



Faculty of Cognitive Sciences and Human Development

**ATTENTION & MEMORY MAKEOVER: UNVEILING THE POWER
OF DIGITALART IN PRESCHOOL**

Raja Nur Batriesya Binti Raja Zairul Hafizam

Bachelor in Psychology (Honours)

2022

**ATTENTION & MEMORY MAKEOVER: UNVEILING THE POWER OF
DIGITAL ART IN PRESCHOOL**

RAJA NUR BATRIESYA BINTI RAJA ZAIRUL HAFIZAM

This project is submitted
in partial fulfilment of the requirements for a
Bachelor of Psychology with Honours

Faculty of Cognitive Sciences and Human Development
UNIVERSITI MALAYSIA SARAWAK
(2022)

The project entitled '**Attention & Memory Makeover: Unveiling The Power Of Digital Art In Preschool**' was prepared by **Raja Nur Batriesya Binti Raja Zairul Hafizam (81020)** and submitted to the Faculty of Cognitive Sciences and Human Development in partial fulfillment of the requirements for a Bachelor of Psychology with Honours

Received for examination by:



(Name of Supervisor)

Date:

8/8/2024

Gred

A-

ACKNOWLEDGEMENT

In the name of Allah, the Most Gracious, the Most Merciful. Blessings and peace be upon the Prophet Muhammad, peace and blessings be upon him. First and foremost, I would like to express my deepest gratitude to my family, the foundation of my life: my father, Mr. Raja Zairul Hafizam, for his unwavering support and guidance; my mother, Mrs. Mostyna Bee binti Mohd Jalil, for her constant encouragement and love; and my brother, Raja Muhammad Firdaus, for being a source of joy and a reminder of the importance of family. Be my strongest supporters and always catch me when I fall. My sincerest appreciation also goes to Madam Ross Azura, whose guidance and help were invaluable throughout this study. Without her help not only physically but mentally support has helped me go through the journey to finish the study. I am incredibly grateful to my friends, Hasnatie, Azra, Amanda, Aesha, Wani, Ain, Ainaa, Syahirah, Iqbal, and Syed. They were my comrades-in-arms, sharing not only the difficulties but also the joys of this journey. I cannot go through this journey if they are not with me. A special thank you to Izzati, Farah, and Pasihah, who have been by my side through thick and thin, offering unwavering support and encouragement throughout this entire experience. They always show their love and support to me especially when I am in a down state and with happy laugh and cry together make stronger to go through this journey. For my senior Amni, thank you for being there to help me and always giving helpful tips and guidelines to do the research. Without her help, I might be stuck finishing the research. Lastly my groupmates, Safwah, Ina, and Solehah, always give their help physically and emotionally to me. They are the kindest friends that I have and cause of them I can go through the journey smoothly.

LIST OF TABLES

Table 3.1.1	Summary of Technique Analysis	29
Table 4.1.1 (a)	Frequency and Percentage of Participants' Gender	30
Table 4.2.1(a)	Table of Mean and Standard Deviation.	31
Table 4.2.1(b)	Table of Independent Samples Test	31
Table 4.2.2 (a)	Table of Mean and Standard Deviation	32
Table 4.2.2 (b)	Table of Independent Sample Test	32
Table 4.2.3 (a)	Table of Paired Sample Statistics	33
Table 4.2.3 (b)	Table of Paired Sample Test	33
Table 4.2.4 (a)	Table of Paired Sample Statistics	34
Table 4.2.4 (b)	Table of Paired Sample Test	34
Table 4.2.5(a)	Table of Group Statistics	35
Table 4.2.5 (b)	Table of Independent Samples Test.	35
Table 4.3	Summary Table of Finding	40

LIST OF FIGURES

Figure 1	Research Framework Investigate The Digital Art Impact on Attention and Working Memory	9
Figure 2.2	Example of computerized version Stroop Test	24
Figure 3.2	Flowchart for procedure	26

