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Original Article

Developing and Validating a Growth Mindset Educational Intervention Based on Dweck's Theory and Investigating its Effectiveness on Girls' Intrinsic, Germane, and Extraneous Cognitive Load

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Abstract

Background and Aim: The growth mindset, as proposed by Dweck, is a pivotal element in enhancing student motivation and learning. This mindset encourages students to perceive their abilities as skills that can be honed and improved. Such a perspective can significantly enhance the learning process and academic behaviors, inspiring students to strive for continuous improvement. The present study aimed to develop and validate a growth mindset educational intervention based on Dweck's theory and investigate its effectiveness on girls' intrinsic, germane, and extraneous cognitive load.

Materials and Methods: This study employed an applied, mixed-methods approach. The research was conducted in three phases: Phase 1 (qualitative) involved the development of the educational package, while Phases 2 and 3 (quantitative) focused on its validation and effectiveness. The statistical population for the validation phase consisted of 10 specialists in the field who were purposively selected. For the quantitative part, the population consisted of second-grade female high school students in Tehran's Education District 2, who were studying during the 2024-2025 academic year. The sample consisted of 30 students (15 in the experimental group and 15 in the control group), who were selected through random sampling. The experimental group received the growth mindset training over 10 sessions, each lasting 70 minutes, while the control group received no training. The Cognitive Load Scale, developed by Klepsch, Schmitz, and Seufert (2017), was used as the research instrument. Data were analyzed using a one-way analysis of covariance (ANCOVA) in SPSS 24.

Results: The findings confirmed that the growth mindset educational package possessed appropriate validity. Furthermore, the results of the univariate analysis of covariance (ANCOVA), controlling for pre-test scores, revealed significant differences between the experimental group and the control group in Cognitive Load scores, including Intrinsic Load, Germane Load, and Extraneous Cognitive Load ($p<0.001$). These findings not only indicate the positive effect of the educational intervention on reducing Cognitive Load in female students but also provide practical insights for educators to design effective teaching strategies.

Conclusion: The growth mindset educational package can serve as a practical tool for enhancing adolescents' cognitive abilities and is effective in reducing their cognitive load.

Keywords: Growth mindset, Dweck's theory, Validation, Cognitive load

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Introduction

Adolescence, a critical phase in the transition to adulthood, is marked by profound physical and mental changes that can lay the foundation for future success (1). Conducting studies to achieve frameworks and methods for improving lifestyle during this period is of significant importance (2). Among the influential variables affecting adolescents' growth mindset, academic success, and individual performance is the concept of cognitive Load. Cognitive Load theory, first introduced by Sweller in 1988, emphasizes the limited capacity of the human mind for processing information; thus, an excessive load can hinder learning (3-5). Cognitive Load represents the mental effort and resources required to understand and analyze information (4). Influential factors such as task complexity, the way information is presented, and the learner's prior knowledge affect the level of Cognitive Load (3, 6, 7). A high Cognitive Load can deplete mental cognitive resources and disrupt learning and problem-solving processes (8). According to this theory (9, 10), there are three types of Cognitive Load in the learning process. Intrinsic Load is related to the content of the material and the information processing required to understand it (11, 12) and results from the inherent complexity of the material (13, 14), the complexity of the learning topic (9, 15), and is a direct function of the learner's expertise and prior knowledge (14). It increases with the number, complexity, and novelty of information elements that must be processed simultaneously in working memory (4, 16). Extraneous Cognitive Load results from instructional methods and the way educational materials are structured and presented (16-18). It refers to the mental resources a learner expends on processing information that is irrelevant to the primary learning content (9, 15, 18), causing individuals to spend more time and mental energy on finding and processing this information (18) and diverting their attention (13). Unorganized, incoherent, and inconsistent materials increase Extraneous Load (19). Research has shown that a collaborative and rich environment enhances students' confidence in their academic capabilities, ultimately contributing to better educational outcomes (20). Germane Load is necessary for creating cognitive schemas and depends on the amount of working memory resources used to manage and cope with Intrinsic Cognitive Load (21). It relates to the deep processing of material (22) and, if managed correctly, can increase motivation and self-efficacy (23). Germane Load refers to the resources spent on processing and integrating new information with prior knowledge (9, 15). Cognitive Load is likely perceived and experienced differently by individuals in various ways (24). Individuals show significant differences in their appraisals depending on their interpretation of an event and their thought patterns (25). A key goal of appraisal theories is to understand differences in emotions by identifying primary appraisals. These theories investigate appraisal dimensions related to motivation that correspond to specific emotional experiences and explain how these experiences are differentiated (26, 27).

