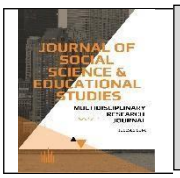

Journal of Contemporary Social Science and Education Studies
E-ISSN: 2785-8774
Vol 3, Issue 1 (2023)

Improving autistic students' visual–motor skills through handwriting intervention

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Article Info

Article history:

Received: Aug 22, 2022
Revised: 6 Jan 2023
Accepted: 15 Feb 2023
Published: 1 April 2023

Keywords:

Autistic student
Memory
Brain Gym Visual–
Motor Skills
Handwriting practice

ABSTRACT

Autism (Autism Spectrum Disorder) is a neurodevelopmental disorder that affects sensory, cognitive, and motor systems (Mosconi et al., 2011). Although most autistic students with handwriting difficulties have been given intervention at the primary school level, their handwriting problems have not yet been resolved. This case study aimed to identify the effect of "*Cekap Menulis*" on autistic students' visual-motor skills. As the sample for this study, three autistic students aged 12 with handwriting difficulties were chosen from an intervention center. They were given around 20 minutes of visual-motor skills training after around 5 minutes of Brain Gym warming up exercise before handwriting practice. "*Cekap Menulis*" is a combination of the Brain Gym concept and The Size Matters Handwriting Program supported by Vygotsky's Theory. Data was collected by repeated measurement of respondents' visual-motor skills using a visual motor assessment instrument followed by a semi-structured interview. The result showed that all the respondents had significantly improved their visual-motor skills. Their visual motor skills were developed through purposeful learning activities that included Brain Gym, visual motor activities, motivation, and continuous guidance from teacher and parents through visual cues, verbal feedback, and hand-on-hand handwriting practice.

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INTRODUCTION

In motor visual skills, both visual (eye) and motor (hand) processes are used efficiently together to perform daily activities such as dressing and handwriting (Shin et al., 2015). Visual–motor skills are essential to the success of handwriting skills because they greatly influence one's ability to copy and transpose text (Feder & Majnemer, 2007, 27, p. 734). Recent studies show that impaired motor coordination and motor visual skills abilities are closely related to a child's ability to master handwriting skills (Duiser et al., 2020). According to Taverna et al. (2020), motor visual skills are an important component of handwriting skills. This is because handwriting skills can only be attained when motor visual skills are mastered (Malderali et al., 2015). In short, motor visual skills are the basic skills of the early stages of writing skills that need to be mastered (Suhaimi, 2019) for autistic students to write clearly and fluently (Salameh-Matar et al., 2016). Studies show that the motor and cognitive domains of children without autism spectrum disorder are not correlated (Jenni et al., 2013) while the motor domain (motor visual skills) and cognitive domain (working memory) of children with autism spectrum disorder correlated when IQ (cognitive level) was controlled (Bhat et al., 2018). This means that the working memory of children without autism spectrum disorder can be linked to cognitive levels, but for children with autism spectrum disorder, memory impairment problems occur as additional impairments (Bohm et al., 2010). According to Hartman et al. (2010), who conducted a study among students with intellectual deficits, students with weak motor skills have weak memory skills; however, studies related to the relationship between motor and cognitive domains are still lacking. Motor skill problems in individuals with autism are primarily related to motor coordination (Fazlioglu & Gunsen., 2011).

Recent studies show that autistic students with motor skills deficits need comprehensive interventions that not only focus on motor skills but also on social and cognitive factors (Bhat, 2020). Similarly, Tseng and Chow (2000) suggested that students with handwriting problems and slow writing require interventions that focus on both motor visual skills and memory (involvement of cognitive functions such as writing exercises). This difficulty in properly spacing out the words can be attributed to cognitive and visual-spatial deficits commonly observed in autistic students (Rosenblum et al., 2016). According to Rosenblum et al. (2019), working memory is positively correlated with the handwriting quality of autistic students. Working memory is also an important factor in the development of writing (Graham, 2018). The ability to know and recall a letter, such as remembering the shape, name, and sound of the letter, are important skills to the development of handwriting. The handwriting process involves the planning of motor visual skills, and the planning of efficient motor visual skills depends on good memory (Memisevic & Sinanovic, 2013). Unfortunately, autistic students also have poor memory due to motor impairment. The left frontal lobe of autistic students is less active during information processing in working memory (Rabiee et al., 2020), which complicates the mastery of handwriting skills among autistic students. The condition worsens when they do not receive appropriate treatment due to the scarcity of information about handwriting teaching instruction. Although many studies have shown that handwriting interventions are effective in improving aspects of handwriting skills such as writing clarity (Donica, 2015; Engel et al., 2018; Pfeiffer et al., 2015), handwriting interventions studied among autistic students are still lacking (Johnson et al., 2015). The problem persists because the most effective handwriting intervention methods have yet to be identified (Grindle et al., 2017).