ABSTRACT

This study aimed to understand the impact of digital art toward attention and working memory kindergarten student. The digital age has ushered in a new era of artistic expression, with digital art becoming increasingly prevalent. While the impact of technology on education is a topic of ongoing investigation, the potential benefits of digital art in learning environments compared to traditional physical art remain underexplored. This study aimed to examine whether exposure to digital art influences attention and working memory in kindergarten children. Utilizing an experimental design, the research involved 20 kindergarteners who participated in tasks designed to assess their attention and working memory after exposure to either digital or physical art. The findings of the study revealed no significant difference in attention or working memory performance between the groups exposed to digital and physical art. These results contribute to the ongoing dialogue regarding the integration of digital art into educational settings. While digital art may not directly enhance attention and working memory in kindergarteners, further research is needed to explore its potential impact on other cognitive processes and learning outcomes. This study serves as a valuable starting point for future investigations and provides insights for educators and parents as they navigate the evolving landscape of educational methods and technologies for young children

ABSTRAK

Kajian ini bertujuan untuk memahami kesan seni digital terhadap tumpuan dan ingatan kerja kanak-kanak tadika. Era digital telah membawa kepada era baharu ekspresi artistik, dengan seni digital menjadi semakin berleluasa. Walaupun kesan teknologi terhadap pendidikan adalah topik kajian yang masih dikaji, potensi manfaat seni digital dalam persekitaran pembelajaran berbanding seni fizikal tradisional masih kurang diterokai. Kajian ini bertujuan untuk mengkaji sama ada pendedahan kepada seni digital mempengaruhi tumpuan dan ingatan bekerja di kalangan kanak-kanak tadika. Menggunakan reka bentuk eksperimen, penyelidikan melibatkan 20 tadika yang mengambil bahagian dalam tugas yang direka untuk menilai tujuan dan ingatan kerja mereka selepas terdedah kepada seni digital atau fizikal. Dapatan kajian menunjukkan tiada perbezaan yang signifikan dalam perhatian atau prestasi memori kerja antara kumpulan yang terdedah kepada seni digital dan fizikal. Keputusan ini menyumbang kepada topik berterusan mengenai integrasi seni digital ke dalam tetapan pendidikan. Walaupun seni digital mungkin tidak secara langsung meningkatkan perhatian dan ingatan bekerja di tadika, penyelidikan lanjut diperlukan untuk meneroka potensi kesannya terhadap proses kognitif dan hasil pembelajaran yang lain. Kajian ini berfungsi sebagai titik permulaan yang berharga untuk penyiasatan masa depan dan memberikan pandangan untuk pendidik dan ibu bapa semasa mereka menavigasi landskap kaedah dan teknologi pendidikan yang berkembang untuk kanak-kanak kecil.

Kata kunci: Seni Digital, Tumpuan, Memori Kerja, Kanak-kanak Tadika, Teknologi Pendidikan

TABLE OF CONTENT

ACKNOWLEDGEMENT.....	1
LIST OF TABLES	i
LIST OF FIGURES.....	ii
ABSTRACT.....	iii
ABSTRAK	iv
CHAPTER ONE.....	4
INTRODUCTION.....	4
1.0 Introduction	4
1.1 Background of Study	4
1.2 Problem Statement.....	8
1.3 Research Objectives.....	9
1.3.1 General Objective	9
1.3.2 Specific Objectives	9
1.4 Research Questions.....	10
1.5 Research Hypotheses	10
1.6 Conceptual Framework.....	11
1.7 Significance of Study.....	11
1.8 Definition of Terms	12
1.8.1 Digital Art.....	12
1.8.2 Art-Based Learning.....	12
1.8.3 Attention	12
1.8.4 Working Memory	12
1.9 Limitation of study	13
CHAPTER 2.....	14
LITERATURE REVIEW.....	14
2.0 Introduction	14
2.1 Digital Art-Based Learning.....	14
2.2 Attention	15
2.4 Working memory	16