Cognitive appraisal theories suggest that when performing a task, an individual mentally evaluates the demands and their abilities to fulfill them (28). An individual perceives a challenge when they believe they can meet the demands and perceives a threat when they believe they cannot (29, 30). Thus, when Cognitive Load increases, the likelihood of anxiety and fear also increases. However, if the individual can manage this load well, they will experience more positive appraisals and pleasant emotions. Therefore, effective management of Cognitive Load has a significant impact on positive appraisals.

The Cognitive Load an individual experiences is directly and closely related to their motivation (31, 32). A motivational construct linked to memory self-efficacy and personal control is a growth mindset, which involves the belief in the malleability of intelligence (33). For example, positive emotions (34) or interest in a topic (35) are associated with a decrease in perceived task difficulty. According to Miele and Molden (36), mindsets create meaning systems that

organize goals, characteristics, feelings of helplessness, and beliefs about effort, among other things. Implicit theories of intelligence categorize individuals based on their beliefs about intelligence. Some people believe that intelligence is malleable, while others believe that intelligence is fixed (37, 38). Different mindsets explain why students with equal abilities in similar situations exhibit different achievement goals and behavioral patterns, and thus display differences in learning processes and outcomes (39). While there are no clear numerical statistics on the prevalence of growth versus fixed mindsets among students, research has shown that individuals' mindsets about abilities and intelligence can lead them down different paths of motivation and learning (40).

The central tenet of the growth mindset training is that such education promotes a growth mindset (33, 41-44). Kapasi and Pei (45) stated: "Promoting a growth mindset in students is a worthy effort to help students experience academic success and mental well-being." Supporting the notion that intelligence is flexible is associated with numerous learning benefits, including increased mastery goals, persistence in the face of challenges, and the development of positive coping strategies (46, 47). The research by Ba, Ming, and Zhang demonstrated that the Growth Mindset enhances self-efficacy and effort regulation (48). Based on research conducted in 2025, the Growth Mindset is directly associated with improved self-regulated learning strategies and academic success.

Furthermore, it encompasses problem-solving, creativity, and adaptability (49). Beyond these overt behavioural aspects, a growth mindset may influence individuals' basic information processing, attention to errors, learning retention, and transfer (50-52). Based on these findings, a growth mindset intervention has been developed in educational settings to enhance students' cognitive abilities and learning outcomes (53). The study by Cook, Castillo, Gas, and Artino (54) showed that learners who reported a higher growth mindset belief had lower perceived extraneous load and higher mastery goal orientation. Furthermore, the study by Chen and Chang (55) provides empirical evidence for a positive relationship between anxiety emotion and Cognitive Load. Collectively, Hawthorne, Vella-Brodrick, and Hattie (56) suggest that positive emotions, such as a cheerful mood, before a learning task, increase Germane Load. In contrast, positive emotions during a learning task appear to help reduce Extraneous Cognitive Load. Negative emotions, especially anxiety, can act as an Extraneous Cognitive Load and also disrupt the transfer of information to long-term memory by interfering with the information storage principle.