In this study, "*Cekap Menulis*" intervention is specially designed to improve the handwriting of autistic students. It is the combination of Brain Gym and The Size Matter Handwriting Program concepts that underlies Vygotsky's sociocultural learning theory (1978). Through simple coordination movement, Brain Gym can complete the transmission of information in the brain and thus optimize learning capabilities. Bilateral skill activities such as Cross Crawl, for example, can evenly activate both hemispheres of the brain. The activity involves movement on both sides of the body, which necessitates coordination of eye, ear, hand, leg, and even head movements. Cognitive can be improved to smoothen the learning process when both sides of the hemisphere and the four main areas of the brain (lobes) are stimulated. As a result, it's useful in improving handwriting skills along with legibility, writing lower case letters on red and blue-line paper, and justifying space between alphabet and word (Ocampo et al., 2017). The Size Matter Handwriting Program Intervention comprises explicit teaching, correction, self-assessment, verbal feedback, and visual motivation (Pfeiffer et al., 2015). Furthermore, The Size Matter Handwriting Program Intervention supports the development of handwriting skills sequentially, beginning with exact alphabet construction, line positioning of alphabet writing, and a clear sense of the alphabet. It suggests the teachers motivate their students by incorporating

engaging learning activities and rigorous objectives in their lessons according to the need of the students, as well as modifying their teaching methods based on the students' achievements. The " *Cekap Menulis* ", which combines the Brain Gym intervention with the Size Matter Handwriting Program, must be supported by Vygotsky's sociocultural learning theory because these two interventions are not specifically designed for autistic students.Given that the process of handwriting plays an important role in the activation of working memory, increasing the attention span, self-regulation, and clarity in the thought process of the (hand) writer (Karavanidou, 2017), and motor visual skills are basic features of early learning of writing skills that need to be mastered (Suhaimi, 2019) to help autistic students write clearly and fluently (Salameh-Matar et al., 2016), it is critical to provide information on the impact of "*Cekap Menulis"* handwriting intervention on their development of visual–motor skills.

RESEARCH OBJECTIVE

This study sought to identify the effect of the "*Cekap Menulis"* handwriting intervention in autistic students' visual–motor skills aged 12 years old and above in an intervention center.

LITERATURE REVIEW

Handwriting is taught primarily through copying letters and words (Maldarelli et al., 2015). Copying letters and symbols are thought to engage higher executive functions of the brain involved in the processes of self-regulation, attention, impulse control, and working memory (McClelland & Cameron, 2012). Many studies show that the use of tracing and copying can facilitate learning of handwriting to help autistic students to learn the correct form, size, alignment, and spacing of letters. Researchers such as Carlson et al. (2009), Cosby et al. (2009), Thompson et al. (2012), and LeBrun et al. (2012) have proven the efficacy of using the letter tracing procedure under the "Handwriting Without Tears" program to help train individual autistic students to improve the spatial aspects of their handwritten content, which in turn led to an improvement in the legibility of their handwriting. Meanwhile, Batchelder et al. (2009) proved the efficacy of using a dot-to-dot tracing procedure for teaching handwriting to children. This technique was used to teach a 14-year-old autistic student how to write one's own name. The participant was presented with three worksheets, each consisting of four lines and five dotted letters printed on the worksheet. The participant was asked to trace the letter by connecting the dots. The exercise improved the participant's ability to write his name from 60% to 100%. Moreover, the overall legibility of all the letters improved. This shows that tracing training is effective in improving the quality of autistic students' handwriting.

Meanwhile, the combination of fading prompts with the tracing procedure also has proven effective in improving the ability of autistic students to write legibly (Smith et al., 2013). The prompts given to the participants faded gradually from one phase to another. For instance, the participants were asked to trace a letter written using thick solid lines in the first phase, whereas, in the later phases, the participants were asked to connect dots to form a particular letter. Finally, the participants were presented with a blank sheet of paper and were asked to write a letter.

Explicit instructions given to children have also proven to be powerful for autistic students to properly construct words (Sugasawara & Yamamoto, 2007). For example, Case-Smith et al. (2011) have developed an integrated handwriting program for first-grade students. The program involved a co-teaching model in which the occupational therapist and teacher collaborate to provide individualized training on handwriting. As a part of the training, consistent verbal cues (for letter formation) were given to the participants. After that, the participants were given feedback regarding how the errors can be corrected along with praise for the efforts being put in by the participants. The participant's handwriting improved after the training. Given that the techniques suggested for improving the handwriting skills of autistic students include caregiver-, peer-, and therapist-mediated strategies, and those techniques relied on an individual's ability to follow the instructions of the intervention, "*Cekap Menulis"* combined the Brain Gym and the Size Matters Handwriting Program (SMHP) based on Vygotsky's Theory. Brain Gym can improve cognitive function through simple coordination movement, while SMHP is a handwriting intervention, developed by an occupational therapist, which is