2.5 Attention span and working memory's reaction time between genders	17
2.6 Previous Finding.....	18
2.6.1 Art-based learning and attention	18
2.6.2 Art-based learning and working memory	18
CHAPTER 3.....	20
METHODOLOGY	20
3.0 Introduction	20
3.1 Research Design	20
3.2 Population, and Sample	21
3.3 Instruments	21
3.3.1 Stroop Test	21
3.3.2 Coglab.....	23
3.4 Procedures and Data Collection.....	23
3.5 Pilot Study	25
3.6 Data Analysis Procedures	25
3.6.1 Descriptive Data Analysis	25
3.6.2 Inferential Data Analysis	25
3.6.2.1 Independent sample T-test.....	25
3.6.2.2 Paired Sample T-Test.....	26
3.7 Summary	27
CHAPTER FOUR	28
FINDINGS AND DISCUSSION	28
4.0 Introduction	28
4.1 Demographic Data	28
4.1.1 Gender of Participants.....	28
4.2 Main Findings.....	29
4.2.1 To compare attention span between the physical and digital art groups.....	29
4.2.2 Working Memory among the physical art and digital art group	30
4.2.3 Effectiveness of digital art-based learning toward attention span and working memory among preschool students	31
4.2.4 Effectiveness of physical art-based learning toward attention span and working memory among preschool students	32
4.2.5 compare the attention span and working memory's reaction time between genders.	33
4.3 Discussion.....	35

4.3.1 Attention span and working memory among the digital art group and physical art groups	35
4.3.2 Effectiveness of digital art-based learning toward attention span and working memory among preschool students	36
4.3.3 Effectiveness of physical art-based learning toward attention span and working memory among preschool students	38
4.3.4 compare the attention span and working memory's reaction time between genders.	39
CHAPTER FIVE	41
LIMITATION, IMPLICATION, RECOMMENDATION	41
5.0 Introduction	41
5.1 Limitation of Study	41
5.2 Implications of Study	42
5.3 Recommendations.....	43
REFERENCE	45
APPENDIX A	52
APPENDIX B	53

CHAPTER ONE

INTRODUCTION

1.0 Introduction

Early childhood is the time when self-awareness and socialization start to take shape. The preschooler learns that there is a world outside of his own small home and family and wants to participate in its exploration and transformation (Ferenç & Turda, 2021). As a result, the youngster grows to understand that he is a multifaceted individual. Therefore, activities that can help with their cognitive development are important to sharpen their learning and understanding. Since the 20th century, technology has become one of the important things in human life and become a basic need to communicate, doing work and complete the task given.

1.1 Background of Study

Traditionally, art is used in education to spark interest and attention in students. It actively engages various aspects of learning, including cognitive, emotional, visual, and physical processes (Christensen & Gomila, 2018). However, identifying engaging and effective teaching methods for preschoolers remains a challenge (Gaitas & Alves Martins, 2016). Here, art-based learning (ABL) emerges as a promising solution. Participation in the arts not only provides a unique learning experience, but also empowers young learners to achieve greater levels of success (Banisudha, n.d.). Although frequently employed in therapeutic settings (Moula, 2020), ABL has broader potential, offering an alternative method to infuse effective teaching behaviors across different areas of learning.

More than just fun and playful, art activities like drawing, painting, and sculpting offer therapeutic benefits for children. Studies by Liu (2020) and Cetin & Danacı (2015) highlight the effectiveness of art appreciation in boosting children's language expression, emotional

exploration, and communication skills. Art provides a safe space for them to express emotions, interact with others, and overcome anxieties. Furthermore, research shows that incorporating art education in preschools (ages 4-5) positively impacts cognitive and psychosocial development, improving their selective attention skills. This suggests that art isn't just a creative outlet, but a powerful tool for nurturing young minds and emotions.

Spanning ages 3-6, early childhood is a critical time for rapid cognitive and psychosocial development. Malaysian preschools address this, fostering physical, cognitive, and social growth. Based on Piaget's theory, these young minds grasp object relations, cause & effect, identity, and basic categorization, alongside numbers. They even demonstrate attention, memory, language, and sensory/working memory skills like recognition and recall. Working memory, believed to be foundational for various cognitive controls, is seen as a key to unlocking other aspects of human cognition like perception and emotion (Chai et al., 2018).

