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HANDWRITING TRAINING: DOES IT IMPROVE WORKING MEMORY IN ELEMENTARY SCHOOL STUDENTS?

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ABSTRACT

The development of information and digital technology is currently growing very rapidly. One proof of the very rapid progress of information and digital technology is the increase in the amount of information that can be obtained from various sources. The ability needed to process new information to help understand learning is working memory. Working memory is short-term memory in the brain for storing and manipulating information so as to help the learning process and understanding a person's behavior. Working memory skills are important to be trained from an early age. There is a need for learning about working memory which can be developed in elementary schools. Previous research shows that working memory can be improved through handwriting training. However, research on the effect of handwriting training on working memory in Indonesia is still very limited. This research aims to determine the effect of handwriting training on working memory in elementary school students. The method used is quasi-experimental. Participants in this research were 4th grade elementary school students. This research uses an experimental group and a control group. The experimental group was given handwriting training for 10 days. The experimental group and control group were given a pre-test before the experiment and a post-test after the experiment to measure the differences between the two groups. The results of this research can support the level of awareness regarding the importance of handwriting training for elementary school students.

Keywords: *Handwriting training, working memory, elementary school*

1. PREFACE

Cobos and Contreras (2018) stated that this era is an era full of information. Our society is largely influenced by three driving forces. One of them is a massive increase in the quantity of information available (Höchtl et al., 2016). Humans have a limited capacity to process information. When the amount of information received exceeds this capacity, humans will experience overload (Eppler & Mengis, 2004). This condition can cause difficulties in understanding information, feelings of confusion and frustration, and psychological stress (Eppler, 2015; Eppler & Mengis, 2004; Thorson, Reeves, & Schleuder, 1985).

Young recipients of information are more easily influenced by the information they receive, including information presented in the news (Beaudoin, 2008). This is because they have less experience and knowledge. This statement is also supported by Benselin and Ragsdell (2015) who show that the younger generation's perception of the influence of information overload (IO) is influenced by their level of information literacy. Nordenson (2008) also stated that the online information environment is very demanding. He added that young users use media too often and multitask in receiving information, so they pay less attention to information and feel more affected by information overload (IO).

At the stage of receiving and processing information, a cognitive approach is needed to study how the human brain works to process sensory input, which is usually called information processing theory (IPT) (Atkinson & Shiffrin, 1968). In IPT, there are three things that the human brain compares to how a computer operates. These three things are receiving input, processing information, and implementing output. At the information processing stage, sensory memory will filter important and relevant information to be stored in working memory (Atkinson & Shiffrin, 1968). Working memory is a system used to process information, such as categorizing, comparing, or combining new information with information stored in long-term memory. Working memory is also a basic function that we use for thought control (Bastos et al., 2018).

Working memory has a limitation. These limitations mean that a person's ability to use information efficiently can be disrupted by the amount of information that is potentially available and relevant (Bawden & Robinson, 2009). Gwizdka (2013) examined how one's searching behavior is influenced by the capacity of working memory. Studies show that individuals who have high working memory capacity are more enthusiastic about searching for information in challenging situations compared to individuals with low working memory capacity (Gwizdka, 2013). A study from Gwizdka (2017) also shows that individuals with high working memory capacity have longer absolute reading times compared to individuals who have low working memory capacity.

Efforts are needed to increase the capacity of working memory. Several studies have been conducted to improve working memory. One research example involves playing congklak. Research shows that playing congklak can increase working memory capacity (Putra, Tiatri, Soetikno, 2017).

Another effort that can be made is handwriting training. Handwriting training has been found to be related to working memory. Handwriting has been found to be predictive of working memory capacity, fluency, spelling, and gender (Lichtsteiner, Wicki, Falmann, 2018). The automaticity of handwriting predicts a person's speed and orthographic skills. Furthermore, handwriting is associated with conserving cognitive resources (Wicki et al., 2014). However, researchers have not found research in Indonesia that examines handwriting training in relation to increasing working memory capacity. For this reason, researchers intend to conduct research on whether handwriting training can increase working memory capacity in elementary school students. It is hoped that this research will provide valuable information regarding whether handwriting training is still needed in elementary schools.

2. RESEARCH METHOD

This research involved participants in 4th grade elementary school students, 1 homeroom teacher, and 1 research assistant. There are 10 students in class 4, consisting of 5 male students and 5 female students. This research uses a quasi-experimental method. The quasi-experimental method is a type of research method that does not use random assignment but instead uses predetermined groups (Cook, 2015). This research uses a one-group pre-test-post-test design, namely experimental research carried out in one group. This research also uses quantitative and qualitative approaches. Results from the quantitative approach using measuring instruments are processed using the SPSS software. The qualitative approach is in the form of homeroom teacher interviews regarding the overall results of the experiment.

This research was carried out for 9 days. On the first day, it started with a pre-test which included 2 measuring instruments, namely a digit span measuring instrument to measure working memory and a reading comprehension measuring instrument to measure students' reading comprehension.

