

The Effect of Modifying the Sleep Pattern on Reducing the Math Learning Disorder among Elementary School Students

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Abstract

Background

The present study aimed to evaluate the effect of sleep pattern modification on reducing the math learning disorder in the sixth-grade elementary school students in the Kerman city, Iran.

Materials and Methods: This study was carried out using a semi-empirical, pre-, and post-survey method. A control group and sample population of 2,950, including all of the girl students studying in the sixth grade of the elementary school in the of Kerman in the 2019-2020 academic year, and 40 people with the highest score in the Sleep Disorder Scale for Children (SDSC), who were willing to cooperate with the researcher, were selected as samples and were randomly put into two groups of 20 individuals. The subjects participated in 45-minute sleep pattern modification sessions one day a week for six weeks, and the control group did not receive any council or treatment during this period. At the end of this period, both groups were evaluated using a post-survey approach. The tools used in this study include SDSC questionnaires and Keymath test. Multivariate Analysis of Covariance (MANCOVA), and Analysis of Covariance (ANCOVA) was used to analyze the theories.

Results: The results of the study showed that sleep pattern modification has a significant effect on math learning, and the modification of sleep pattern effect coefficient on math learning was 0.974. The further results of the study showed that sleep pattern modification significantly affected learning basic concepts, mathematical operations, and applications of mathematics, and the effect of sleep pattern modification on learning basic concepts, mathematical operations, and applications of mathematics was 0.922, 0.904, and 0.935, respectively.

Conclusion

According to the results, sleep pattern modification can reduce students' math learning disorder; therefore, it is suggested to examine, and if needed, modify the sleep pattern of students with a math learning disorder.

Key Words: Elementary School Students, Sleep Pattern, Math Learning.

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1- INTRODUCTION

A math learning disorder is one of the specific learning disabilities, which is significantly related to calculation abilities. A child's mathematical skills must be significantly lower than their age, IQ, and academic performance to diagnose this disorder (1). This term usually does not include the visual, hearing, motion, mental, or environmental, cultural, and economic limitations related to disabilities (2). Disorder in one or more basic mental processes is a person's method of utilizing their mental processing methods in the brain's special functions. Analysis and description and individual sensory and motion perceptions appear in forms of inability to hear, speak, read, write, or collecting thoughts and expressing them in the right hemisphere of the brain, and performing short, or rather significant calculations in the left hemisphere of the brain (3).

Learning disabilities are one of the disorders affecting children's abilities and cause behavioral and psychological problems, including anxiety, depression, escaping from school, eating, and sleep disorders. Several studies in different countries show that approximately 10% of children have some specific learning disorder. Nevertheless, parents and teachers must not lose hope; because experts' years of experience dealing with such children show that on the condition of early diagnosis by parents or teachers, and getting help from experts, these children can be treated (4). According to the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders, math learning disorder includes the inability to carry out calculation abilities according to the child's normal IQ and education level. Therefore, children have problems in four skill groups: linguistics, perceptive, math, and math-related focus (5). In recent years, the research literature in the field of math learning disorder has had relatively good

progress; therefore, the characteristics of children with math learning disorder have been examined from different perspectives. Among related fields, there is a common agreement about the fact that math learning disorder is common in younger children, and has serious academic consequences. The math learning disorder term is used for students. Who despite having a natural IQ and full vision and hearing abilities are weak in carrying out calculation skills.

In this group of students, there are serious problems in learning mathematical skills, from learning numbers to carrying out mathematical operations and spatial perception problems, and problem-solving. Usually, this problem extends to both education and daily life, causing disorder in mathematical skills (7). Applications of mathematics depend on problem-solving abilities. Many face mathematical academic issues, not because of their inability, but due to their learning disorder (4). Students who have better analytical performance can carry out their roles more efficiently in the future (8).

