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Examining the Impact of Fine Motor Skills on Emotional Processing and Selective Attention in Elementary School Students

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A B S T R A C T

The aim of the current study was to examine the impact of fine motor skills on emotional processing and selective attention in elementary school students. This quasi-experimental research was a pre-test/post-test design with a control group. A total of 30 students with learning disabilities were selected through simple random sampling and allocated into experimental (15 students) and control (15 students) groups. The research instruments included the Baker et al. (2007) Emotional Processing Scale and the Stroop Color and Word Test (1935). Students in the experimental group participated in 14 sessions, each lasting 60 minutes, of a fine motor skills training program. The data obtained were analyzed using the covariance analysis method. The results showed that the training in fine motor skills had a positive and significant effect on the emotional processing and selective attention of elementary school students in Gonbad city. Therefore, it can be concluded that training in fine motor skills can improve emotional processing and selective attention in students.

Keywords: *Fine motor skills, emotional processing, selective attention.*

1. Introduction

Learning is the most fundamental process through which a helpless and desperate being, over time and through interaction with physical growth, transforms into an individual whose cognitive abilities and thought power know no bounds. The vast diversity and temporal span of human learning, extending throughout the lifespan, have led to significant variability among individuals in their learning and educational processes, despite many similarities among humans. Some individuals encounter difficulties in the learning process due to learning disorders (Aghaziarati et al., 2023; Aghaziarati et al., 2021).

Selective attention is one factor associated with learning disorders (Vancappel et al., 2021). Selective attention is responsible for the efficient allocation of cognitive resources for information processing. It refers to the ability to selectively focus on certain sources of information while ignoring others (Khanjani et al., 2019). Attention is crucial for cognitive functioning and behavior because even minor lapses can impact learning (Abbasi Fashami et al., 2020; Jabarzadeh Chaharbrod et al., 2023).

Emotional processing is another variable that affects students' academic performance (Froyen et al., 2013), typically associated with difficulties in body coordination, eye-hand coordination, spatial orientation, distinguishing right from left, up from down, and sequencing of letters and words (Grynberg et al., 2012). Emotional processing refers to the process by which emotional disturbances are absorbed and diminished, allowing other behaviors and experiences to proceed unimpeded (Tanhadoust et al., 2021). Some demonstrated in their research that optimal learning performance is not devoid of emotions, and when emotions are involved in learning and emotional processing is enhanced, learning performance improves accordingly (Ferrucci & Priori, 2014).

Given that learning disorders can pose a significant challenge for children, their families, and society, finding solutions to address this issue is of great importance. One such solution is the development and enhancement of fine motor skills, which involve the use of small muscles in coordination with senses, especially eye-hand coordination (Ferrucci & Priori, 2014). Mastering a new movement is a natural occurrence for most individuals, integrated into their motor development process and utilized to navigate life's challenges and adapt to their environment. The execution of delicate hand movements, a distinctive human trait, includes precise and skilled grasping and manipulation, requiring independent finger movements, opposable thumb positioning, and tactile perception (Hashemi malekshah et al., 2021; Jiang, 2022). The role of movement in children's lives is significant as their growth and development are linked to their motor complexities. As humans evolve, their motor abilities become more sophisticated. Movement is pleasurable for every child and provides them with a sense of security. When a child learns motor skills, various factors such as cognition, physical development, physical readiness, prerequisite skills, skill level diversity, motivation, and goals can either facilitate or hinder the learning process. Motor skills are considered fundamental and essential for school readiness and academic learning (Koziol et al., 2023; Movahedi & Esmaeili, 2015). Piaget believed that internalizing sensorimotor foundations leads to understanding and innovation in children, moving beyond the tangible to acquire a visual and mental dimension (Emarati et al., 2012; Ferrucci & Priori, 2014). Tasks such as coloring and drawing are considered fine motor skills. If a student struggles with fine movements, it is likely they will also have difficulties with gross motor skills, as these two types of motor skills are closely related. Fine motor difficulties manifest in tasks such as coloring, drawing, cutting, threading beads, using scissors, dotting lines, and buttoning clothes. The presence of fine motor difficulties, especially eye-hand coordination issues, leads to discrepancies in various bodily movements and causes problems in writing, reading, and math (Darvishi et al., 2020; Ferrucci & Priori, 2014; Movahedi & Esmaeili, 2015).

