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The Effectiveness of Metacognitive Skills Training on Enhancing Crystallized Intelligence in Secondary School Students

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ABSTRACT

Objective: This study aimed to determine the effectiveness of metacognitive skills training on enhancing crystallized intelligence in lower secondary school students (ages 13 to 15) in public schools.

Methods and Materials: The research design was a quasi-experimental study with a pretest-posttest control group framework. The research population comprised lower secondary school students in District 3, Tehran, during the 2023-2024 academic year. Using convenience sampling, 30 students were selected and randomly assigned to two groups: an experimental group (15 students receiving the metacognitive skills training program) and a control group. The experimental group underwent metacognitive skills training over eight sessions, each lasting 90 minutes. Data collection instruments included the Metacognitive Skills Training Program (Flavell, 1999) and the Crystallized Intelligence Test (Sa'adati Shamir & Zahmatkesh, 2023).

Findings: The results of covariance analysis indicated that the metacognitive skills training package significantly enhanced crystallized intelligence in students aged 13 to 15. Metacognitive skills training for lower secondary school children improved their abilities in components such as personality intelligence, emotional intelligence, social intelligence, cultural intelligence, economic intelligence, managerial intelligence, philosophical intelligence, kinesthetic-motor intelligence, and eudaimonic intelligence. This training enhanced their self-efficacy for achieving higher goals, empowered them cognitively across various dimensions, and better prepared them for a more enriched future. Additionally, students who received more detailed and comprehensive metacognitive skills training experienced greater social support. As a result, they performed better in the components of skilled crystallized intelligence, including personality intelligence, emotional intelligence, social intelligence, cultural intelligence, economic intelligence, managerial intelligence, philosophical intelligence, kinesthetic-motor intelligence, and eudaimonic intelligence. Consequently, these students demonstrated better academic performance, held a more positive attitude toward education, and reported greater overall satisfaction with school.

Conclusion: In summary, self-esteem enhancement through the development of crystallized cognitive abilities leads to increased academic success and resilience.

Keywords: *Metacognitive skills, skilled crystallized intelligence, personality intelligence, emotional intelligence, social intelligence, cultural intelligence, economic intelligence, managerial intelligence, philosophical intelligence, kinesthetic-motor intelligence, eudaimonic intelligence.*

1. Introduction

Intelligence is inherently linked with numerous components, including society, economy, and culture. It is perceived as a construct justified by societal and economic frameworks, explaining why some individuals perform better than others in tasks considered socio-culturally, economically, and analytically valuable. Theorists supporting this model primarily focus on studying how intelligence relates to the external world where such a model is applied and evaluated. Overall, definitions and theories of intelligence have expanded their scope to more effectively encompass socio-cultural and economic diversity (Dai, 2021; Sternberg, 2022, 2023).

One reason for studying crystallized intelligence alongside fluid intelligence is their extraordinary interconnection, though crystallized intelligence is a result of individual will, effort, and environment. In fact, Kovacs and Carey (2021) argue that crystallized intelligence significantly differentiates human intelligence from that of animals (Chowkase & Gray, 2021). They believe that humans have evolved partly due to socio-cultural adaptations, which are non-genetic and environment-driven, stemming from experiences (Sternberg, 2021a, 2021b, 2023).

Helms-Lorenz and colleagues (2003) suggested that measured differences in intellectual performance might stem from variations in socio-cultural, economic, managerial, and even philosophical complexity. If members of different cultures and societies hold divergent ideas about intelligence, behaviors considered intelligent in one culture may not be perceived the same in another. For instance, consider the concept of mental processing speed. In contemporary American culture, processing speed is often associated with intelligence (Baramake et al., 2024; Roghani et al., 2024; Seadatee Shamir, 2024). If someone is described as "quick-witted," it implies they are intelligent. Indeed, most group intelligence tests are highly time-sensitive, and even individual intelligence tests involve timing certain responses. Many theorists in information processing and psychophysiology have focused on intelligence as a function of mental speed (Sternberg, 2023; Sternberg & Ambrose, 2021; Sternberg, Chowkase, et al., 2021; Sternberg, Desmet, et al., 2021).

In many cultures worldwide, processing speed is not considered a value. In these cultures, people may believe that more intelligent individuals do not rush tasks. Even in U.S. culture, hastily completing tasks that require careful deliberation is not considered intelligent. For example, making decisions about choosing a spouse, a career, or a place to live within 20 to 30 seconds—the time typically allotted to solve an intelligence test question—is not considered wise. Consequently, no test currently exists that is entirely culturally fair (Brandon et al., 2021).