Based on research, Cognitive Load and mindset interact with each other, with each influencing the other. An individual's mindset can affect how they perceive and manage Cognitive Load. For instance, having a growth mindset, which emphasizes the belief in one's ability to improve, may help individuals perceive Cognitive Load as a temporary challenge rather than an indication of limited ability (57). Both Cognitive Load and mindset have been extensively researched in fields such as education, psychology, and cognitive science. Researchers have investigated the impact of Cognitive Load on learning outcomes, problem-solving abilities, and information retention (3, 4, 6, 7) Ultimately, studying the relationship between Cognitive Load and mindset can lead to the development of evidence-based strategies for improving cognitive performance and learning outcomes (8). Therefore, it is essential to investigate how a growth mindset affects the retention and transfer of learning, as well as related process variables such as cognitive load (52).

The concept of a growth mindset, as proposed by Carol Dweck, has been widely studied and utilized across various educational fields. However, research gaps still exist that need to be addressed for a complete understanding and effective implementation of the growth mindset training. The application of the growth mindset theory in specific educational contexts, such as learning and instruction, is still emerging and requires further exploration to adapt effective interventions (58, 59). Most current research on the growth mindset focuses on improving achievement motivation or performance outcomes measured by grades. A knowledge gap exists regarding how a growth mindset influences factors during learning processes, such as perceived Cognitive Load.

Furthermore, very few studies have investigated the effect of a growth mindset in children (60). While some studies have explored the relationship between a growth mindset and working memory, the specific cognitive

tasks and their varying loads require further investigation to clarify how mindset affects cognitive performance under different conditions (61). Citing the research literature and considering the necessity and importance of reducing Cognitive Load, numerous studies have been conducted on intelligence beliefs, but research that multi-dimensionally examines the effectiveness of a growth mindset on Cognitive Load has been neglected. Therefore, the purpose of the present study is to investigate whether a growth mindset intervention based on Dweck's theory effectively reduces intrinsic load, Extraneous Cognitive Load, and germane load.

Methods

The present study employed an applied mixed-methods approach for data collection, consisting of three phases. Phase 1 constituted the qualitative part of the research, while Phases 2 and 3 comprised the quantitative part of the research. The main goal was to develop and validate a developmental growth mindset educational intervention based on Dweck's theory and to determine its effectiveness on Cognitive Load.

The first phase, which involved developing the growth mindset educational intervention based on Dweck's theory (Table 1), was a qualitative phase conducted using a thematic analysis approach. To develop the educational intervention, the background, theoretical foundations, and research literature related to the Dweck-based growth mindset theory were reviewed. The core components of this theory were extracted and reorganized into a conceptual framework. Credible sources were selected using purposive sampling based on specific criteria, including scientific validity and a suitable time frame (1998-2022), from both domestic databases (such as IranDoc, Noormags, and Civilica) and international databases (like Google Scholar, ProQuest, and ScienceDirect). The resource search was conducted using relevant keywords, and the extracted data were analyzed using thematic analysis in MAXQDA software. The content development stages included determining the general headings, converting them into more detailed sub-headings, and compiling the necessary content to achieve the educational objectives. The second phase, focusing on intervention validation, was conducted using a quantitative approach. For this phase, an expert panel was utilized to validate the educational intervention; the third phase aimed to assess the effectiveness of the intervention. The underlying paradigm for this phase was quantitative, and data were collected using a quasi-experimental design with a pretest-posttest and control group.

Materials

The statistical population for this phase consisted of female second-grade high school students in the two educational districts of Tehran who were studying during the 2024-2025 academic year. Given the study's experimental design and the minimum sample size of 15 individuals per group for experimental research (62), a sample of 30 students was selected using a multi-stage cluster random sampling approach. First, a district was selected. Then, a list of all public girls' first-grade high schools in the selected district was prepared. One school was randomly selected from this list, and within that school, one class was randomly assigned to the experimental group and another class was randomly assigned to the control group. After considering the inclusion criteria for the research, an appropriate number of individuals were selected and asked to complete the questionnaires. Finally, the data collected in this phase were analyzed using one-way analysis of covariance (ANCOVA) with SPSS-24 software.

