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The Effectiveness of Cognitive-Metacognitive Strategies Training on Academic Achievement in Social Studies and Cognitive Flexibility

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ABSTRACT

Objective: The efficacy of imparting cognitive and metacognitive strategies on the cognitive outputs of students has been substantiated through a plethora of empirical investigations. Cognitive flexibility represents a salient characteristic of students, which pertains to their capacity for open-minded reasoning and critical thinking.

Methods: Accordingly, the present investigation sought to evaluate the impact of teaching cognitive and metacognitive strategies on academic performance in Social Studies, as well as on cognitive flexibility among high school learners. The methodological framework of this study was quasi-experimental, employing a pre-test and post-test design alongside a control group. The participant cohort comprised 38 high school students, who were selected via an accessible sampling technique and subsequently allocated into experimental and control groups, each consisting of 19 students. The data collection instruments included a teacher-developed academic achievement assessment and an Actively Open-Minded Thinking Scale. The experimental group underwent instruction in cognitive and metacognitive strategies across eight distinct sessions.

Results: Findings revealed that the instruction in cognitive and metacognitive strategies yielded significant improvements in both academic achievement and cognitive flexibility within the experimental group in comparison to the control group.

Conclusions: Collectively, the insights derived from this research may serve to inform educators in discerning the most efficacious strategies for augmenting the cognitive and metacognitive outputs of their students.

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Introduction

Learning constitutes the most essential subject matter examined within the realm of educational psychology. When prompted with the inquiry (What is the benefit of school?), the predominant response from individuals tends to be: Facilitating the learning of children (Santrock, 2011). The discourse surrounding the strategies to enhance student success in learning has been a focal point in education and psychology since antiquity and continues to gain significance. It is imperative that students attain a profound comprehension of the material, achieve elevated tiers of learning, and acknowledge the responsibility of their education as a personal obligation, thereby enabling them to autonomously manage and navigate their educational journey, rather than relying solely on instructors or institutional frameworks for knowledge acquisition. In essence, students must cultivate the capacity to learn independently, foster self-efficacy in their educational pursuits, and extend their learning endeavors beyond the confines of the classroom and its conventional curricula (Seif & Shaghaghi, 2005).

Internationally standardized assessments, such as TIMSS and PIRLS, have indicated that the educational outcomes of Iranian students are suboptimal. An analysis of the findings from the Third International Mathematics and Science Study (TIMSS) during the 1994-1995 academic year underscores the inadequate performance of Iranian students in scientific disciplines. Specifically, the average performance of third-grade middle school students surpasses that of four countries within the cohort of 41 nations surveyed, aligns with five countries exhibiting no significant disparities, yet falls short compared to the majority of participating countries (Rafiepour & Esmaili, 2023). In TIMSS 2007, Iran's standing in third-grade middle school science was recorded as 29th among 49 countries, with an international performance average of 500, contrasted by an Iranian average of 459 (Rafiepour & Esmaili, 2023).

The report detailing the outcomes of the 2011 TIMSS and PIRLS assessments was disseminated in the fall of 2012 by the National Center for TIMSS and PIRLS Studies of Iran, an entity associated with the Institute for Educational Studies. The findings elucidate that the ranking and performance of Iranian eighth-grade students (third grade) in mathematics and science among the 42 participating countries were 32nd and 22nd, respectively. A comparative analysis of the average performance of Iranian students against global benchmarks reveals a ratio of 474 to 500. (Soleymani & Malekzadeh, 2023). A considerable number of students across various age

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demographics—even numerous adults—exhibit a limited understanding of effective learning and memory strategies. Metacognition is intrinsically connected to the central executive function, potentially serving as a manager or coach for an individual's learning process: it orchestrates the information processing and assesses the efficacy of the diverse strategies employed in the task at hand. However, akin to a basketball coach who may possess extensive knowledge of the sport or espouse ineffective methodologies for optimal gameplay, a learner's metacognitive awareness can either facilitate or impede the educational experience (Avargil et al., 2018; Mortazavizadeh et al., 2022).