If the children suffer from methodical issues are not treated, they may suffer other issues, such as problems in school, behavioral problems, low self-esteem, anxiety or fear of math, test anxiety, social problems over lack of academic progress, limited options for future careers- because some professions require performing basic mathematical operations- dropping out of school, and in adulthood, inability to calculate income, expenses, and bankruptcy (9). According to the researches, approximately 17% of students in elementary school face the math learning disorder (10), and in some cases, this number is reported as high as 21% (11). Therefore, discussing math learning disorder and recognizing the effective factors in reducing this disorder seems essential. Different cognitive and non-cognitive factors can cause math learning

disorder, and some factors can intensify this disorder among children, such as sleep disorder (12). According to previous studies, the prevalence of sleep disorder among children is 0.21; in other words, 21% of the children have insomnia (13). Aiken (2016) reported a 0.23 prevalence of sleep disorder among students with 7-11 years old (14). Recent researches have shown that short-term sleep deprivation in healthy people leads to disorders, which people with sleep disorders suffer from, not only tiredness, but also cell regeneration problems, deficiency in learning memory, increased stress and anxiety, and reduced quality of daily life. There is a strong relationship between sleep and professional performance and people's mental awareness. Moreover, sleep deprivation in university students can affect their academic performance (15).

Insomnia can affect students' learning and academic performance, in such a way that the chances of depression and anxiety increase, and the capability of dealing with daily stresses decreases. In such conditions, the child's learning abilities greatly drop. Furthermore, the amount and fashion of night sleep can affect people's cognitive functions and level of focus for carrying out daily activities (16). It seems that one method to reduce math learning disorder in students, especially in early ages, is sleep pattern modification, since, if children can follow the regular sleep pattern, their academic performances, especially in calculations, like mathematics, will improve (17).

Since there have been rare studies in this field in the country, the present study aimed to evaluate the role of sleep pattern modification in reducing the math learning disorder among the elementary school students, and endeavors to provide an answer to the following question: Will sleep pattern modification affect math learning disorder among the elementary school students?

2- MATERIALS AND METHODS

This research is conducted in a semi-empirical, pre-, and post-survey approach with a control group. The sample population includes all of the girl students, studying in the sixth grade of elementary in the City of Kerman in the 2019-2020 academic year. The sample size for the primary screening, according to the Morgan table, was 341 students, among which 40 had the highest score on the SDSC and were willing to cooperate with the researcher and were randomly put into intervention and control groups. To evaluate the theories, MANCOVA and ANCOVA tests were used. Data analysis was performed using SPSS. A P-value of less than 0.05 was considered statistically significant.

2-1. Measuring tools

2-1-1. The Sleep Disturbance Scale for Children (SDSC) Questionnaire

This questionnaire was designed by Bruni and Ottaviano et al. in 1996. SDSC test is used to evaluate sleep disorders among children with 6-15 years old. This questionnaire is related to the sleep rhythm, awakesness, and probable sleep problems, including 17 questions, which evaluate the disorders in three parts, problems in going to sleep (5 questions), the sleep continuity (7 questions), and awakesness (5 questions). The answers are in the form of five choices (22). This questionnaire is the parents' form, the validity of this test is assessed in Iran and is verified, and its reliability coefficient is reported 0.82 through Cronbach's alpha. Ghane'ian and Kazemi Zahrani (2016) considered this questionnaire's validity to be suitable and reported its reliability coefficient through Cronbach's alpha to be 0.73 (18).

2-1-2. Keymath Test

The common keymath test in Iran was designed by Connolly (1990) to diagnose

math learning disorder among elementary school students. This test evaluated 13 mathematical operations in three fields of basic mathematical concepts (including numeration, geometry, and rational numbers), mathematical operations (including addition, subtraction, multiplication, division, and mental computation), and applications of mathematics (including measurement, time and money, problem-solving, data analysis, and estimation). Each one of the mathematical operations has 18 questions, except counting, geometry, measuring, and time and money, which have 24, and based on the educational stage, each one of the 13 aspects has a top question, which students from that educational stage are expected to be able to answer, and for each correct answer, they will be given a score of 1, and for each wrong answer, a score of 0 (23). Ismaili and Hooman (2002) reported 0.69 validity for this test. The reliability coefficient for this test, through Cronbach's alpha, was 0.80 (19). This test is used to recognize students with a math learning disorder.

2-2. Method

The present study has an independent variable, including sleep pattern modification, and a dependent variable, including math learning disorder. First, SDSC questionnaire, and then Keymath test was carried out on 341 sixth grade of elementary school students in the city of

Kerman to recognize the students with improper sleep and math learning disorders, then 40 students with the lowest score in SDSC questionnaire and lowest score in Keymath test, who were willing to cooperate with the researcher, were selected, and randomly assigned in two different groups. The intervention group received necessary treatments for sleep pattern modification through six sessions, while the control group received no treatments during this period. After these sessions, both groups were evaluated in a post-survey approach in terms of math learning disorder, in order to evaluate the effect of this sleep pattern modification on math learning.