The inclusion criteria for the present study were: providing consent, not having participated in similar educational programs, no history of cognitive disorders, and not using specific medications that could affect the study results. The exclusion criteria included the participant's unwillingness to continue cooperation or participation in the study, involvement in similar educational programs during the study, and absence from more than two educational sessions.

The tools applied in this study were as follows:

Cognitive Load: To measure intrinsic load, extraneous cognitive load, and germane load, the Cognitive Load Questionnaire by Klepsch, Schmitz, and Seufert (11) was used. This instrument consists of 8 items and covers three factors: two items for measuring intrinsic load, three for extraneous cognitive load, and three for germane load. The questionnaire is scored on a 7-point Likert scale ranging from "completely false" to

"completely true." The validity and reliability of this instrument were calculated by comparing individuals' rated responses with theoretically predicted outcomes, and it was determined that all items could differentiate between tasks with different loads. Klepsch et al. (11) reported the reliability of this instrument using Cronbach's alpha, with values of 0.81, 0.86, and 0.70 for the items related to intrinsic load, extraneous cognitive load, and germane load, respectively (63). The reliability of the questionnaire in the present study was obtained using Cronbach's alpha, yielding a value of 0.73.

Content Validity Ratio (CVR): This index was developed by Lawshe (64). To calculate this index, the opinions of specialists (10 experts) in the relevant field were utilized. Criteria such as scientific and practical experience in fostering a growth mindset were defined for the selection of specialists. After identifying and evaluating their research and educational backgrounds, credible experts in the field were invited to cooperate.

Table 1. Summary of the Growth Mindset Package Content

Sessions	Session Objectives
Session 1: Introduction and an Introduction to Growth Mindset	Introduction to one another, awareness of group rules, number of sessions, and how to be present and active. Introduction to the Brain and Its Growth and Development. Introduction to Dweck's growth mindset theory (familiarity with growth and fixed mindsets) and the importance of these two mindsets in daily life.
Session 2: Self-Awareness and Thought and Behavior Patterns	Self-awareness and its importance in daily life. Techniques for increasing self-awareness include meditation, mindful breathing, and self-questioning. Identifying and analyzing patterns: identifying negative patterns, methods for changing negative patterns, and recreating life events.
Session 3: Automatic Thoughts and Their Role in Problems	Familiarity with automatic thoughts, self-defeatism, and their role in problems. Identifying automatic thoughts. Techniques for managing automatic thoughts. The impact of automatic thoughts on behavior and emotions.
Session 4: Mental Empowerment, Mindset Diagnosis, Personal Self-Talk, and Positive Self-Talk	Familiarity with automatic thoughts, self-defeatism, and their role in problems. Identifying automatic thoughts. Techniques for managing automatic thoughts. The impact of automatic thoughts on behaviour and emotions.
Session 5: The Effects of Mindset on Learning	Familiarizing adolescents with the effects of mindset on the learning process. Teaching the correct interpretation of feedback and its effect on mindset. How mindset influences academic performance and motivation. Encouraging them to change their attitude towards learning and challenges. Presenting scientific evidence from Carol Dweck's research.
Session 6: Brain Flexibility - Practice and Learning, and the Importance of Effort and Perseverance in Success	Explaining the concept of effort and perseverance. Providing examples of famous people who achieved success through effort. Writing personal goals and planning to achieve them with an emphasis on effort.
Session 7: Dealing with Failure: Creativity and Play as Keys to Growth	Exploring the concept of failure and how to change one's attitude towards it. Providing techniques for managing emotions after failure. Group exercises help identify and analyze past failures, allowing for learning from them. Introducing the concepts of creativity and play in learning and growth.
Session 8: Creating SMART Goals	Introducing the concept of SMART goals (Specific, Measurable, Achievable, Relevant, and Time-bound). The importance of goal-setting in the learning process. Writing personal SMART goals and planning to achieve them. Using metacognition techniques to manage the goal-setting process.
Session 9: Enhancing Self-Belief	How to enhance self-belief. Explaining the importance of self-belief in the learning and growth process. Techniques for enhancing self-belief. Writing a list of personal strengths and achievements and how to use them to enhance self-belief.
Session 10: The Importance of Feedback in Learning and Creating a Supportive Environment	The role of feedback in the learning and growth process. Techniques for receiving and using feedback. Group exercises for exchanging constructive feedback on each other's work. Strategies for creating a supportive environment at school and home. Designing a plan to create a supportive environment in the classroom or at home.