effective in improving students' handwriting in terms of neatness. "*Cekap Menulis"* began with Brain Gym, warm-up activities that consist of visual–motor skills activities that lasted approximately 20 minutes before moving on to guided lowercase letter handwriting practice with visual cues and verbal feedback provided. The *Cekap Menulis* intervention utilizes Vygotsky's (1978) learning theory to help autistic students with handwriting problems attain mastered handwriting skills. According to Vygotsky (1978), cognitive development is a process that relies entirely on the social interaction of the environment that helps a student relate existing knowledge to new knowledge. This phenomenon is known as the zone of proximal development. This zone aims to help children reach a level of cognitive development from a social level to a personal level. To achieve the zone of proximal development, scaffolding should be provided so that students are able to self-assess and master a skill without assistance. Principles of scaffolding include student-centered teaching, motivation to increase interest in learning, and focusing on the understanding or evaluation of a skill to be achieved.

As shown by Vygotsky (1978) as expressed in Suardipa (2020), learning occurs as a result of student interaction with the environment with the condition that scaffolding must be provided in full in the initial stage and then gradually decrease when the student can do a task without depending on the teacher. With that, teachers need to provide scaffolding through various types of teaching strategies accompanied by help and guidance of different levels according to the current situation for enabling students to master a skill (Dastpak et al., 2017). However, difficulty mastering handwriting skills is caused by problems internally, autistic students have poor motor skills and poor memory which is compounded by the external problem of lack of information and knowledge teachers and parents have caused autistic students with handwriting problems didn't get proper scaffolding. Since there are recent studies that shows that autistic students need to be given scaffolding to help them master a skill on their own, the scaffolding must take into account the student's current situation to determine the objective teaching based on student potential (Austin & Peña, 2017). Vygotsky's (1978) learning theory is suitable as a support for the "Cekap Menulis" intervention because scaffolding can help autistic students improve their learning ability and then strengthen their memory according to their current progress. This study aims at answering the following research question:

i. To what extent is the "*Cekap Menulis*" intervention effect on visual-motor skills of autistic students with handwriting difficulties?

METHODOLOGY

This case study consists of three phases. Pre-tests are conducted in the first phase. The "Cekap Menulis" intervention is implemented in the second phase. In the second phase, quantitative data was collected through an informal assessment of students' visual motor skills. Qualitative data were collected through interviews with special education teachers who played the role of treatment providers regarding all changes in students' visual motor skills during the "Cekap Menulis" intervention teaching session. Finally, the post-test is conducted in the third phase. Through this case study, the researcher have the opportunity to make a clear explanation starting from the handwriting problem identified in the first phase, changes in visual motor skills which was identified during the implementation of the "*Cekap Menulis*" intervention in the second phase, and retention of students' handwriting skills in the third phase. The independent variable of this study was the "*Cekap Menulis"* intervention. The *Cekap Menulis* intervention serves as the primary teaching method in helping autistic students with handwriting problems write lowercase letters legibly on four-line books through cognitive training and the assistance of environmental agents. The main learning activities of *Cekap Menulis* include visual–motor activities and continuous guided handwriting training through visual cue, verbal feedback, and hand-over-hand handwriting practice. The dependent variable of this study was the visual–motor skills of autistic students with handwriting difficulties.

Samples

The sample target population for this study consisted of autistic students aged 12 years and above. Autistic students with intellectual disabilities were excluded from this study. The sampling method was used because only the most suitable sample for this study was selected. The selection of the sample of this study was conducted through screening of students based on the sampling criteria set. Pupils 12 years and older were deliberately selected because the researcher wanted to evaluate the intervention with pupils who had not yet mastered handwriting skills even though they had undergone remedial instruction during primary school. The second criterion is that they must be able to respond to the teacher when their name is called. The third criterion is that they must have similarities in socio-economic terms and live in a district that is close to the intervention center. A checklist adopted from Mehta (2021) was used to identify autistic students with handwriting problems. Additional information about each sample is as follows:

Sample	A	B	C
Age	15	13	16
Gender	Female	Male	Male
Functional level	1	1	1
IQ severity	MODERATE	MODERATE	MODERATE
Degree of autism	MILD	MILD	MILD
Routines	Can handle change but prefer routines	Can handle change but prefer routines	Can handle change but prefer routines
Physical signs	Problems with coordination Wake up in the middle of the night	Sensitive to textures Problems with coordination	Sensitive to sounds Problems with coordination
Interaction with superior	Listens to superior, accepts correction, follows superior directions.	Interact with superior with minimal support	Listens to superior, accepts correction, follows superior directions.
Treatment	Educational and school-based therapies	Educational and school-based therapies	Educational and school-based therapies
Medication	-	Antipsychotics	Antipsychotics