2-3. Sleep Pattern Modification Program

Sleep pattern modification was carried out based on Barbaresi's model (2005) through 45-60 minute sessions, once a week, for six weeks (7).

3- RESULTS

Forty sixth-grade girls of elementary school students, who had the lowest score in the SDSC questionnaire and keymath test, participated in this study. The average scores in basic mathematical concepts, normal mathematical operations learning, average learning of applications of mathematics, and average math learning are presented in **Table.1**.

Table-1: Descriptive statistics of research variables in control and experimental groups in pre-test and post-test.

Variables	Group	Pre-test, Mean \pm SD	Post-test, Mean \pm SD
Basic mathematical concepts	Control	26.35 \pm 2.889	28.05 \pm 2.645
	Experimental	28 \pm 2.991	41.1 \pm 3.669
Mathematical operations learning	Control	42 \pm 4.779	44.85 \pm 4.998
	Experimental	43.85 \pm 4.923	69.45 \pm 7.416
Applications of mathematics	Control	37.75 \pm 6.008	41.3 \pm 5.564
	Experimental	40.7 \pm 7.131	63.45 \pm 8.63
Math learning	Control	106.1 \pm 7.594	114.2 \pm 7.135
	Experimental	112.5 \pm 9.594	174 \pm 11.328

3-1. Inferential Findings

Theory 1: Sleep pattern modification affects math learning in elementary school students.

ANCOVA test was used to analyze the mentioned theory. According to the results

in **Table. 2**, after adjusting the pre-survey scores, sleep pattern modification has had a meaningful effect on elementary school students' math learning ($\eta^2=0.974$, $P<0.05$, $F_{(1, 37)}=1410.51$), and the effect of sleep modification on elementary school students was 97.4%.

Table-2: Analysis of covariance the effect of sleep pattern modification on math learning in students participating in the study.

Variables	Total sum of squares	DF	Mean sum of squares	F	Sig.	η^2
Pre-test	2751.23	1	2751.23	155.66	0.001	0.808
Group	24930.49	1	24930.49	1410.51	0.001	0.974
Error	653.70	37	17.67	-	-	-

DF: Degree of freedom.

Theory 2: Sleep pattern modification is effective on the learning mathematical basic concepts, operations, and applications of mathematics among elementary school students

MANCOVA was used to analyze the theory mentioned above. According to the results in **Table.3**, after adjusting the pre-survey scores, sleep pattern modification has had a significant effect on learning basic mathematical concepts, operations, and applications of mathematics among elementary school students ($\eta^2=0.976$, $\Lambda=0.024$, $P<0.05$, $F_{(2, 35)}=483.46$), and the effect of sleep pattern modification simultaneously on learning basic mathematical concepts, operations, and applications of mathematics was 0.976. The results in **Table.4** shows that the two

control and intervention groups had significant differences in post-survey tests on learning basic mathematical concepts ($\eta^2=0.922$, $P<0.001$, $F_{(1, 39)}=415.45$), operations ($\eta^2=0.904$, $P<0.001$, $F_{(1, 39)}=330.89$), and applications of mathematics ($\eta^2=0.935$, $P<0.001$, $F_{(1, 39)}=500.64$), which shows the significant effect of sleep pattern modification on learning basic mathematical concepts, operations, and applications of mathematics among elementary school students. According to the Eta coefficient, the effect of sleep pattern modification on learning basic mathematical concepts, operations, and applications of mathematics was 0.922, 0.904, and 0.935, respectively.

Table-3: Results of MANCOVA test to evaluate sleep pattern modification on math learning components.

Effect	Test	Value	F	DF	Error DF	Sig.	η^2
Group	Pillai effect	0.976	483.456	3	33	0.001	0.976
	Wilks' Lambda	0.024	483.456	3	33	0.001	0.976

DF: Degree of freedom.

Table-4: MANCOVA test results for comparison of post-test components of mathematical learning in the control and experimental groups.

Group	Variables	Total sum of squares	DF	Mean sum of squares	F	Sig.	η^2
	Basic mathematical concepts	1195.338	1	1195.338	415.449	0.001	0.922
	Mathematical operations learning	7336.855	1	7336.855	330.892	0.001	0.904
	Applications of mathematics	301.892	1	301.892	500.641	0.001	0.935

DF: Degree of freedom.