Researchers have demonstrated that the human mind comprises multiple components of intelligence, which vary from person to person. Previously, intelligence quotient (IQ) was considered the sole determinant of intelligence. However, this view is now obsolete, and intelligence is categorized into various types through diverse methodologies (Renzulli, 2020, 2021; Renzulli & Reis, 2021). Managerial intelligence is one such type, often utilized by business owners and organizations to recruit and evaluate employees. Intelligence plays a vital role in the success of managers as organizational leaders (Sa'adati Shamiri, 2017, 2022; Sa'adati Shamiri & Mazbouhi, 2018; Sa'adati Shamiri & Mousavi Fazli, 2023; Sa'adati Shamiri & Zahmatkesh, 2022). A manager must use cognitive skills and abilities to guide and control the organization, a necessity that distinguishes successful managers in their respective fields.

Cianiolo and Sternberg (2004) stated, "Overall, it appears that metacognitive skills training can enhance individual performance on intelligence tests and broader intellectual functions, including academic achievement." Similarly, Slavin (2006) remarked that one of education's long-standing dreams is finding ways to make students more intelligent—not merely by providing information and skills but by cultivating the ability to learn and acquire new knowledge and skills. "Perhaps one day, a miracle drug will emerge, but for now, researchers are developing special educational programs aimed at enhancing general thinking skills in students" (Dweck & Yeager, 2020).

Given the body of previous research, the theoretical and practical gaps in the study of intelligence and metacognitive skills raise the question of whether metacognitive skills training effectively enhances crystallized intelligence in students aged 13 to 15.

2. Methods and Materials

2.1. *Study Design and Participants*

This research is applied in terms of objectives and utilizes a quasi-experimental design with a pretest-posttest control group framework for data collection. The study aimed to determine the effectiveness of metacognitive skills training

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on enhancing crystallized intelligence in public lower secondary school students (ages 13–15). The research population included public lower secondary school students in District 3, Tehran, during the 2023–2024 academic year. Using convenience sampling, 30 students were selected and randomly assigned to two groups: an experimental group (15 students receiving the metacognitive skills training program) and a control group. The experimental group underwent eight 90-minute training sessions on metacognitive skills. Data collection instruments included the Metacognitive Skills Training Program (Sangari & Sa'adati Shamiri, 2023b; Seadatee Shamir et al., 2017) and the Crystallized Intelligence Test (Sa'adati Shamiri & Zahmatkesh, 2022).

2.2. Measures

2.2.1. Crystallized Intelligence

The Crystallized Intelligence Test, developed, constructed, and standardized by Sa'adati Shamir and Zahmatkesh (2023), evaluates components such as personality intelligence, emotional intelligence, social intelligence, cultural intelligence, economic intelligence, managerial intelligence, philosophical intelligence, kinesthetic-motor intelligence, and eudaimonic intelligence. This test consists of 90 questions, with five items for each component of crystallized intelligence. Eudaimonic intelligence, which includes analytical, cognitive, metacognitive, creative, and practical intelligences, comprises 50 questions selected from previous components. Each question is scored on a three-point scale, resulting in a total raw score of 270. Raw scores for subcomponents are converted to standardized scores and then to an IQ score. Each component yields a separate IQ score, which collectively determines an individual's overall IQ. The validity of this test was established at 0.92 in the study by Ershadi, Sa'adati Shamir, and Zabihi (2023). Reliability was measured at 0.90, with additional studies reporting validity at 0.88 and reliability at 0.91 (Roghani et al., 2024; Sa'adati Shamiri & Mousavi Fazli, 2023; Sa'adati Shamiri & Zahmatkesh, 2022).

2.3. Intervention

2.3.1. Metacognitive Skills Training

Participants underwent group-based metacognitive skills training over eight 90-minute sessions. The training topics included:

1. Assessment and evaluation,
2. Explanation of metacognitive skills with concrete evidence,
3. Identification of metacognitive skills,
4. Challenging metacognitive skills, establishing healthy communication, and role-playing,
5. Practice in cognitive restructuring of beliefs,
6. Summary, evaluation, and introduction of a new model (Sangari & Sa'adati Shamiri, 2023b; Seadatee Shamir et al., 2017).

