore, the interaction effect between time and group was statistically significant for all components, including talent ($F = 5.64$, $p = 0.001$), effort ($F = 3.83$, $p = 0.020$), and context ($F = 13.41$, $p = 0.001$),

Iranian Journal of Educational Sociology
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indicating that changes over time differed significantly between the experimental and control groups. In addition, the between-group effect was statistically significant for all components, including talent ($F = 3.16$, $p = 0.040$), effort ($F = 4.32$, $p = 0.020$), and context ($F = 12.37$, $p = 0.001$), demonstrating that overall academic self-efficacy differed significantly between the problem-solving techniques training group, self-regulation training group, and control group. The effect sizes (eta squared values) indicated moderate to large intervention effects, particularly for the context component ($\eta^2 = 0.35$), suggesting that the interventions had substantial practical significance.

Table 3

Bonferroni post hoc test results for pairwise comparisons between groups

Component	Comparison	Mean Difference	Standard Error	Significance
Talent	Problem-Solving vs. Self-Regulation	2.20	1.69	0.190
	Problem-Solving vs. Control	6.15	1.69	0.001
	Self-Regulation vs. Control	3.95	1.69	0.070
Effort	Problem-Solving vs. Self-Regulation	2.90	1.53	0.040
	Problem-Solving vs. Control	5.70	1.53	0.001
	Self-Regulation vs. Control	3.80	1.53	0.010
Context	Problem-Solving vs. Self-Regulation	0.40	1.08	0.990
	Problem-Solving vs. Control	5.40	1.08	0.001
	Self-Regulation vs. Control	5.00	1.08	0.001

The Bonferroni post hoc comparisons presented in Table 3 showed that both problem-solving techniques training and self-regulation skills training were significantly more effective than the control condition in improving academic self-efficacy components. Specifically, both experimental groups demonstrated significantly higher scores than the control group in talent, effort, and context components ($p < 0.05$). However, the difference between the two experimental groups was generally not statistically significant for talent ($p = 0.190$) and context ($p = 0.990$), indicating comparable effectiveness of the two interventions in these domains. In contrast, a statistically significant difference was observed between the problem-solving and self-regulation training groups in the effort component ($p = 0.040$), indicating that self-regulation skills training was more effective than problem-solving techniques training in improving students' effort-related academic self-efficacy. Overall, these findings demonstrate that both interventions significantly improved academic self-efficacy, with self-regulation training showing relatively stronger effects in specific motivational dimensions.

4. Discussion and Conclusion

The present study examined whether teaching problem-solving techniques and training self-regulatory skills could enhance academic self-efficacy among EFL learners across three measurement points (pretest, posttest, and follow-up). The descriptive pattern of results indicated that both intervention groups showed clear increases in the mean scores of academic self-efficacy components from pretest to posttest, while the control group remained largely stable or showed slight declines. Importantly, the gains in both experimental groups were largely maintained at follow-up, suggesting that the acquired skills were not merely short-lived test effects but translated into more durable changes in learners' academic beliefs and functioning. These trends were supported by the inferential findings from the mixed repeated measures ANOVA (with Greenhouse–Geisser correction), which showed significant within-subject effects of time for all components, as well as significant time × group interaction effects, indicating that the improvement trajectories differed across the intervention and control groups. Additionally, the between-group effects were significant, confirming that the overall levels of academic self-efficacy components differed meaningfully among the three groups following the interventions. Taken together, these results provide convergent evidence that both training packages were effective in improving academic self-efficacy and that the benefits persisted beyond the immediate end of training, which is consistent with the broader literature showing that academic self-efficacy is malleable and can be strengthened via targeted instructional and psychological interventions (Affuso et al., 2023; Clemente et al., 2024; Sutherland et al., 2023). The maintenance of gains at follow-up is especially notable, as longitudinal research suggests that self-beliefs such as self-efficacy and self-concept often show reciprocal relationships with achievement over time, meaning that early improvements in efficacy can initiate

Iranian Journal of Educational Sociology
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adaptive feedback cycles that stabilize and reinforce motivation and performance (Marsh et al., 2024; Palmu, 2024; Wu et al., 2021).