INSTRUMENTATION

In this study, a Visual-Motor Skills Assessment instrument validated by five special education experts was used to assess the visual change in students' motor skills over the course of treatment. It is based on Suhaimi's

(2019) Visual Skills Assessment Instrument. The instrument is made up of five aspects: visual skills, bilateral coordination skills, gross motor skills, fine motor skills, and hand-eye coordination skills. Each of these aspects has at least one item to be evaluated. Scores were calculated using a scale based on the criteria specified on the instrument's scale. The total score was calculated by dividing the number of obtained scores by the maximum score and multiplying by 100. Tracking the laser light movement moving from left to right, from left to right then to the lower left and right, clockwise and anticlockwise, and lazy 8 tracing are the five items assessed for the visual skills component. Cross crawl in a standing motion 20 times is one item rated for bilateral coordination skills. Netting the ball ten times, bouncing the ball while walking forward within two meters, and bouncing the ball while walking to the right 2 yards were three items assessed for gross motor skill. The five components of the skills must be included in the visual–motor skills assessment instrument because they are all crucial components of mastery of handwriting skills (Case-Smith & Schneck, 2015). Two fine motor skills items were assessed: grasping five marbles in hand and inserting them one by one into the mineral bottle and grasping ten buttons and inserting them one by one into the 4 in a Row game shelf. For the aspect of hand-eye coordination skills, three items were evaluated. Part A assessed students' ability to copy various types of lines, Part B assessed students' ability to copy geometric shapes, and Part C assessed students' ability to copy a combination of geometric shapes. The Visual–Motor Skills Assessment Instrument generates scores based on the criteria specified in the scale space.

PROCEDURE

This study was conducted in an intervention center located in Bandar Seberang Perai Tengah, Penang. The intervention center was selected because it is located in the same area as the researcher. This can facilitate the researcher to conduct a study over the movement control order period. This study was divided into three phases over eight weeks total. Phase one lasted one week, phase two lasted six weeks, and phase three lasted one week. Each treatment session lasted approximately 1 h 40 min, including a twenty-minute break. The teacher chosen to collect data during the review period is an experienced special education teacher with 25 years of experience teaching in special education. The first phase assessment conducted in the first week aimed to determine the student's handwriting problems before treatment was given. In the second phase, the informal assessment was conducted repeatedly until the student's results were stable on a weekly basis. In the third phase, which is the retention phase, no treatment is given. The tentative schedule during the intervention period appears in Table 1.

Table 1: Tentative Intervention Schedule

Week/ lowercase letters	Warm-up activities	Main activities
1 c, o, a, g, d	1. PACE (The Brain Buttons, Drink Water, Cross Crawl and Hook Up) (4 minutes). 2. Visual training (track laser light points with eyes without moving head) (1 minute). 3. Patting drums and moving the body according to music beat (10 minutes).	1. Net the ball (10 times) (25 minutes). 2. Trace lazy 8 between two horizontal lines printed on laminated A4 paper (5 minutes). 3. Lowercase letters handwriting guidance using Alphabet 8S (30cm x 21cm) (10 minutes) . 4. Lowercase letters practice on the laminated four-lined paper printed with Alphabet 8S (10 minutes).

		5. Handwriting practice on the four-lined paper (10 minutes). 6. Write learned letters in the air and spell syllables beginning with letters written (5 minutes).
2 q, e, s, f, i	1. PACE (The Brain Buttons, Drink Water, Cross Crawl, and Hook Up) (4 minutes). 2. Visual training (Track the movement of a ping pong ball from left to right and from top to bottom [1 minute]). 3. Jump over small rattan loops and insert bean bag into a small cup (10 minutes).	1. Bounce the ball (15 minutes). 2.Bounce the ball while walking (10 minutes). 3. Trace lazy 8 between two horizontal lines printed on laminated A4 paper (5 minutes). 4. Lowercase letters handwriting guidance using Alphabet 8S (30cm x 21cm) (10 minutes). 5. Lowercase letters practice on the laminated four-lined paper printed with Alphabet 8S (1.5 cm between each line) (10 minutes). 6. Handwriting practice on the four-lined paper (10 minutes). 7. Write learned letters in the air and spell syllables beginning with letters written (5 minutes).
3 j, l, t, b, k	1. PACE (The Brain Buttons, Drink Water, Cross Crawl and Hook Up) (4 minutes). 2. Visual training (Track the movement of the ring finger stretched forward without moving the head [1 minute]). 3. Insert the beads into the egg rack by holding a marble in the same hand (10 minutes).	1. Insert flat buttons into the 4 In A Row game rack (25 minutes). 2. Trace lazy 8 between two horizontal lines printed on laminated A4 paper (5 minutes). 3. Lowercase letters handwriting guidance using Alphabet 8S (30cm x 21cm) (10 minutes). 4. Lowercase letters practice on the laminated four-lined paper printed with Alphabet 8S (1.5 cm between each line) (10 minutes). 5. Handwriting practice on the four-lined paper (10 minutes).