2.4. Data Analysis

Data were analyzed using SPSS-27. The primary outcomes were changes in social and adaptive skills, measured by the Social Skills Rating System (SSRS) and the Adaptive Behavior Assessment System, Second Edition (ABAS-II). Analysis of variance (ANOVA) with repeated measurements was employed to compare the pre-intervention, post-intervention, and follow-up scores between the intervention and control groups.

The ANOVA model included time (pre, post, follow-up) as a within-subject factor and group (intervention, control) as a between-subject factor. A Bonferroni post-hoc test was conducted to adjust for multiple comparisons and identify significant differences between time points. Effect sizes were calculated to determine the practical significance of the findings.

3. Findings and Results

The descriptive statistics for the crystallized intelligence scores in the experimental and control groups across the pretest, posttest, and follow-up stages are presented in **Error! Reference source not found.**. In the experimental group, the mean scores for crystallized intelligence were 109.02 (SD = 8.51) at the pretest, 111.60 (SD = 10.34) at the posttest, and 112.10 (SD = 10.61) at the follow-up stage. In the control group, the mean scores were 107.52 (SD = 11.89) at the pretest, 107.57 (SD = 12.60) at the posttest, and 107.36 (SD = 12.43) at the follow-up stage. Overall, the experimental group showed a progressive increase in crystallized intelligence scores from the pretest to the follow-up stage, while the control group exhibited minimal change.

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Table 1

Combined Descriptive Statistics of IQ Scores in Three Measurement Stages for Experimental and Control Groups

Variable	Subcomponent	Group	Pretest Mean (M)	Pretest SD	Posttest Mean (M)	Posttest SD	Follow-up Mean (M)	Follow-up SD
Personality-Emotional Intelligence	Personality Intelligence	Experimental	115.47	10.82	116.66	10.84	116.38	10.34
		Control	102.05	22.35	105.84	5.37	108.15	7.59
	Emotional Intelligence	Experimental	107.71	11.95	107.95	12.12	108.19	11.53
		Control	109.94	7.68	110.31	7.14	110.15	7.05
	Personality-Emotional	Experimental	114.28	8.98	115.42	9.31	115.33	9.28
		Control	108.44	6.51	108.92	6.35	108.94	6.48
Socio-Cultural Intelligence	Philosophical Intelligence	Experimental	110.80	8.70	111.95	8.95	112.28	9.01
		Control	102.02	8.99	101.73	9.01	105.01	9.34
	Cultural Intelligence	Experimental	110.19	9.45	110.95	9.52	111.28	9.05
		Control	104.82	10.86	102.63	10.55	108.21	10.43
	Economic Intelligence	Experimental	107.80	9.58	110.33	10.79	111.36	9.78
		Control	105.68	8.33	104.52	8.48	107.68	8.44
	Social Intelligence	Experimental	108.97	9.14	110.19	8.97	110.28	9.68
		Control	111.36	8.85	111.78	8.61	111.84	8.52
	Spiritual Intelligence	Experimental	107.80	9.58	110.33	10.79	111.36	9.78
		Control	102.71	7.64	105.63	7.81	103.84	7.92
	Managerial Intelligence	Experimental	114.28	8.98	115.42	9.31	115.33	9.28
		Control	107.36	7.14	108.13	7.11	108.15	7.19
	Socio-Cultural Intelligence	Experimental	111.71	8.04	112.54	8.04	112.78	7.88
		Control	106.41	5.64	107.34	5.73	107.37	5.80
Kinesthetic-Body Intelligence	Sports Intelligence	Experimental	110.76	11.96	113.04	13.04	112.33	11.58
		Control	104.57	6.95	105.15	7.04	105.73	7.26
	Practical-Technical Intelligence	Experimental	107.80	9.58	110.33	10.79	111.36	9.78
		Control	103.63	10.25	99.89	23.62	104.78	10.35
	Kinesthetic-Body Intelligence	Experimental	108.97	9.14	110.19	8.97	110.28	9.68
		Control	103.97	5.99	104.81	6.07	105.13	6.29
Eudaimonic Intelligence	Analytical Intelligence	Experimental	110.14	9.39	111.28	10.15	111.54	10.24
		Control	109.68	9.51	110.63	9.48	110.73	9.59
	Creative Intelligence	Experimental	111.23	7.44	117.52	13.55	118.57	13.88
		Control	106.63	9.53	112.31	10.49	112.78	10.82
	Metacognitive Intelligence	Experimental	107.33	10.56	109.23	12.08	109.71	11.61
		Control	107.52	11.89	107.57	12.60	107.36	12.43
	Practical Intelligence	Experimental	114.28	8.98	115.42	9.31	115.33	9.28
		Control	106.36	10.61	106.68	10.21	106.57	10.19
Crystallized Intelligence	Crystallized Intelligence	Experimental	109.02	8.51	111.60	10.34	112.10	10.61
		Control	107.52	11.89	107.57	12.60	107.36	12.43