On the second to ninth days, researchers provided an intervention in the form of handwriting exercises. Students were asked to rewrite the stories dictated by the researcher. Finally, on the ninth day, after the last intervention carried out in the first session, the researcher gave a post-test with the same measuring instrument. Before the end of the session, the researcher conducted an interview with the homeroom teacher. The time required for the interview is 5 minutes. The questions asked by the researchers were regarding the overall results of the experiment which was carried out for 9 days. Examples of questions asked were, "Were there any changes that the homeroom teacher saw during the intervention?", "How enthusiastic were the students regarding the intervention program given for 8 days?" The purpose of these questions is to find out a direct picture from the class teacher regarding the intervention program provided and how engaged the students are regarding this program.

Reading comprehension measuring tool to measure reading comprehension uses tales of folklores. The readings for measuring reading comprehension were obtained from a collection of stories published by the Ministry of Education and Culture, Research and Technology (2023). Table 1 shows the Reading Comprehension measurement tool used.

Table 1
Reading Comprehension Measurement Tool

Reading Comprehension Measurement Tool			
Name		Sex	
Age		Female	Male
Grade	IV		
School	SDS L		
Hari/Tanggal Tes	Wednesday, 25 October 2023		

Instructions:
Read the following story carefully, then answer the 10 questions below briefly and accurately.

Example:

Table 2

No.	Question and Answer
1.	What is the name of the current President of the Republic of Indonesia?
	Answer: The name of the current President of the Republic of Indonesia is Mr. Joko Widodo. ❌
	Answer: Mr. Joko Widodo ✅

Table 3

Darman and Darmin
Once upon a time in an area in Jakarta there lived a rich merchant named Mr. Salim. He was a well-known landlord. He owned land not only in Jakarta but also in the Karawang area. Mr. Salim's income, apart from rent, is also from fruit trading. Mr. Salim's wife died a long time ago from typhus. The family was late in dealing with it because they thought Mr Salim's wife was suffering from a common cold. After the death of his wife, Mr. Salim had to raise his children alone. Mr. Salim has two children. The first child is named Darman and the second child is named Darmin. Mr. Salim's two children have very different characteristics. Since childhood, Darman has loved playing silat. To deepen his martial arts skills, he did not hesitate to seek knowledge at various martial arts schools. However, the knowledge he had was not put to good use. He often gets involved in fights with youths around his village. Every day some people complain to Mr. Salim because of Darman's actions. Mr. Salim has tried to send Darman to school, but he often plays truant. Finally, Mr. Salim let him choose his own path in life. It's different with Pak Salim's second child, Darmin. Since childhood, he has diligently attended religious studies around his village. He also often helps neighbors in trouble. At school, Darmin is known as a smart child. Therefore, his father often asked him to help with financial bookkeeping.

3. RESULT AND DISCUSSION

This study used the digit span measurement tool from the Wechsler Adult Intelligence Scale Fourth Edition (WAIS-IV) and the forward-backward digit model from Jensen & Osborne (1979) to measure participants' working memory.

Table 4

Average Test Results of the Pre-Test and Post-Test of the Digit Span Measuring Instrument

Statistics							
		EDtot	BDtot	DStot	FDptot	BDptot	DSptot
N	Valid	10	10	10	10	10	10
	Missing	2	2	2	2	2	2
Mean		3.9000	2.7000	4.6000	5.1000	3.5000	5.5000

Based on Table 4, it can be explained that the average score obtained by participants in the pre-test was 3.9 in forward digits; 2.7 in backward digits; and 4.6 in digit sequencing. Furthermore, the average score obtained by participants on the post-test was 5.1 in forward digits; 3.5 in backward digits; and 5.5 in digit sequencing. It can be concluded that there was an increase in the average obtained during the pre-test and post-test.

On the reading comprehension measuring instrument, no differences were found in the pre-test and post-test answers. However, during direct observation, it was found that there were differences in the participants' processing time. Processing time was 7 minutes faster with a total of 23 minutes in the post-test. During the pre-test, the processing time was slower with a total time gain of 30 minutes. Researchers and research assistants also looked at the differences in the process of working on reading comprehension measuring instruments during the pre-test and post-test. During the pre-test, almost all participants repeated reading the reading questions in the process of answering questions 3 to 4 times. However, during the post-test, 4 out of 10 participants who took the reading comprehension measuring tool answered by rereading the reading questions a maximum of 1 time. The rest still repeat looking at the reading questions to answer the questions 2 to 3 times.

The researcher also interviewed the homeroom teacher of class 4. Based on the results of the interview, the homeroom teacher stated that handwriting activities were one of the shortcomings of the program at the elementary school. As a result, according to what the researchers found, there were deficiencies in the participants' writing. Researchers found subpar handwriting, participants who had difficulty distinguishing when to use uppercase and lowercase letters, participants who were still confused about the placement of punctuation marks, and others. The homeroom teacher also mentioned that there was a program that was similar to the intervention program carried out by the researchers. A similar program is to rewrite the reading dictation, but with a typed version using a computer device. Another outcome that was obtained from the interviews was that the participants were very happy, enthusiastic, and attached to the experimental program provided by the researcher.

4. CONCLUSIONS AND RECOMMENDATIONS

This research shows that handwriting training can improve working memory in elementary school students. Even though handwriting training does not appear to be able to improve reading

comprehension, based on observations, there appears to be an increase in the participants' ability to understand reading.

Based on this research, handwriting training can be recommended for use in the learning of elementary school students in Indonesia. This research has limitations, namely the small number of students involved. To be more convincing, it is recommended that in future research, handwriting training is to be conducted with a larger number of participants.

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