With respect to the first core finding, the effectiveness of problem-solving techniques training can be interpreted through cognitive-behavioral and instructional mechanisms that directly target learners' perceptions of competence and control. Problem-solving instruction typically increases learners' sense of agency by providing structured steps for identifying academic obstacles, generating solution alternatives, evaluating consequences, and implementing strategies in real learning contexts. When learners repeatedly experience that problems are solvable through systematic steps, they are more likely to attribute success to controllable factors (effort, strategy use) rather than fixed ability, thereby strengthening self-efficacy. This interpretation aligns with evidence from problem-based learning and problem-solving interventions showing improvements in students' problem-solving ability, academic performance, and self-efficacy, particularly when learning is active and contextualized (Abda & Pambudi, 2024; Fitriana & Waswa, 2024; Rahman et al., 2024). Studies in diverse educational settings have similarly shown that structured problem-based approaches and cooperative problem-solving processes cultivate academic confidence by promoting mastery experiences, which are among the strongest sources of self-efficacy development (Aslan, 2021; Sari et al., 2021; Yapatang & Polyiem, 2022). In addition, research focusing on how students enact problem-solving steps (e.g., Polya-like sequences) suggests that explicit scaffolding of problem-solving processes not only improves cognitive performance but also shapes students' beliefs about their capacity to succeed in challenging tasks (Rahmah et al., 2022; Riyadi et al., 2021). The present findings are therefore theoretically coherent: as learners acquired more reliable cognitive tools for dealing with learning problems, they likely experienced increased confidence in their academic abilities, which was reflected in the posttest and sustained follow-up elevations of self-efficacy components. Furthermore, in technology-enriched contexts, problem-solving support tools and interactive learning media have been shown to strengthen learners' engagement and competence beliefs, implying that skill-building, when paired with meaningful application, can robustly influence academic self-efficacy (Andrini, 2024; Daryanes et al., 2023).

Regarding the second core finding, self-regulation skills training also produced significant improvements in academic self-efficacy, and in at least one key domain (effort-related self-efficacy), the self-regulation group outperformed the problem-solving group. This pattern is consistent with the conceptual linkage between self-regulated learning and self-efficacy: self-regulation training directly targets the processes through which students set goals, plan learning, monitor progress, manage distractions, and evaluate outcomes. When learners become more capable of managing their learning behaviors and tracking improvement, they typically perceive greater control over outcomes and develop stronger confidence in their ability to succeed academically. This aligns with meta-analytic and intervention research indicating that self-regulated learning programs improve academic performance, strategic learning behaviors, and motivational outcomes (Lee et al., 2023; Theobald, 2021; Zheng & Sun, 2024). Evidence also suggests that self-regulation interventions can be domain-specific and especially effective when they train learners to apply strategies to concrete tasks and contexts, which may explain why self-regulation training can yield robust effects on motivational components such as effort and perseverance (Karlen et al., 2023; Lee et al., 2023). In applied educational contexts, self-regulated learning is consistently associated with improved learning outcomes and higher academic confidence because students learn how to translate intentions into sustained behaviors, such as planning study time, monitoring comprehension, and adjusting strategies when performance feedback indicates a need for change (Johnson et al., 2021; Mahmud & German, 2021). Moreover, research has shown that self-regulated learning can mediate the relationship between learning processes (e.g., self-directed learning) and academic self-efficacy, indicating that strengthening self-regulation may be a particularly direct route to improving efficacy beliefs (Hwang & Oh, 2021). The present study's finding that self-regulation training had a stronger effect on effort-related self-efficacy is therefore plausible: effort beliefs are closely tied to persistence, planning, self-monitoring, and emotional control during tasks, all of which are core targets of self-regulation training (Delima & Cahyawati, 2021; Edwards et al., 2021).

A third important point is that the interventions likely operated not only through cognitive strategy acquisition but also through reduction of maladaptive academic behaviors that undermine self-efficacy, such as academic procrastination, anxiety, and disengagement. The literature consistently indicates that procrastination and test anxiety correlate with weaker academic motivation, reduced persistence, and poorer performance, which can erode academic self-efficacy over time (Desai et al., 2021;

Iranian Journal of Educational Sociology
E-ISSN: 2645-3460

Scheunemann et al., 2021). For learners who face sustained demands in language learning, procrastination can be especially damaging because it reduces exposure to practice and feedback, thereby limiting opportunities for mastery experiences. In this regard, both interventions could reduce procrastination indirectly: problem-solving training can help learners break tasks into manageable steps and resolve "stuck points," while self-regulation training can strengthen time management, goal commitment, and self-monitoring. This interpretation is consistent with findings that problem-solving-based guidance programs reduce academic procrastination among secondary students (Realfan et al., 2025), and with evidence that academic procrastination can be predicted by academic self-efficacy and emotional regulation difficulties (Rad et al., 2025). Similarly, research indicates that students with learning difficulties or challenges in self-regulation may show weaker academic performance and higher procrastination, suggesting that interventions targeting regulatory capacities can have cascading benefits for confidence and achievement (Goroshit & Hen, 2021; Johnson et al., 2021). Beyond procrastination, self-efficacy is also intertwined with emotional and motivational functioning; improved self-efficacy can serve as a protective factor against social anxiety-related academic disruptions and can support sustained achievement behaviors (Ahmed et al., 2023). Additionally, when students' motivational ecosystems improve—through better perceived support, improved monitoring, and higher engagement—academic self-efficacy can rise and remain stable, reflecting the kind of durable follow-up pattern observed in the present study (Affuso et al., 2023; Mir Mahmoudi, 2025; Yang & Lian, 2025).