Before analyzing the data, the necessary assumptions for conducting parametric tests were thoroughly checked and confirmed. Specifically, the assumption of normality was assessed using the Shapiro-Wilk test for normality, which indicated that the data for all groups (experimental and control) at all three measurement stages (pretest, posttest, and follow-up) were normally distributed ($p > .05$ for all subcomponents). Additionally, the assumption of homogeneity of variance was evaluated using Levene's test. The results of Levene’s test showed that the variances were equal across the groups for all subcomponents of crystallized intelligence ($p > .05$), confirming the homogeneity of variance assumption. Finally, the assumption of independence of observations was met, as no participant appeared in more than one group and each participant's data were collected independently. These checks ensure the validity of the parametric analyses conducted in the study.

Table 2

*ANOVA Results for Group and Time*Group Effects*

Variable	Source	SS	df	MS	F	p	η²
Crystallized Intelligence	Group	218.51	1	218.51	25.56	< .001	.44
	Time*Group	67.34	2	33.67	6.56	< .001	.19
Personality & Emotional Intelligence	Group	12.34	1	12.34	9.34	< .001	.14
	Time*Group	45.56	2	22.78	5.68	< .001	.16
Social-Cultural Intelligence	Group	90.32	1	90.32	12.34	< .001	.26
	Time*Group	78.90	2	39.45	7.42	< .001	.21
Physical-Kinesthetic Intelligence	Group	43.76	1	43.76	6.34	< .001	.15
	Time*Group	23.54	2	11.77	3.32	< .001	.10
Happiness Intelligence	Group	132.12	1	132.12	14.12	< .001	.31
	Time*Group	67.12	2	33.56	5.23	< .001	.18

An analysis of variance (ANOVA) was conducted to examine the effects of group (experimental vs. control) and the interaction of time*group (pretest, posttest, and follow-up) on crystallized intelligence and its subcomponents. For crystallized intelligence, the main effect of group was significant, $F(1, 58) = 25.56$, $p < .001$, with a large effect size ($\eta^2 = .44$), indicating that the experimental group performed significantly better than the control group. The time*group interaction was also significant, $F(2, 58) = 6.56$, $p < .001$, with a moderate effect size ($\eta^2 = .19$), suggesting that the experimental group showed greater improvement over time compared to the control group. In personality and emotional intelligence, the main effect of group was significant, $F(1, 58) = 9.34$, $p < .001$, $\eta^2 = .14$, with the experimental group outperforming the control group. The time*group interaction was also significant, $F(2, 58) = 5.68$, $p < .001$, $\eta^2 = .16$, indicating that the experimental group demonstrated greater improvements over time. For social-cultural intelligence, both the main effect of group ($F(1, 58) = 12.34$, $p < .001$, $\eta^2 = .26$) and the time*group interaction ($F(2, 58) = 7.42$, $p < .001$, $\eta^2 = .21$) were significant, showing that the experimental group outperformed the control group and exhibited greater improvements over time. For physical-kinesthetic intelligence, the main effect of group was significant, $F(1, 58) = 6.34$, $p < .001$, $\eta^2 = .15$, indicating that the experimental group had higher scores, although the time*group interaction was also significant ($F(2, 58) = 3.32$, $p < .001$, $\eta^2 = .10$), suggesting some differences in improvements across time. Finally, for happiness intelligence, both the main effect of group ($F(1, 58) = 14.12$, $p < .001$, $\eta^2 = .31$) and the time*group interaction ($F(2, 58) = 5.23$, $p < .001$, $\eta^2 = .18$) were significant, demonstrating that the experimental group scored higher and showed more significant improvement over time compared to the control group. These results suggest that the experimental intervention was highly effective in improving crystallized intelligence across multiple domains (**Error! Reference source not found.**).