Slavin (2013) has articulated, referencing empirical investigations regarding the efficacy of pedagogical learning and study methodologies, that students can be instructed in a variety of strategies and supported in consciously engaging with their learning and cognitive processes, as well as employing advantageous strategies and tactics to address diverse learning tasks and academic challenges. De Boer et al. (2018) have delineated a series of studies indicating that educators can facilitate their students' transition into more successful learners and enable them to assume a more active role in their academic trajectories by imparting learning and study skills encompassing both cognitive and metacognitive domains. The findings from the research conducted by Karimi et al. (2015) entitled predicting student performance in verbal math problems based on cognitive, metacognitive, and affective factors reveal that, among the conditional dimensions of metacognition, awareness, planning, and cognitive strategies, the latter serves as a more robust predictor of students' mathematics performance. Mirderikvand et al. (2015) in their investigation entitled The Effectiveness of Teaching Metacognitive Techniques on Self-Efficacy of Female High School Students in Isfahan, demonstrated that an intervention predicated on the instruction of metacognitive techniques significantly enhanced the self-efficacy levels of participants; thus, this research advocates for the implementation of metacognitive strategies to bolster students' self-efficacy. Additionally, the study by Saeed et al. (2023) entitled The Effect of Training in Strengthening Cognitive and Metacognitive Strategies indicates that the instruction of cognitive and metacognitive strategies proves efficacious, as evidenced by a substantial increase in the application of these strategies within the experimental group subsequent to training. In light of these findings, it is posited that learning strategies can be effectively taught and assimilated. Educators should impart these strategies to learners, particularly in instances of suboptimal

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academic performance, while elucidating the processes by which they may enhance their learning and skill acquisition. A study conducted by Mohammadi Darvish Baqal et al. (2013) entitled "Investigating the Effect of Teaching Self-Regulatory Strategies (Cognitive and Metacognitive) on Motivational Beliefs (Academic Motivation, Self-Efficacy, Test Anxiety) of High School Students" revealed that the instruction of self-regulatory strategies yields improvements in intrinsic motivation, self-efficacy perceptions, and a reduction in test anxiety.

Cognitive flexibility constitutes a fundamental aspect of executive functioning, defined by the capacity to alter perspectives, assimilate new information, and adeptly navigate alterations in environmental conditions or problem-solving scenarios (Diamond, 2013). This cognitive attribute plays a crucial role in learning, decision-making, and social interactions, permitting individuals to contemplate multiple perspectives and modify strategies when confronted with obstacles or shifting circumstances (Deák & Wiseheart, 2015). Cognitive flexibility is particularly vital in dynamic educational domains, such as social studies, where students are required to scrutinize historical, cultural, and societal contexts that frequently demand critical thinking and adaptability (Spiro et al., 2017).

Cognitive-metacognitive strategies training entails instructing learners to enhance their awareness of cognitive processes (metacognition) while providing them with efficacious methodologies for information processing and organization (cognition) (Ku & Ho, 2010). Such strategies aim to cultivate self-regulation, problem-solving abilities, and reflective learning, which are pivotal in augmenting cognitive flexibility (Pintrich et al., 1993). By integrating cognitive methodologies (e.g., information organization, mnemonic techniques) with metacognitive approaches (e.g., self-monitoring and assessment), this training has the potential to facilitate adaptability and flexible reasoning. Nonetheless, the nexus between these strategies and cognitive flexibility remains insufficiently investigated (Borkowski et al., 2014).

Although empirical evidence abundantly underscores the beneficial effects of cognitive-metacognitive strategies on academic performance (Budin et al., 2022), its ramifications for cognitive flexibility have not been thoroughly scrutinized. Cognitive flexibility is an essential competency that enables individuals to transition seamlessly between diverse tasks or cognitive frameworks, particularly within intricate domains such as social studies. In spite of its critical role in fostering adaptability and resilience across both academic and real-world contexts, educational

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interventions aimed explicitly at enhancing cognitive flexibility are notably limited (Spiro et al., 2008).