Although research has been conducted on the impact of fine motor training (such as visual arts, rhythmic movements, group games, and mindfulness) on improving learning disorders (Bayrami et al., 2021; Darvishi et al., 2020; Farid et al., 2021; Jabarzadeh Chaharbrod et al., 2023; Kordbche et al., 2022; Movahedi & Esmaeili, 2015; Pirabasi & Safarzadeh, 2018; Xu et al., 2023; Yousefi & Hashemian Nejad, 2021; Zarenezhad et al., 2019; Zeini et al., 2016), there has been no study on its direct effects. However, examining studies related to the impact of such training on various learning disorders seems beneficial. Furthermore, fine motor skills as fundamental skills significantly affect academic traits such as reading and math skills. Riemer and colleagues (2018) demonstrated that fine motor skill training increases students' attention. Given the above, the researcher seeks to answer the question: Are fine motor skills effective in improving emotional processing and selective attention in elementary school students in Gonbad-e Kavus?

2. Methods and Materials

2.1. Study Design and Participants

This research, given its objectives, was applied and utilized a quasi-experimental pre-test and post-test design with a control group. The study population consisted of all elementary school students aged 7 to 10 years with learning disorders in the 2023-2024 academic year, totaling 135 students who visited the Gonbad Comprehensive Assessment, Rehabilitation, and Early Intervention Educational Center. A total of 30 students were selected through simple random sampling and randomly assigned to two groups: experimental (15 students) and control (15

students). All participants completed the Baker et al. (2007) Emotional Processing Questionnaire and the Stroop Color-Word Test. Subsequently, the experimental group received fine motor skills training, while the control group did not receive any intervention. After the training sessions, participants in both groups once again completed the Stroop Color-Word Test and the Baker et al. Emotional Processing Scale. Inclusion criteria were: no psychological disorders, no acute illnesses; and exclusion criteria included: absence from more than two sessions.

2.2. Measures

2.2.1. Emotional Processing

The Emotional Processing Scale, created by Baker, Thomas, Thomas, and Owens in 2007, consists of 38 items and is used to measure styles of emotional processing. Each item is answered on a 5-point Likert scale (ranging from "not at all" to "extremely"), with individual scores ranging from 0 to 152. A revised version of this scale includes a five-factor structure with 25 items, developed by Baker et al. (2007). The Cronbach's alpha coefficients and test-retest reliability of this scale have been reported as .92 and .79, respectively. The Cronbach's alpha coefficient for this scale was calculated as .95. The correlation coefficient between this scale and the Emotion Regulation scale was found to be .54 (Ogińska-Bulik & Michalska, 2020).

2.2.2. Selective Attention

The Stroop Color and Word Test was first developed by Ridley Stroop in 1935 to measure selective attention and cognitive flexibility. The Stroop Test is one of the most important tests used by researchers to measure response inhibition. The test includes 12 congruent color words (where the color of the word matches its meaning) and 9 incongruent color words (where the color of the word does not match its meaning, for example, the word "red" shown in yellow color). The task of the participant is to quickly read a list of color names from right to left in the first stage. In the second stage, name each of the color bars from left to right as quickly as possible. In the third stage, quickly name the color in which each word is printed. For scoring and interpreting the results of this test, the following scores are calculated separately for groups: number of errors, number of correct responses, and reaction time. Research on this test indicates its validity and reliability in assessing inhibition in adults and children, with test-retest reliability reported between .80 and .91 (Hossin Khanzade et al., 2019).