The broader educational context further supports the importance of building both problem-solving and self-regulation capacities as complementary pathways to academic self-efficacy. Research integrating social-cognitive perspectives with learning input factors suggests that problem-solving and critical thinking skills contribute to sustainable learning performance, which is typically accompanied by stronger competence beliefs (Almulla & Al-Rahmi, 2023). In parallel, evidence indicates that learners' preferences for learning technologies and their engagement with non-traditional learning supports can influence academic self-efficacy, implying that interventions should be attentive to how students learn and what supports they perceive as empowering (Sutherland et al., 2023). Emerging research on AI-related learning contexts also highlights that the use of AI tools may interact with critical thinking and problem-solving skills to predict academic performance, suggesting that modern learning ecologies increasingly reward students who can regulate their learning, evaluate information, and solve problems independently (Bukhari, 2025; He, 2024). Moreover, creativity-related and domain-specific differences in problem-solving performance, as documented in cognitive research, suggest that learners may vary in how they benefit from specific training emphases; this further supports the value of offering multiple intervention routes, such as problem-solving versus self-regulation, to optimize outcomes across diverse learners (He & Wong, 2021). Finally, students' academic self-assessment practices and perseverance of effort are empirically linked to academic self-concept and learning outcomes, which reinforces the conceptual logic that interventions improving strategic learning and persistence (especially self-regulation training) can yield disproportionate benefits in effort-related efficacy beliefs (Riaz et al., 2022; Wild & Grassinger, 2023; Yang et al., 2023).

Overall, the present findings suggest that both interventions are effective and that their effects are meaningfully sustained. The similarity of results between problem-solving and self-regulation training across multiple components implies that both programs can serve as viable evidence-informed approaches for enhancing EFL learners' academic self-efficacy. At the same time, the stronger effect observed for the self-regulation group in the effort component suggests that self-regulation training may be particularly useful when the educational goal is to strengthen persistence, task engagement, and sustained effort—processes that are central to language learning success and to maintaining gains over time. These conclusions are broadly consistent with intervention and meta-analytic evidence showing that self-regulation training enhances motivation and performance outcomes across educational levels (Theobald, 2021; Zheng & Sun, 2024), while problem-based and problem-solving approaches strengthen competence beliefs through mastery experiences and active engagement (Abda & Pambudi, 2024; Pimdee et al., 2024; Rahman et al., 2024).

Limitations. This study had several limitations that should be considered when interpreting the findings. The sample was limited to male EFL learners within a specific educational context, which may reduce generalizability to female learners, other age groups, or different institutional and cultural settings. In addition, the sampling method was

Iranian Journal of Educational Sociology
E-ISSN: 2645-3460

purposive and the sample size, while adequate for the applied design, was relatively modest for detecting smaller between-intervention differences. The study relied on self-report measurement of academic self-efficacy, which may be influenced by response bias or social desirability. Finally, the follow-up period was limited, and longer follow-up intervals would be helpful for assessing the longer-term sustainability of intervention effects.

Suggestions for future research. Future studies should replicate this research in more diverse samples, including female learners and learners from different regions, grade levels, and educational systems. Researchers should also consider including objective academic outcomes (e.g., course grades, standardized test scores, classroom performance indicators) and behavioral measures (e.g., study time tracking, task completion rates) to triangulate self-report changes in self-efficacy. Comparing blended or integrated interventions (combining problem-solving and self-regulation elements) against single-component training may clarify whether additive or synergistic effects exist. Finally, future work could use longer follow-up periods and explore potential mediators (e.g., reduced procrastination, improved engagement, better emotional regulation) and moderators (e.g., baseline proficiency, prior achievement, learning difficulties) that explain who benefits most and why.

Suggestions for practice. In educational practice, curriculum designers and EFL teachers can incorporate structured problem-solving instruction and self-regulation training into regular classroom routines to strengthen learners' academic self-efficacy. Teachers can support problem-solving by explicitly teaching steps for identifying academic challenges, generating strategy options, and reflecting on outcomes after tasks. To strengthen self-regulation and effort, instructors can implement goal-setting routines, self-monitoring checklists, guided reflection activities, and structured homework planning that encourage students to plan and evaluate their learning. School leaders and educational counselors can also use short-term group workshops to teach these skills systematically, particularly for students who show low persistence, weak study habits, or motivational decline. Integrating these interventions into supportive classroom environments may help sustain gains over time and promote more confident, engaged, and resilient language learners.

Authors' Contributions

Authors equally contributed to this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

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Declaration of Interest

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Ethical Considerations

All procedures performed in studies involving human participants were under the ethical standards of the institutional and, or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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