After explaining the objectives and providing operational definitions related to the content of the educational package, they were asked to classify each proposition based on a three-part Likert scale. The content validity ratio for all objectives in this training protocol ranged from 0.80 to 1.0.

Content Validity Index (CVI): To examine the content validity index, following the method developed by Waltz and Bausell (65). The CVI values for all educational objectives ranged from 0.90 to 1.0.

Results

The descriptive statistics (including mean, standard deviation, skewness, and kurtosis) of the variables are presented in Table 2. Following the examination of the statistical assumptions for the one-way ANCOVA, the results related to the research hypotheses were analyzed and reported using the one-way analysis of variance test in SPSS version 24. Participants were aged 15 (26.66%), 16 (56.66%), and 17 (16.66%). Family size distribution was as follows: 10% (2 members), 20% (3 members), 43.33% (4 members), and 26.66% (5 members). Birth order showed that 43.33% were first-born children, 40% were second-born, and 16.66% were third-born. The educational level of fathers ranged from below a high school diploma (6.66%) to a doctorate (10%), while the education of mothers ranged from below a high school diploma (10%) to a doctorate (3.33%).

The skewness and kurtosis values for the Cognitive Load components fall within the range of -2 to +2. It indicates that the data are approximately normally distributed. The mean scores for the Cognitive Load components in the experimental group were higher in the post-test than those in the control group. A key assumption of ANCOVA is that a linear relationship must exist between the covariate (pre-test) and the dependent variable (post-test) (Gilles, 2002). In this study, the regression lines were examined using a scatter plot. The results showed a linear relationship between the covariate and the dependent variable, thus confirming the linearity assumption. The skewness and kurtosis values for the Cognitive Load components fall within the range of -2 to +2. It indicates that the data are approximately normally distributed. The mean scores for the Cognitive Load components in the experimental group were higher in the post-test than those in the control group. A key assumption of ANCOVA is that a linear relationship must exist between the covariate (pre-test) and the dependent variable (post-test) (Gilles, 2002). In this study, the regression lines were examined using a scatter plot. The results showed a linear relationship between the covariate and the dependent variable, thus confirming the linearity assumption.

The main effect of the group is significant, as the F-value for all four tests is significant at the ($p < 0.001$) level. It indicates that a significant difference exists between the experimental and control groups on at least one of the dependent variables (Table 3 and 4).

Table 2. Descriptive Statistics for Cognitive Load Variables

Group	Component	Test	Mean	Standard Deviation	Skewness	Kurtosis
Experimental	Intrinsic Load	Pretest	7.73	2.07	-0.19	-0.55
		Posttest	10.86	1.84	-0.22	-0.81
	Extraneous Cognitive Load	Pretest	9.00	1.60	0.12	-0.97
		Posttest	15.00	1.41	-0.87	-0.033
	Germane Load	Pretest	13.46	1.50	0.074	-0.19
		Posttest	8.66	1.87	1.08	1.13
	Total Cognitive Load Score	Pretest	30.20	2.11	0.013	-0.72
		Posttest	32.86	2.55	-0.065	0.29
Control	Intrinsic Load	Pretest	8.33	0.89	-0.10	-0.67
		Posttest	8.20	1.37	0.16	0.082
	Extraneous Cognitive Load	Pretest	9.53	1.68	0.55	-0.29
		Posttest	9.46	1.35	-0.018	-0.39
	Germane Load	Pretest	12.13	0.91	-0.93	0.51
		Posttest	13.20	2.050	0.44	-0.61
	Total Cognitive Load Score	Pretest	31.13	2.87	0.15	-0.34
		Posttest	30.86	2.50	-0.14	-0.36