		6. Write learned letters in the air and spell syllables beginning with letters written (5 minutes).
4 h, m, n, r, p	1. PACE (The Brain Buttons, Drink Water, Cross Crawl, an Hook Up) (4 minutes). 2. Visual training (Track the movement of the ring finger stretched forward without moving the head [1 minute]). 3. Insert the beads into the egg rack by holding a marble in the same hand (10 minutes).	1. Insert the marble into a bottle of mineral water (25 minutes). 2. Trace lazy 8 between two horizontal lines printed on laminated A4 paper (5 minutes). 3. Lowercase letters handwriting guidance using Alphabet 8S (30cm x 21cm) (10 minutes). 4. Lowercase letters practice on the laminated four-lined paper printed with Alphabet 8S (1.5 cm between each line) (10 minutes). 5. Handwriting practice on the four-lined paper (10 minutes). 6. Write learned letters in the air and spell syllables beginning with letters written (5 minutes).
5 u, y, v, w, x	1. PACE (The Brain Buttons, Drink Water, Cross Crawl, and Hook Up) (4 minutes). 2. Visual training (Trace the point of the flashing laser light with the eyes without moving the head [1 minute]). 3. Bounce the ball along the lanes in different directions and net the ball (5 minutes). 4. Grip 10 buttons in hand and insert them into the 4 In A Row game rack with the same hand (25 minutes).	1. Copying various types of lines and geometric shapes (10 minutes). 2. Trace lazy 8 between two horizontal lines printed on laminated A4 paper (5 minutes). 3. Lowercase letters handwriting guidance using Alphabet 8S (30cm x 21cm) (10 minutes). 4. Lowercase letters practice on the laminated four-lined paper printed with Alphabet 8S (1.5 cm between each line) (5 minutes). 5. Handwriting practice on the four-lined paper (10 minutes). 6. Write learned letters in the air and spell syllables beginning with letters written (5 minutes).

6 a to z revision	1. PACE (The Brain Buttons, Drink Water, Cross Crawl, and Hook Up) (4 minutes). 2. Visual training (Track the movement of the flashlight without moving the head [1 minute]). 3. Crawl on a mattress, then form letters with dough (20 minutes).	1. Form Lazy 8 between two horizontal lines (5 minutes). 2. Lowercase letters handwriting guidance using Alphabet 8S (15 minutes). 3. Lowercase letters practice on the laminated four-lined paper printed with Alphabet 8S (30cm x 21cm) (15 minutes). 4. Handwriting practice on the four-lined paper (1.5 cm between each line) (15 minutes). 5. Write learned letters in the air and spell syllables beginning with letters written (5 minutes).

There were 30 treatment sessions, five days a week over six weeks. Each session consisted of four slots, which take 80 minutes including a 20-minute break. The total time for the motor visual skills training sessions during the "*Cekap Menulis"* intervention period took 230 minutes per week at the intervention center, and 230 minutes per week at the students' homes. The informal assessment was carried out daily based on the respondent's visual–motor skills. Each intervention session began with a Brain Gym exercise (basic visual–motor coordination movement or activity) followed by a repetition exercise of the motions demonstrated by the teacher to engage the students' attention to observe the teacher's demonstration. Guidance was offered through visual cues and instructional aids such as Alphabet 8s to raise their attention and strengthen their memory on how to form lowercase letters in the correct sequence. Following that, reinforcement exercises such as reading sentences based on pictures were conducted to help students remember the lowercase letter formation they learned. Finally, feedback and encouragement, such as praise and stars given before, during, and after each session, served to reduce errors made by the respondents and reinforce their encouraged movement (handwriting sequence). Throughout the process, the researcher kept track of the progress made by all three samples. The effect of the "*Cekap Menulis"* handwriting intervention on the visual–motor skills of autistic students was determined through repeated measurement with a visual–motor skills instrument.

DATA ANALYSIS

The quantitative data collected via the Visual Motor Skills Assessment instrument was recorded in a table and translated into a line graph for analysis by using descriptive analysis methods. The interview data collected was analyzed manually using thematic analysis methods.

FINDINGS

The study revealed that all three respondents experienced a significant improvement in visual–motor skills after receiving the "*Cekap Menulis"* handwriting intervention. The main reason no progress was shown in the early stage of the intervention was that they were not yet familiar with the changes in the activities given.