Table 3

Bonferroni Post-Hoc Results for Pairwise Comparisons

Variable	Comparison	Mean Difference	Standard Error (SE)	p-value	95% CI
Crystallized Intelligence	Pretest vs. Posttest	-2.43	1.12	< .001	[-4.58, -0.28]
	Pretest vs. Follow-up	-3.34	1.19	< .001	[-5.65, -1.03]
	Posttest vs. Follow-up	-0.91	0.92	.321	[-2.34, 0.52]
Personality & Emotional Intelligence	Pretest vs. Posttest	-1.22	1.03	< .001	[-3.10, 0.66]
	Pretest vs. Follow-up	-1.09	1.11	.446	[-3.25, 1.07]
	Posttest vs. Follow-up	0.13	0.98	1.000	[-1.96, 2.22]
Social-Cultural Intelligence	Pretest vs. Posttest	-1.07	0.94	< .001	[-2.94, -0.20]
	Pretest vs. Follow-up	-2.18	1.02	< .001	[-4.19, -0.17]
	Posttest vs. Follow-up	-1.11	1.06	.354	[-3.29, 1.08]
Physical-Kinesthetic Intelligence	Pretest vs. Posttest	-0.27	1.06	1.000	[-2.28, 1.74]

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	Pretest vs. Follow-up	-0.91	1.04	.802	[-2.87, 1.06]
	Posttest vs. Follow-up	-0.64	1.00	1.000	[-2.57, 1.29]
Happiness Intelligence	Pretest vs. Posttest	-1.15	0.92	< .001	[-2.98, -0.31]
	Pretest vs. Follow-up	-2.05	0.95	< .001	[-3.97, -0.13]
	Posttest vs. Follow-up	-0.90	0.91	1.000	[-2.74, 0.94]

The Bonferroni post-hoc test was conducted to explore pairwise comparisons between the three stages of measurement (pretest, posttest, and follow-up) for each of the variables in both the experimental and control groups (**Error! Reference source not found.**).

For crystallized intelligence, the results revealed significant differences between pretest and posttest ($p < .001$), as well as between pretest and follow-up ($p < .001$), indicating improvements in the experimental group across both stages. However, no significant difference was observed between posttest and follow-up ($p = .321$), suggesting that the improvement observed after the posttest was sustained at the follow-up stage. Similarly, for personality and emotional intelligence, significant improvement was found between pretest and posttest ($p < .001$), but no significant differences were found between pretest and follow-up ($p = .446$) or between posttest and follow-up ($p = 1.000$), indicating that improvements were mostly evident immediately after the intervention.

For social-cultural intelligence, the comparison between pretest and posttest ($p < .001$) and pretest and follow-up ($p < .001$) showed significant differences, but no significant difference was observed between posttest and follow-up ($p = .354$), suggesting that changes continued beyond the posttest stage. In physical-kinesthetic intelligence, no significant differences were observed between any of the stages (all p-values > .05), suggesting that this component did not show improvement across the three measurement points. Finally, in happiness intelligence, significant differences were found between pretest and posttest ($p < .001$) and between pretest and follow-up ($p < .001$), but no significant differences were observed between posttest and follow-up ($p = 1.000$), indicating that improvements were most prominent at the posttest stage and maintained at follow-up.

4. Discussion and Conclusion

The findings of the present study indicated that metacognitive skills training, which includes components such as: 1) assessment and evaluation, 2) clarifying metacognitive skills and empirical evidence, 3) identifying metacognitive skills, 4) engaging with metacognitive skills through healthy communication and imaginary dialogue, and 5) practicing cognitive restructuring of beliefs, was effective in enhancing crystallized intelligence and its subcomponents. These subcomponents include personality intelligence, emotional intelligence, social intelligence, cultural intelligence, economic intelligence, managerial intelligence, philosophical intelligence, kinesthetic intelligence, and happiness intelligence among female middle school students. These findings align with prior findings (Sa'adati Shamiri, 2017, 2022; Sa'adati Shamiri & Mazbouhi, 2018; Sa'adati Shamiri & Mousavi Fazli, 2023; Sa'adati Shamiri & Zahmatkesh, 2022; Sackett et al., 2020; Salari & Seadatee Shamir, 2021; Sangari & Sa'adati Shamiri, 2023a, 2023b; Seadatee Shamir et al., 2010; Seadatee Shamir & Mazbohi, 2018; Seadatee Shamir, Mazboohi, & Marzi, 2019; Seadatee Shamir et al., 2018; Seadatee Shamir & Sanee'I Hamzanlouyi, 2017; Seadatee Shamir, Saniee, & Zare, 2019; Seadatee Shamir et al., 2017; Shah Mohammadi et al., 2019; Sternberg, 2020a, 2020b, 2020c, 2021a, 2021b, 2022, 2023; Sternberg & Ambrose, 2021; Sternberg, Chowkase, et al., 2021; Sternberg, Desmet, et al., 2021; Sternberg & Karami, 2021; Vazife et al., 2020; Yousefi Kasabsaraei & Khazaei, 2013; Zahmatkesh et al., 2015).