2.3. Intervention

2.4. Fine Motor Skills Training

Table 1

The Content of Researcher-Made Package

Session	Objective	Activity
First	Establish initial connection	Getting familiar with family situations, playing group games to get to know each other
Second and Third	Increase accuracy and concentration	Tracing, adjusting water volume, crumpling waste papers and newspapers
Fourth	Cutting skills	Cutting along curved, broken, circular lines, etc., on patterns drawn with dotted lines and faint lines
Fifth and Sixth	Increase attention and motor skills, increase attention and hand-eye coordination	Drawing around various geometric shapes using a stencil. Creating sample pages from cardboard, wood, plastic; tying skills: activities involving ropes and threads (e.g., threading shoelaces through holes)
Seventh and Eighth	Hand-eye coordination, increase accuracy and concentration	Playing games like "One-Two-Three", opening and closing clothespins, screws and nuts, and locks and keys. Copying designs, drawing from a model (copying)
Ninth and Tenth	Hand-eye coordination and copying skills	Activities with pencil and paper such as coloring shapes and dotted line designs; copying designs, drawing from a model
Eleventh and Twelfth	Improve motor skills; increase attention and motor skills	Balance movements like balancing a stick in hand, fishing with a toy, carrying a cup of water without spilling; organizing matchsticks, placing them in a box
Thirteenth and Fourteenth	Improve motor skills and review and summary	Motor games like walking on heels, standing on one foot, winding thread around a spool, fishing with a toy, and reviewing previous exercises and conducting a post-test

2.5. Data analysis

The data obtained were analyzed using the covariance analysis method.

3. Findings and Results

As Table 2 illustrates, the post-test mean scores of the research variables in the experimental group were better than those in the control group.

Table 2

Mean and Standard Deviation of Emotional Processing and Selective Attention Variables

Variable	Group	Pre-test Mean	Post-test Mean	Pre-test SD	Post-test SD
Emotional Processing	Control	94.23	96.18	11.95	12.56
	Experimental	95.97	133.47	11.16	13.27
Selective Attention	Control	73.72	74.91	10.12	12.05
	Experimental	74.26	121.12	12.03	12.45

Before examining the research hypotheses, it is necessary to test three assumptions, including normality through the Kolmogorov-Smirnov test, homogeneity of variances through the Levene's test, and homogeneity of regression slopes by the F interaction between the spread variable and the independent variable.

Table 3

Results of Kolmogorov-Smirnov Test, Homogeneity of Variances, and Homogeneity of Regression Slopes

Variable	Test Stage	Z	Significance Level	Levene's Statistic	Significance Level	Interaction Effect	F	Significance Level
Emotional Processing	Pre-test	0.59	0.68	0.645	0.35	Group & Pre-test	1.741	0.226
	Post-test	0.63	0.69	0.475	0.19	-	-	-
Selective Attention	Pre-test	0.79	0.57	0.692	0.56	Group & Pre-test	1.379	0.354
	Post-test	0.68	0.55	0.463	0.37	-	-	-

According to the results obtained from Table 3, with the significance level above .05, the necessary assumptions are met.

Table 4

Results of Multivariate Analysis of Covariance for Examining the Effect of Group Variable on Dependent Variables

Test Type	Value	Hypothesis DF	Error DF	F	P	Effect Size
Hotelling's Trace	0.625	3	30	46.25	0.0001	0.65
Largest Root	0.720	3	30	47.30	0.0001	0.65
Pillai's Trace	0.412	3	30	41.46	0.0001	0.65
Wilks' Lambda	0.588	3	30	50.95	0.0001	0.65

Given Table 4 and the significance of the multivariate test indicators, it confirms that there is a significant difference between the experimental and control groups in terms of post-test dependent variables, controlling for pre-test. Based on this, it can be stated that a significant difference has been created in at least one of the dependent variables, and the effect size indicates that 65% of the difference between the two groups is due to the experimental intervention.