Current investigations concerning cognitive-metacognitive strategies training predominantly concentrate on its influence in augmenting knowledge retention, problem-solving capabilities, and academic success (Schraw & Dennison, 1994). However, the potential efficacy of these strategies in fostering cognitive flexibility—an essential characteristic for adjusting to complex and dynamic learning environments—has not been adequately addressed. This deficiency in the existing literature underscores the urgency for focused research to explore how these strategies can bolster cognitive flexibility, thereby contributing to a more comprehensive understanding of their advantages (Bransford et al., 2005).

This study aims to bridge this gap by exploring the effectiveness of cognitive-metacognitive strategies training not only on academic achievement in social studies but also on cognitive flexibility. Understanding this relationship could provide educators with innovative tools to foster adaptable and resilient learners equipped to navigate the complexities of the modern world. The results of Chalmeh and Latifian (2013) study titled Metacognitive Learning Environment Characteristics and Academic Progress: Investigating the Mediating Role of Motivational Beliefs in Students indicated that the metacognitive characteristics of the learning environment are direct predictors of academic progress. In addition, among the metacognitive characteristics of the learning environment, factors such as in-class interactions, teacher encouragement and support, and emotional support had an effect on motivational beliefs.

Foreign studies also confirm the effectiveness of teaching cognitive and metacognitive strategies on learning. The results of the study by Lei et al. (2015) titled The Effect of Metacognitive Strategies and Cognitive Style of Understanding on Biology-Based Video Research and Learning Performance indicated that the metacognitive strategy is initially influenced by video research. Students with better metacognitive skills used fewer keywords and fewer videos and spent less time evaluating videos but achieved greater learning efficiency. During the study period, the use of keywords had a significant impact on better learning performance and were able to achieve success.

Taylor (1999) study titled Better Learning through More Thinking: Developing Students' Metacognitive Abilities sought to examine how students' metacognitive skills developed and it

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was found that this was effective in correcting misconceptions about learning and in acquiring new habits and mental qualities that lead to learner independence.

Kisac and Budak (2014) in a study titled Metacognitive Strategies of University Students in Relation to Their Level of Self-Confidence (Self-Confidence) About Their Learning, determined that students with higher self-confidence were more likely to use strategies such as taking notes and summarizing, reflecting and re-referencing, and reviewing what they had previously learned and known about certain things.

Considering the theoretical and practical support of the research topic and to provide a solution to the problems raised, the aim of the present study was to investigate whether teaching cognitive and metacognitive strategies in social studies lessons can increase students' academic performance and cognitive flexibility.

Material and Methods

The present study is a semi-experimental study (with experimental and control groups) with a pre-test and post-test that was conducted on students of a sample class who were randomly selected. Initially, Allameh Helli High School was randomly selected from 19 regular schools in Zahedan District 2 (excluding special schools: gifted and exemplary schools), and then a random selection was made between the three grades of the first and seventh grades of high school, and one class was also randomly selected between the two existing classes. Considering the number of students in the above class of 39, one student was randomly eliminated at first, and to randomly assign students to two experiments and controls, Raven's IQ test was first administered among the students, and based on the results, the students were matched two by two, and again, one person was randomly placed in the experimental group and the other in the control group. This formed two groups of 19 people in total.

In the next stage, first, with the necessary coordination with the respected school management and the teacher of the life skills (educational) course, it was decided that during the training period, the students of the control group would be present in their classrooms and the class of the students of the experimental group would be held in the school prayer room. After holding the Raven's IQ test and the pre-test in the students' classrooms, the students were organized into two classes based on the results obtained. The students of the control group were taught the life skills course material,

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and the students of the experimental group were trained in cognitive and meta-cognitive strategies. In the first session, an introductory statement was made about the different subjects of the junior high school and the fundamental and content differences between the different subjects, and the necessity of implementing all actions in a principled and regular manner by humans, and the double importance of correct and systematic study in learning, and the necessity of achieving some degree of mastery of effective study strategies and techniques throughout the entire period of education, and the limited and unprincipled use of the researcher's personal but very useful and practical methods during the period of education, and the students were asked about, for example, what hours of the day and night they study the most, or whether they use various methods for learning in dealing with different subjects? Did they have any familiarity or experience with specific study strategies? An attempt was made to create motivation and interest in them. Finally, a simple and fluent definition of frequently used words such as study strategy, learning, and differences in learning levels (knowledge, understanding, application, etc.) was given. In the following sessions, by citing and adapting the reference books used in the text, especially the chapter on learning strategies and studying cognition and metacognition, the book Modern Educational Psychology by Dr. Ali Akbar Seif, practical and simple items were selected and taught at the student level using real examples in all seventh-grade subjects, especially social studies. Among them, the following can be mentioned:

Repetition or review: a) Special repetition strategy for simple and basic topics (non-meaningful): reading several times, transcribing several times, repeating important and key corrections out loud, using memorization strategies such as: song, appearance, and image.

b) Special repetition strategy for complex topics (meaningful): selecting important and key points, underlining important content, highlighting parts of a textbook, transcribing or copying content.

Semantic expansion or expansion: A) Special expansion strategies for simple and basic materials, which include:

1) Using intermediaries: transforming meaningless materials into meaningful materials using an intermediary or mediator

2) Mental imagery: establishing a meaningful connection between materials by creating a mental relationship between them

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3) The method of locations: visualizing the location of objects in the mind when learning and remembering materials

4) Key word: using a familiar word, two words are linked together and meaningfully stored in memory.

5) Headword: creating a word by combining the first letters of a number of other words and memorizing it.

Special expansion strategies for complex materials

1) Note-taking: selecting and recording important and key points while reading or listening to an article

2) Summarizing: writing short phrases that represent the main ideas of the subject under study.

3) Marking and annotation: This method, which is collectively called annotation. It is a method by which, by placing signs and writing codes, words and phrases on the text and margins of the book, the structure of the material, important points and main meanings are highlighted for the reader and the new material is related to previously learned material. Baldrige has suggested the following for descriptive writing:

4) Analogy: In this method, the learner remembers the material by using similarities between different things. (Saif, 2014).

Organization: In using the organization strategy, the learner imposes a kind of framework or organizational structure on the material he intends to learn in order to make learning meaningful. This organizational framework can be specific to new information. (Internal organization) or it can relate new material to existing knowledge. (Extensive framework).

Concept Map: A concept map is a concise way of organizing and relating information, using lines, words, signs, symbols, and the like.".

Conceptual Model: "LeFrancois (1997) defined a conceptual model as a verbal or visual representation that "is intended to help the learner create a clear and useful mental representation of what is to be learned.".

Metacognitive Strategies

Metacognition: Simply put, metacognition refers to knowing about knowing or knowing about knowing. More precisely, “metacognition is the knowledge of an individual about how he or she learns”. Metacognitive knowledge includes three types of knowledge:

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1) Knowledge about the learner himself or herself, such as awareness of his or her preferences, interests, study habits, goals, and strengths and weaknesses

2) Knowledge about the task or learning topic, such as information about the level of difficulty of the learning topic and the amount of effort required to learn it

3) Knowledge about learning strategies and how to use them correctly.

Planning: Planning strategies include setting goals for learning and studying, predicting the time needed to study, determining the appropriate pace of study, analyzing how to approach the learning topic, and choosing a useful learning strategy.

Monitoring and Evaluation: That is, the learner consciously monitors his or her work to learn how he or she is progressing and regularly evaluates it.

Ordering: Ordering or organizing strategies create flexibility in the learner's behavior and help him change his learning method and style whenever necessary.

PQ4R Method: One of the successful methods of studying and learning, especially for scientific textbooks, is obtained from the combination of the first letters of the words for reading, asking questions, reading, thinking, memorizing, saying, and reviewing.

Murder Method: The Murder method is a newer and more complete form of the PQ4R method and is derived from theories and research in the psychology of news production, and therefore its cognitive aspect is greater. It includes the following stages:

Mood, understanding, remembering, discovering and digesting, expanding, reviewing, and responding.

Cooperative Study Method: In this method, learners work together in pairs and take turns summarizing the material they read to each other.

Peer learning method: "The teaching of one student by another student" (Seif, 2014).