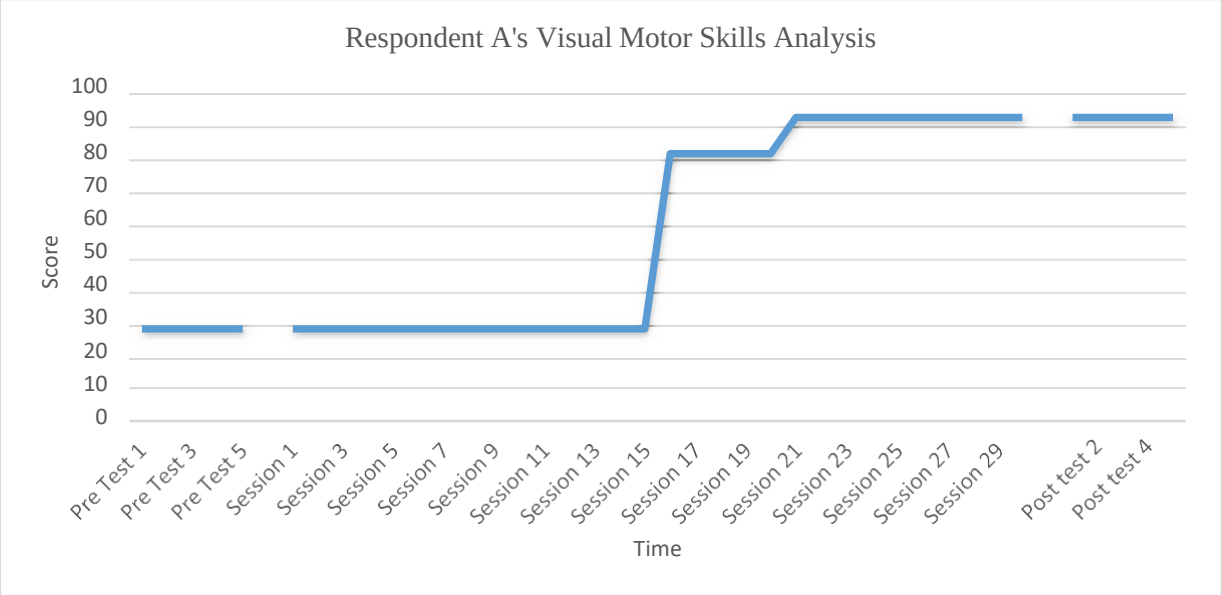

Figure 1: Respondent A's Visual–Motor Skills Analysis

The total increase obtained by Respondent A from the first session to the fifteenth session was 29%. Before receiving the intervention, Respondent A could only insert ten gripped marbles in the palm of his hand and insert them one by one into the mineral bottle with the same hand and bounce the ball five times while walking forward in a straight line. During the "*Cekap Menulis"* intervention, Respondent A showed low progress in performing motor visual skills activities involving visual focus, bilateral coordination, motor visual coordination, and gross and fine motor skills. After receiving the *Cekap Menulis* intervention for three weeks, Respondent A's motor visual skills results increased by 53% to 82%. This student received extra guidance in terms of oral instructions and verbal feedback were given due to no improvement shown at the early stage. At the 21st treatment session, Respondent A's results increased 11% further, reaching 93% with the help of continuous guidance given. The improvement of such motor visual skills is the result of additional verbal feedback in addition to ongoing guidance and practice. This can be detected through the following interview data:

Respondent A needs constant training and guidance at home and she will repeat her mistakes if not given a lot of verbal instruction in the beginning.