Table 5

Results of Between-Subjects Effects for Scores (Pre-test - Post-test)

Dependent Variable	Sum of Squares	Degrees of Freedom	F	Significance Level	Eta Squared	Statistical Power
Emotional Processing	25.36	1	21.13	0.001	0.20	0.66

Selective Attention	37.05	1	7.26	0.001	0.21	0.62

According to the findings of Table 5, there is a significant difference between the mean differences of participants in the control and experimental groups in terms of dependent variables. The power of a statistical test is the likelihood of correctly rejecting the null hypothesis, which in this research is estimated to be at an acceptable level. Also, the eta coefficient, which represents the relationship between variables, is estimated to be at an appropriate level in this hypothesis. Therefore, it can be concluded that training in fine motor skills is effective in improving emotional processing and selective attention in elementary school students in Gonbad Kavus.

4. Discussion and Conclusion

This study aimed to examine the impact of fine motor skills training on emotional processing and selective attention in elementary school students in Gonbad Kavus. The results showed that fine motor skills training has a significant effect on the emotional processing and selective attention of elementary school students in Gonbad Kavus. These findings are consistent with the results of previous research (Darvishi et al., 2020; Emarati et al., 2012; Hashemi malekshah et al., 2021; Koziol et al., 2023; Movahedi & Esmaeili, 2015).

To explain the effect of fine motor training on selective attention, it can be said that children with learning disabilities have a deficit in executive function of attention, which plays a fundamental role in selective attention. Moreover, proponents of the theory of attention span deficit in learning disabilities believe that children with specific learning disabilities have difficulties in concentration, attention, and accuracy (Ferrucci & Priori, 2014). Furthermore, from the perspective of sensory integration theory, the formation of equilibrium responses, motor planning, bilateral coordination, body schema, finger identification, and movements requiring opposition of the fingers and individual finger movements depend on the proper integration of vestibular, proprioceptive, and visual senses. Sensory integration disorders lead to significant problems in fine motor coordination, visual-spatial perception, eye-hand coordination, and the speed, accuracy, and concentration of hand movements (Hashemi malekshah et al., 2021). Additionally, fine movements require postural control, fine motor skills, and sufficient joint stability of the upper limbs, which can be affected by sensory integration disorders and manual dexterity disorders. According to the arousal mechanism theory, these children likely do not pay attention to and accurately perceive primary stimuli related to task performance due to very high arousal levels, and they experience severe perceptual narrowing. Or, with low arousal levels, they have access to a wide range of cues, of which only a limited number are related to effective task performance, imposing an overload on the individual's processing system and damaging performance in both cases (Koziol et al., 2023; Movahedi & Esmaeili, 2015). Elementary students need attention and concentration to hold information for planning and prediction in their minds; thus, if fine motor skills are not strengthened, they face difficulties in tasks requiring time-dependent coordination, such as maze navigation, eye-hand coordination, and coordination of upper and lower limbs (Emarati et al., 2012). Therefore, fine motor skills training can significantly affect emotional processing and selective attention in students.

Given the importance of motor skills in various aspects of development such as physical, sensory, perceptual, cognitive, social growth, and interaction with the environment, especially in children who have a high rate of growth, deficiencies in these areas will be more evident. Fine motor skills are considered crucial as they prepare children for daily activities like walking, running, jumping, playground skills (like climbing), and sports skills (like catching, throwing, and hitting a ball with a bat), enhancing emotional intelligence. These skills are essential for self-care in daily life for activities such as dressing (which requires balancing on one foot without losing equilibrium). Furthermore, fine motor abilities affect other daily life activities. For example, a child's ability to maintain an upright and straight posture (keeping the torso up) at the table influences their capacity to engage in fine motor skills (writing, drawing, cutting) and sit attentively for classroom instruction, which in turn impacts their emotional intelligence. Fine motor skills ensure students' endurance for a full day at school (sitting upright on the bench, moving from one class to another, carrying a heavy school bag) and enable accurate registration, interpretation, and response to sensory stimuli in the environment and their body, enhancing emotional intelligence.

Since learning disorders can pose a significant problem for children, families, and society, finding solutions to address this issue is essential. One of the therapeutic solutions is the development and enhancement of fine motor skills, which involve the use of both large and small muscles

in coordination with senses, especially eye-hand coordination.

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Declaration of Interest

The authors of the study declare no conflict of interest related to the research.

Ethics Considerations

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

Authors' Contributions

All authors contributed equally in this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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