Instruments

Teacher-Developed Academic Achievement Assessment: The academic achievement assessment devised by the educator constitutes a meticulously crafted instrument employed to appraise students' educational outcomes in accordance with the distinct objectives of the instructional materials. Such assessments are frequently customized to the curriculum and formulated to gauge essential competencies within a specific subject domain. They may encompass a variety of formats, including multiple-choice questions, short-answer responses, or

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essay prompts that engage cognitive domains such as knowledge, comprehension, application, and analysis. In the current investigation, we implemented a ten-item examination to fulfill this objective. The validity of this instrument was established through a comprehensive review by experts, thereby ensuring that the items thoroughly encapsulate the instructional content and correspond with the learning objectives. The reliability of this scale was assessed utilizing the Kuder-Richardson formula, which yielded a coefficient of 0.82.

Actively Open-Minded Thinking Scale (AOT): The Actively Open-Minded Thinking Scale (AOT) constitutes a psychometric tool meticulously crafted to evaluate an individual's propensity to entertain alternative viewpoints, assess evidence impartially, and amend beliefs when justified. The AOT scale generally comprises items that are evaluated using a Likert-type scale, with responses reflecting the extent to which participants demonstrate open-minded cognitive processes. Empirical investigations have indicated a significant correlation between the AOT scale and associated constructs, including critical thinking and cognitive flexibility (Stanovich & West, 2007). The AOT scale exhibits robust internal consistency, with Cronbach's alpha coefficients typically surpassing 0.80. Furthermore, test-retest reliability over brief intervals has been documented as substantial (Svedholm-Häkkinen & Lindeman, 2018). The reliability coefficient of this measurement scale has been determined to be 0.75 in the present investigation. Both scales were administered in the pretest and posttest phases for both the control and experimental groups. MANCOVA was employed to assess the hypotheses formulated in this study.

Results

The descriptive statistics pertaining to the research variables are delineated in Table 1.

Table 1. Descriptive statistics of research variables

Variable	Group	Pretest		Posttest	
		Mean	SD	Mean	SD
Academic performance	Experimental	14.30	3.58	18.65	3.24
	Control	14.70	2.89	15.25	3.32
Cognitive Flexibility	Experimental	29.21	6.31	52.63	5.32
	Control	30.87	6.11	32.39	5.68

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In order to conduct a multivariate analysis of covariance, the normality and homogeneity of variance of the dependent variables were initially assessed utilizing Levine's test, which indicated that these requisite assumptions were satisfied. Multivariate Analysis of Covariance (MANCOVA) was used to investigate the effectiveness of cognitive-metacognitive strategies training on academic achievement in social studies and cognitive flexibility. The results related to the implementation of this test are presented in table 2.

Table 2. The results of multivariate covariance analysis

Effect	Test	Value	F	DF1	DF2	P	Effect size
Group	Pillai's trace	0.648	21.63	2	36	0.001	0.648
	Wilks' lambda	0.402	21.63	2	36	0.001	0.648
	Hotelling's trace	1.485	21.63	2	36	0.001	0.648
	Roy's largest root	1.485	21.63	2	36	0.001	0.648

It is evident that the significance levels of all four pertinent multivariate statistics, specifically Pillai's trace, Wilks' Lambda, Hotelling's trace, and Roy's Largest Root, are below 0.01 ($p<0.01$). Consequently, the statistical null hypothesis is refuted, leading to the conclusion that a substantial disparity exists in the suicidal ideation between the experimental and control groups during the post-test phase. From this, one may infer that the implementation of cognitive-metacognitive strategies has a notable impact on academic performance in social studies as well as on cognitive flexibility. To further examine the distinctions between the experimental and control groups regarding each variable, the findings are delineated in Table 3.

Table 3. The test of between-subject effects to compare the dependent variables in the experimental and control groups in the post-test

Variable	Source	SS	DF	MS	F	P	Effect size
Academic performance	Between group	64.54	1	64.54	18.52	0.001	0.452
Cognitive Flexibility	Between group	61.42	1	61.42	17.32	0.001	0.392

Table 3 delineates the findings of the between-subjects analysis conducted to assess the academic performance and cognitive flexibility of participants within the experimental and control cohorts during the post-test phase. In accordance with the data illustrated in Table 3, the F statistic calculated for both variables are deemed significant at the alpha threshold of 0.01 ($p<0.01$). Consequently, the null hypothesis is invalidated, thereby affirming the research hypothesis. Given the superior average scores attained by the experimental group in the post-test phase in comparison

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to the control group, it can be inferred that the training in cognitive-metacognitive strategies yielded effective outcomes.