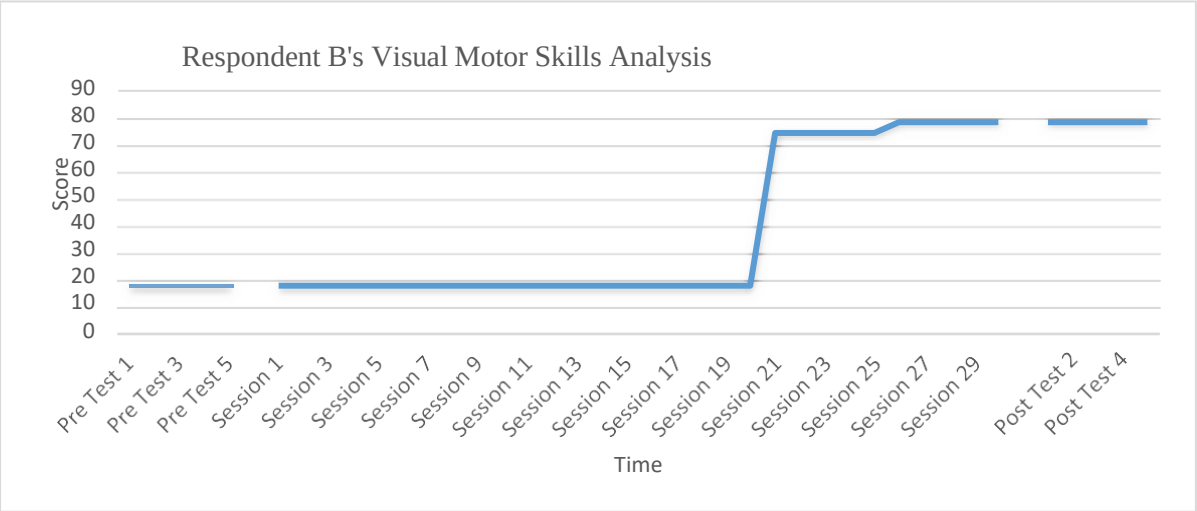

Figure 2: Respondent B's Visual–Motor Skills Analysis

At the beginning of the treatment period, Respondent B's visual–motor skills were at a very low level of only 18%. This is because prior to the intervention, his movements were stiff due to a deficit of motor skills. Respondent B was only able to copy part of the lines and geometric shapes correctly. During the *Cekap Menulis* intervention, Respondent B began to show progress in terms of gross and fine motor skills, although there were still stops shown while carrying out activities that required bilateral coordination. In addition, Respondent B was also able to copy all types of lines and geometric shapes correctly when an extra amount of physical guidance held by hand was given. After undergoing training for four weeks, Respondent B's visual–motor skills score increased by 57% to 75% because an extra amount of hand-over-hand guidance was given continuously. At the 26th treatment session, Respondent B's visual–motor skills increased another 4% to 79% with the help of continuous guidance given. Respondent B was able to perform all motor visual skills activities independently. He was also able to bounce the ball while walking forward and also to the right in a straight line two yards apart without guidance. The improvement is the result of ongoing additional physical guidance in addition to visual guidance, feedback, and motivation from teachers and his family members. Based on the interview data, the Special Education teacher found that Wei Wei's visual motor skills increased at a slow rate. Wei Wei needs more physical guidance to improve his visual motor skills. This can be detected through the following interview data:

Respondent B *needs physical guidance during the practice of scoring and bouncing the ball.*

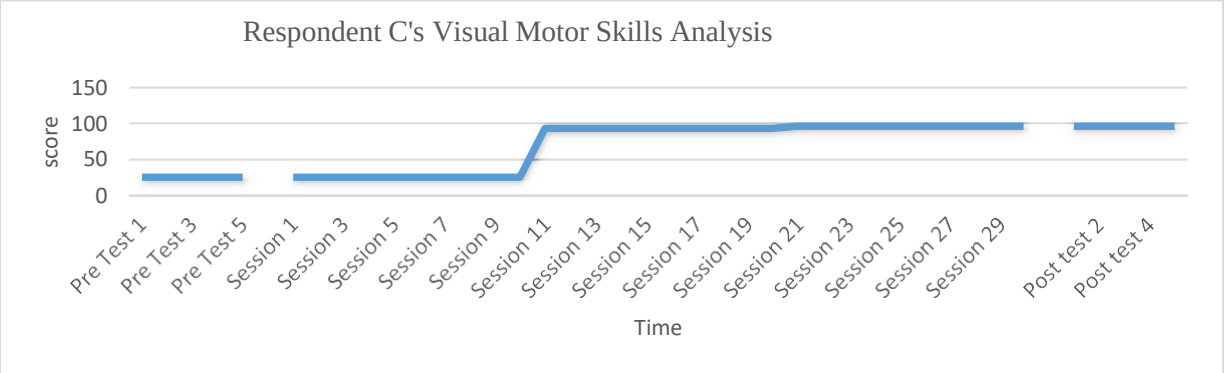

Figure 3: Respondent C's Visual–Motor Skills Analysis

In the early stages of the treatment period, Respondent C's visual–motor skills were at 25%. This is because prior to the intervention, Respondent C was only able to bounce the ball five times while walking forward in a straight line two yards apart and copy part of the straight line correctly. During the "*Cekap Menulis"* intervention, Respondent C was able to copy all types of lines and geometric shapes including combinations of geometric shapes correctly when visual guidance and verbal feedback were given. Although Respondent C did not like to be held, he still showed determination to try again and started to show improvement in all activities after praise and tracing dot-to-dot geometric shapes. The combination of geometric shapes was given each time after he was able to carry out the dot-to-dot completely. At the 11th treatment session, Respondent C's visual–motor skills had increased by 68% to 93%. It is because more praises were given in addition to tracing practice. After receiving 20 sessions of the "*Cekap Menulis"* intervention, motor visual skills increased another 3% to 96% with the help of continuous guidance. Respondent C successfully performed all activities including the fine motor skills activities that were most difficult for him in the early stages of the intervention. The special education teacher found that Respondent C's visual–motor skills increased at a rapid rate after Respondent C was given praise. The findings of this study suggest that guidance and training should be provided continuously to improve motor visual skills. The rate of improvement of motor visual skills of the three respondents differed because the level of motor development of each respondent was different. The type of extra guidance that was needed varied according to the level of motor development of each respondent.