Table 3. Results of Univariate Analysis of Covariance (ANCOVA) on Post-Test Cognitive Load Scores (Total Cognitive Load, Intrinsic, Germane, and Extraneous Cognitive Load) in the Experimental and Control Groups, Controlling for Pre-Test Scores

Effect	Test	Value	F-value	Hypothesis df	Error df	Significance level	Effect size
GROUP	Pillai's Trace	0.866	33.952	4	21	0.000	0.866
	Wilks' Lambda	0.134	33.952	4	21	0.000	0.866
	Hotelling's Trace	6.467	33.952	4	21	0.000	0.866
	Roy's Largest Root	6.467	33.952	4	21	0.000	0.866

Table 4. Results of One-Way ANCOVA within MANCOVA on Posttest Scores of Cognitive Load (Total Cognitive Load, Intrinsic Load, Germane Load, and Extraneous Cognitive Load), Controlling for Pretest Scores

Source	Variable	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance	Effect Size
Group	Intrinsic Load	40.549	1	40.549	45.203	0.000	0.650
	Germane Load	54.780	1	54.780	23.567	0.000	0.495
	Extraneous Cognitive Load	112.606	1	112.606	104.690	0.000	0.814
	Total Cognitive Load	71.108	1	71.108	27.509	0.000	0.534

The ANCOVA F-ratios for the Intrinsic Load component (F=40.203, p<.001), the Germane Load component (F=23.567, p<.001), the Extraneous Cognitive Load component (F=104.690, p<.001), and the Total Cognitive Load score (F=27.509, p<.001) were all significant. This finding suggests a significant difference between the experimental and control groups in terms of the Cognitive Load variable and its components. Therefore, the hypothesis is confirmed.

Discussion

The results of the one-way ANCOVA revealed that the growth mindset intervention, based on Dweck's theory, had a significant effect on Cognitive Load and its components (Intrinsic Load, Extraneous Load, and Germane Load). Relevant and closely related studies include those by Koorn (66), Mansoukhi (67), Hawthorne, Vella-Brodrick, and Hattie (56), Chen and Chang (55), Suman (8), Molden, and Dweck (44), Moser et al. (50), Ba, Ming, and Zhang (48), Xu, Broadbent, and Zhang (49), Schroder et al. (51), and Xu et al. (52). The growth mindset educational package developed in the present study included components for analyzing and interpreting one's own emotions and behaviors when facing challenges, self-awareness, identifying and analyzing thought and behavioral patterns, identifying automatic thoughts and self-defeatism and techniques to manage them, positive self-talk, understanding the effects of mindset on the learning process, academic performance and motivation, teaching the correct interpretation of feedback and its effect on mindset, encouraging participants to change their attitude toward learning and challenges, and exploring the concept of failure and providing techniques to manage emotions after a setback. Each of these components can play a significant role in improving the factors that lead to a reduction in the different types of Cognitive Load in adolescents. The growth mindset intervention can help reduce Intrinsic Load by strengthening self-awareness and critical thinking, enabling individuals to understand better how they process information and which learning strategies are most effective. For instance, exercises focused on identifying thought patterns and examining cognitive processes can help learners recognize their strengths and weaknesses, leading to a significant improvement in their Intrinsic Load. Regarding Extraneous Cognitive Load, which refers to the influence of the environment and external factors on cognitive processes, the growth mindset intervention can help individuals manage their social interactions and learning environment more effectively. By using techniques such as collaborative learning and interacting with others, they can benefit from diverse experiences and perspectives, thereby managing their Extraneous Cognitive Load. Finally, for Germane