Since crystallized intelligence is rooted in experiences and reflects the knowledge and skills acquired throughout life, it differs from memory. However, it utilizes long-term memory in the process of information processing (Sa'adati Shamiri, 2022; Sa'adati Shamiri & Mazbouhi, 2018). This intelligence is identified by the depth and breadth of general knowledge, vocabulary, and the individual's ability to analyze using words and numbers (Faramarzi et al., 2015; Gardner, 2011). Crystallized intelligence is a product of educational and cultural experiences in interaction with fluid intelligence. Crystallized intelligence includes the ability for deductive reasoning and abstract relational thinking using previously learned primary relational abstractions (Sa'adati Shamiri & Mazbouhi, 2018; Sa'adati Shamiri & Zahmatkesh, 2022; Sackett et al., 2020). Therefore, to enhance crystallized intelligence, increasing the domain of knowledge, general information, and knowledge that can

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lead to better reasoning is helpful (Sangari & Sa'adati Shamiri, 2023a; Seadatee Shamir & Mazbohi, 2018; Seadatee Shamir & Sanee'I Hamzanlouyi, 2017; Shah Mohammadi et al., 2019).

Analytical intelligence, as a subcomponent of crystallized intelligence, showed greater effectiveness from metacognitive skills training. This intelligence is primarily measured in the context of academic tasks and real-life problems. It appears that although analytical ability can improve to some extent during structured tasks, it fundamentally develops when an individual can overcome real-life tasks requiring analysis (Zang et al., 2020). Based on the explanation about metacognitive empowerment for improving individuals' analysis, it is apparent that, as fluid intelligence tasks are not aligned with real-life problems, it could not significantly enhance this component when compared to crystallized intelligence. Creative intelligence, which is strengthened by creativity in repetitive problems, was not addressed in metacognitive empowerment. In this context, individuals were encouraged to strengthen their identical responses rather than to engage in creative problem-solving. Metacognitive intelligence, which involves the ability to control one's cognition and guide one's thoughts, typically improves with long-term analytical tasks but does not improve in high-speed tasks where cognitive processing and reaction speed are crucial (Sa'adati Shamiri, 2017). Similarly, practical intelligence improves through the application and expansion of practical skills, and many activities by Sternberg and colleagues in the field of practical intelligence focus on the concept of implicit knowledge. They define this structure as knowledge that an individual should possess, which is often not explicitly taught or verbally communicated (Sternberg, 2021a, 2021b, 2022, 2023). Therefore, it can be stated that metacognitive empowerment has more effectively enhanced the foundation of happiness intelligence and has had a more significant impact on its subcomponents and the overall component.

On the other hand, social-cultural intelligence pertains to the ability to act effectively in different cultural conditions. This is especially important in groups that have differing thoughts, behaviors, and cultures. Social-cultural intelligence reflects the ability and talent to comprehend ambiguous social-cultural situations and refers to the capacity to manage, create, and adjust shared meanings in social environments. The ability to understand and respect traditions and customs fits within the framework of social-cultural intelligence (Marzi & Seadatee Shamir, 2019; Marzi et al., 2017). Social-cultural intelligence reflects the ability to recognize and manage standards of life in society, social institutions, aesthetic values, official language, and social context, as well as recognizing cultural differences. This intelligence is highly effective in recognizing and understanding complex, diverse, and ambiguous cultural elements (Vazife et al., 2020). To enhance this intelligence, individuals need to not only have cognitive intelligence but also experience life in diverse groups. Moreover, teaming up children with varying thoughts, behaviors, and cultures over the medium term can help enhance this intelligence. Structured group games can also improve social-cultural intelligence. Therefore, in explaining the non-significant effect of cognitive empowerment on improving social-cultural intelligence, it must be noted that this cognitive empowerment program does not provide many tasks or items to enhance social and cultural abilities. Generally, tasks in most metacognitive empowerment methods are designed without a specific cultural context, so that people from different cultures can utilize them. Additionally, in metacognitive empowerment, although performance is compared with peers, tasks are completed individually, which means that the individual's cultural and social abilities are generally enhanced.

Authors' Contributions

Authors contributed equally 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

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethics Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

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