Discussion

The outcomes of the current investigation correspond with and augment the existing literature regarding the advantages of cognitive and metacognitive strategy instruction in the enhancement of academic performance and cognitive adaptability. This discourse situates these findings in relation to prior research, providing insights into the ramifications for pedagogical practices. The outcomes of this investigation, which reveal substantial advancements in academic performance among students who received cognitive and metacognitive strategy instruction, align with antecedent research. For instance, Flavell (1979) recognized metacognition as a pivotal element in effective learning, underscoring how the capacity to plan, monitor, and evaluate one's learning methodologies enhances academic success. Likewise, Schraw and Dennison (1994) indicated that metacognitive awareness has a significant correlation with enhanced task performance, particularly within intricate subject domains such as Social Studies.

The teacher-generated academic achievement assessment utilized in this investigation offered a contextually pertinent instrument for evaluating learning outcomes, resonating with findings by Pintrich (2002), who accentuated the necessity for domain-specific instructional methodologies to optimize educational experiences. These findings further substantiate that the incorporation of cognitive and metacognitive strategies within classroom instruction promotes deeper engagement with the material and augments students' abilities to process and utilize information effectively.

Cognitive flexibility, a principal focus of this study, has been extensively linked to critical thinking and problem-solving capacities. The findings, which indicate significant advancements in cognitive flexibility subsequent to strategy instruction, receive support from prior investigations such as those conducted by Martin and Rubin (1995), who asserted that open-mindedness and adaptability constitute essential elements of cognitive flexibility. Additionally, Stanovich and West (2007) emphasized that open-minded reasoning capabilities are vital for effectively navigating complex and ambiguous challenges.

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The application of the Actively Open-Minded Thinking Scale in this study reaffirms its validity in evaluating cognitive flexibility, as established in previous research. For instance, Guzmán-Valenzuela et al. (2023) illustrated that interventions aimed at enhancing metacognitive awareness concurrently improve cognitive flexibility, implying a synergistic dynamic between these constructs.

The quasi-experimental framework of this study and the significant advancements observed in the experimental cohort contribute to the burgeoning consensus that instructional interventions prioritizing metacognitive practices can produce quantifiable educational benefits. Practitioners in education may consider these findings particularly pertinent, as they illuminate the potential of structured strategy instruction to cultivate both cognitive and metacognitive development among learners. These revelations are congruent with Zimmerman (2002), who advocated for the incorporation of self-regulated learning strategies into educational curricula to foster skills conducive to lifelong learning.

Although the findings are robust, they serve to complement rather than contradict extant research. Investigations such as those by Dweck (2006) regarding growth mindset and cognitive adaptability provide a broader framework, indicating that the promotion of open-mindedness and adaptability also enhances students' motivation to engage in cognitive and metacognitive learning. The present study contributes to this discourse by offering empirical substantiation of the direct influence on academic performance and cognitive flexibility. Furthermore, the emphasis on Social Studies within this inquiry accentuates the pertinence of these strategies in disciplines necessitating higher-order thinking and reasoning skills. This focus aligns with Boekaerts (1999), who delineated the distinct challenges associated with imparting metacognitive strategies in subjects that require critical evaluation and synthesis of diverse information.

In conclusion, the outcomes of this investigation highlight the effectiveness of pedagogical approaches that incorporate cognitive and metacognitive strategies in promoting both academic performance and cognitive adaptability. These findings not only corroborate existing literature but also broaden our comprehension of the practical implementation of these strategies within secondary education environments. Subsequent research endeavors might examine the sustained effects of such interventions and their relevance across various educational frameworks.

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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 ethics committee of University of Sistan and Baluchestan.

Author contributions

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

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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.

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