DISCUSSION

The findings of the study showed that "*Cekap Menulis"* was effective in the visual–motor skills of autistic students with handwriting problems. This is because visual–motor skills activities that include components of gross motor skills, visual focus, fine motor skills, bilateral coordination skills, and hand-eye coordination skills allowed all three respondents to perform the visual and motor coordination required for writing. The findings of the study support Tseng and Chow (2000), who suggested that students with handwriting problems and writing slowly need interventions that combine a focus on motor visual skills and memory (involvement of cognitive functions such as writing exercises). In addition, all respondents were also able to recall techniques for undergoing all components of the skills assessed. The "*Cekap Menulis"* intervention proved that motor visual skills training was effective not only in the coordination of visual and motor skills but also in the memory of autistic students with handwriting problems. This finding is in line with Suardipa (2020) who stated that learning occurs as a result of student interaction with the environment with the condition that scaffolding must be provided in full on the initial stage and then gradually decrease when the student can do a task without depending on the teacher. This means that Vygotsky's Theory, which is employed as the core of the "*Cekap Menulis"* teaching, is well-suited to autistic students with memory and motor skills deficiencies, which in turn suggests that environmental agents and cognitive training are just as crucial in assisting autistic students with handwriting difficulties in improving their visual-motor skills. The provision of appropriate scaffolding was made possible by parents' cooperation throughout the intervention period. Their capacity to concentrate during the process of mimicking the teacher's actions improved as a result of the continuous visual–motor and guided handwriting training. Hence, these results may call for an integrated approach in the clinical application that considers both a bottom-up approach focused on improving memory and the more common top-down approaches to improve handwriting quality. Finally, the findings of this study shed new light on efforts to diversify methods of teaching handwriting skills to solve the problem of autistic students having difficulty with the skill. However, this intervention is not recommended for full visual-motor intervention purposes as the sample of this study only involved autistic students with handwriting difficulties. Since this study's findings not only provide the reader with a clear picture of the teaching method of the "*Cekap Menulis"* intervention but also demonstrate that autistic students' visual–motor skills should be prioritized to help those autistic students with handwriting difficulties optimize handwriting learning ability, researchers can turn to "*Cekap Menulis"* to delve deeper into this field. Teaching and learning activities based on the needs of autistic students with handwriting difficulties and based on the concepts of SMHP and Brain Gym not only allow respondents to engage in active mental training activities required for handwriting but can also address their motor skills impairments. Through the "*Cekap Menulis"* intervention, teachers and parents are expected to teach with confidence by referring to the "*Cekap Menulis"* intervention as a guideline. Students with autism no longer

need to be plagued by handwriting problems that interfere with the learning process. Overall, the findings of this study are in line with the findings of the literature review that the assistance of environmental agents and cognitive training can improve the effectiveness of handwriting interventions.

CONCLUSION AND RECOMMENDATION

This study demonstrated that "*Cekap Menulis"* can improve the visual–motor skills of autistic students through explicit teaching methods that emphasize both visual–motor skills and guided handwriting training. Involving autistic students in these cognitive training activities can assist them in remembering how to write lowercase letters in the proper order. This proves that both cognitive training and environmental agents play an important role in helping autistic students improve their visual-motor skills.

LIMITATION

This study was limited to autistic students with handwriting problems at an intervention center in Seberang Perai, Penang only. Therefore, it is proposed that further research be conducted in every state in Malaysia. In terms of sample size, this study was limited to a small number of samples using a case study. It is suggested that this study could involve a larger total number of autistic students with different research methods. Also, future researchers should expand the aspects of the study to evaluate the effect of the intervention on writing behavior and speed. Since this study only focused on lowercase letter legibility, future studies should focus on number writing skills.

ACKNOWLEDGMENTS

The authors thank Associate Professor Dr. Aznan Che Ahmad, Associate Professor Dr. Low Hui Min, Ts Dr. Rozniza Zaharudin, Dr. Lee Lay Wah, Tan Bee Seim, Ng Ai Tiang, and Siti Aminah Ishak for completing this study.

DECLARATION OF CONFLICTING INTERESTS

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

FUNDING

The authors received no financial support for the research, authorship, and/or publication of this article.

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