4- DISCUSSION

The present study aimed to evaluate the effect of sleep pattern modification on reducing the math learning disorder in the sixth graders of elementary students in the Kerman city. The findings of the study showed that sleep pattern modification has a significant effect on learning math and its components among elementary school students. These results and the findings from the study conducted by Ehteshamzadeh and Mar'ashi (2015) showed that the intensity of insomnia and sleepiness are respectively the best predictors of young boys' mathematical performances (20). Ismail-zadeh (2018) concluded that there is a significant and negative relationship between the quality of sleep and math learning disorder in fifth-grade students of the elementary school in the Kashmar city (21). Dmayer et al. (2019), which showed that sleep pattern reduces math learning disorder modification (22), and the results from Aiken's researches (2012), stated that students' abnormal sleep patterns could intensify math learning disorder (14). Moreover, Francisco's results (2018), showed that the quality of sleep has a deterministic role in math learning in the class (23), and Ravensley and Fisher findings (2017), showed that sufficient rest and proper sleep pattern could improve math learning (24). Therefore, it is worth noting that when children go to sleep at a proper time and before 10 o'clock, parents set up a sleep schedule for children, do not take soporific medicines, having a calm state of mind, and the diagnosis of

nightmares cause and treat it. Children's math learning disorder decreases, and their mathematical abilities and performances will significantly improve. Concerning this, sleep and rest are two of the fundamental human needs and are among the physiologic needs in Maslow's hierarchy of needs (7). When the sleep and awakesness cycle is interrupted, it is possible that other physiological functions of the body change, such as fatigue, depression, loss of appetite, lack of focus, intensified diseases, and bodily discomfort. Sleep is the body's physiological mechanism for regaining the lost energy during physical activities in daily life and is considered as an important criterion in preserving the human's physical and psychological health. Sleep deprivation, chronically, is a major risk factor in driving accidents, career incidents caused by fatigue, losing the job, social and family problems, weak health and hygiene, and metabolic and endocrine glands disorder.

- In case that math learning disorder is observed among students, it is suggested that school consultants and teachers examine their sleep patterns since it is one of the causes for a math learning disorder, and in case their sleep patterns are not proper, they should try to set up a proper sleep pattern for themselves.
- School consultants should set up a proper sleep schedule for students with a math learning disorder, and the children must be supervised in abiding

by this schedule.

- There must be a specific time for children with a math learning disorder to go to sleep and wake up, and parents must supervise children in obeying this schedule.
- Students with math learning disorder must avoid using medicines and psycholeptics for sleeping.
- Students with math learning disorder must go to sleep at 22 (10 pm) every night, and parents must emphasize on this.
- Students with math learning disorder must not stay up late and must sleep for 8 hours by 7 in the morning.
- By creating a calm environment for the students with a math learning disorder, parents prepare the background for deep sleep.
- If children have nightmares, it is suggested to diagnose the root cause and treat them.
- School consultants should create a brochure about proper sleep pattern, and distribute them among students and parents.
- The school must consider prizes for students with proper sleep patterns so that other students are encouraged to have proper sleep patterns as well.

4-1. Study Limitations

- The limitations in the information gathering method: The tools used in this research were questionnaires, and people might not reflect the truths, due to different reasons. To solve this problem, it would be better to use interviews and observation or other tools if possible, which was not possible due to time limits and lack of sources and facilities.
- Not controlling all the interfering factors, such as social and economic status, psychological health, and

personality types.

- This research was conducted among girl students studying in the sixth grade of elementary schools in the Kerman city; therefore, it must be generalized cautiously.
- This research was a cross-sectional study; therefore, its generalization is difficult.

5- CONCLUSION

The purpose of this research was to evaluate the effect of sleep pattern modification on reducing the math learning disorder in the sixth-grade students of elementary schools in the Kerman city. The results showed that sleep pattern modification has significantly affected math learning in elementary school students. Moreover, sleep pattern modification had a significant effect on elementary school students in learning basic mathematical concepts, operations, and applications of mathematics. Therefore, it can be concluded that one of the methods of reducing math learning disorder in students is sleep pattern modification. In this regard, it is suggested to examine the sleep pattern of students with a math learning disorder, and if needed, modify it.

6- CONFLICT OF INTEREST: None.

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