Load, which relates to the ability to create and use effective learning strategies, this intervention can help learners develop ideal learning strategies by fostering motivation and proper goal-setting. By teaching techniques for time management, planning, and prioritizing, individuals can increase their Germane Load and, consequently, optimize the learning process. Furthermore, research has shown that Cognitive Load and mindset interact, and an individual's mindset can influence how they perceive and manage Cognitive Load. For instance, having a growth mindset, which emphasizes the belief in one's ability to improve, may help individuals perceive Cognitive Load as a temporary challenge rather than an indication of limited ability (57)

An individual's mindset about intelligence plays a key role in their motivation and learning. When a learner has a fixed mindset, they perceive intelligence as an unchangeable trait. In contrast, someone with a growth mindset views intelligence as a flexible quality that can be developed and improved. Students with a fixed mindset are more likely to stop learning when they encounter difficulties. However, students with a growth mindset tend to show greater perseverance, expend more mental effort, and adopt a more favorable perception of task difficulties within the learning environment. They therefore maintain cognitive engagement, as measured by mental effort. Consequently, these students are likely to experience less Extraneous Cognitive Load and achieve better learning outcomes (66). Another notable pathway through which the growth mindset influences Cognitive Load is its impact on learning goals. When a growth mindset is promoted, students focus more on learning goals that aim for mastery of knowledge and skills. This shift in attributions and goal orientations can influence an individual's motivation, leading to a reduction in perceived Cognitive Load and an improvement in performance (40, 53). Viewing learning through the lens of instructional design and Cognitive Load theory, one could argue that mindset influences the accessibility and activation of working memory, which in turn affects the process of knowledge storage in long-term memory. It could mean that learners with a growth mindset experience less Cognitive Load, especially when a task is more complex (60). Ultimately, students' mindsets about their intelligence and ability impact their motivation, engagement, and learning outcomes (43, 52, 53). Therefore, fostering a growth mindset can be beneficial for increasing learner motivation and improving learning (67, 68). According to Renninger and Hidi (69), cultivating motivation, such as interest, is a critical part of the learning process. Interest initiates and sustains learning, deepens it, and improves performance. Interest is conceptualized as a content-specific motivational variable that can inform us about why students are motivated to engage in and learn about a particular topic (70, 71). It appears that reinforcing a growth mindset increases the perceived value of an activity and may be an effective way to cultivate learners' interest (72). Increased interest and motivation in students can, in turn, lead to sustained effort, the use of more effective strategies, greater tolerance for challenges, and, consequently, an increase in germane load.

Conclusion

The present study faced several limitations. First, the statistical population consisted of female students, so generalizing the results to other groups should be done with caution. Additionally, due to the relative novelty of the Cognitive Load variable in experimental research, a limited body of literature was found that directly used this variable. Furthermore, due to time constraints, it was not possible to conduct a follow-up period to assess the long-term effects of the training. Therefore, it is recommended that future researchers consider incorporating a follow-up period into their studies. In future studies, it is recommended to use novel approaches for measuring Cognitive Load, such as eye-tracking technology, to increase measurement accuracy. In terms of practical application, textbook designers can incorporate appropriate content about a growth mindset to foster students' self-belief and enhance related skills. It is also suggested that programs and workshops on the growth mindset be held for teachers. It would provide them with a deeper understanding and awareness of the importance and impact of a growth mindset on all aspects of life, leading to a more positive view of their students' abilities.

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Ethical Considerations

This study was reviewed and approved by Allameh Tabataba'i University with the ethics ID IR.ATU.REC.1403.169.

Conflict of Interest

The authors declare that they have no conflict of interest.

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