Researchers dove into a group of mental processes called "executive function" (EF), encompassing flexible attention control and holding information in working memory. Crucial for young learners, these processes act as the "air traffic controllers" for brain activity, guiding diverse goals and achievements (Bull & Scerif, 2001). Linked to the prefrontal cortex, EF signals influence other brain regions. Notably, Delage & Frauenfelder (2019) found that strong working memory in preschoolers was key for their linguistic skills to accurately predict their social competence, highlighting the vital role of working memory in shaping early social development.

Over the past two decades, concerns about attention problems in preschool children have garnered significant attention, leading to a surge in research on assessment and intervention strategies. As highlighted in the review by Mahone & Schneider (2012), a

comprehensive assessment of attention and related functions in young children necessitates a multifaceted approach. This includes carefully reviewing the child's developmental history, conducting planned observations in various settings, and employing formal psychometric testing designed specifically for preschoolers. By combining these methods, professionals can gain a deeper understanding of the child's individual strengths and weaknesses, ultimately informing the development of appropriate and targeted interventions to support their success. It's important to note that attention skills in preschoolers are still developing, and differentiating typical age-related variations from potential disorders requires careful evaluation by qualified professionals.

Attention and working memory are like the dynamic duo of self-regulation, playing a crucial role in how children learn, particularly regarding social and emotional aspects. In the realm of elementary education, they are key players. Firstly, research shows that actively diverting attention away from emotionally charged situations allows children to manage their emotions and maintain self-control (Kateri, 2010). Think of the classic marshmallow test: kids who could distract themselves from the delicious treats waited longer, demonstrating successful attention control (Mischel et al., 1989). Secondly, neuroscience reveals children's adaptability through "set shifting," where they reframe initially upsetting stimuli. Their attention, working memory, and inhibitory control come into play when they take a step back, reassessing a situation and minimizing its emotional impact (Kateri et al., 2012). Essentially, these cognitive processes empower children to navigate the social and emotional landscape of learning, making them essential ingredients for success in elementary education.

In a study by Wagovich et al. (2020), children with stuttering underwent tests assessing their attention and visual memory. Compared to a non-stuttering group, children who stuttered

showed lower overall tracking and visual memory accuracy, suggesting potential underlying challenges in attentional processes. Interestingly, when presented with more salient stimuli, both groups exhibited better sustained attention, regardless of stuttering. This highlights the complex interplay between attention and specific disorders like stuttering in preschool children. It also underscores the importance of providing targeted stimulation and support to enhance their cognitive processing abilities. Remember, early intervention for children with such difficulties can significantly improve their learning and development.

As children embark on the incredible journey of learning, understanding how their memories work becomes crucial. Given the novelty of the learning process and memory mechanisms for them (Djalolova, 2022), it's no surprise that numerous research efforts have explored ways to enhance their cognitive abilities, particularly attention and memory. By proposing effective solutions, researchers aim to equip young minds with the tools they need to thrive in their developmental journey.

In today's tech-driven era, digital art and media are rapidly changing the educational landscape. To cater to the needs of younger generations and achieve the fourth Sustainable Development Goal of Quality Education, innovative approaches are required. While the importance of art in learning is widely recognized, research specifically exploring its effectiveness as a learning mediator for preschool children remains scarce. This is particularly true in Malaysia, where digital art as a pedagogical tool is still in its early stages. Therefore, this study delves into the exciting potential of digital art-based learning, investigating its efficacy in enhancing attention and working memory among preschool children. By bridging this research gap, researchers aim to contribute valuable insights into the dynamic field of early

childhood education and potentially unlock new avenues for nurturing young minds in the digital age.

1.2 Problem Statement

Researching the effects of digital art-based learning on children's development is crucial for several reasons. There is not much research done on this study and the last data has not been updated (Leung & Choi, 2023). Not only that, concern over children's declining attention spans and cognitive capacities, which are partially linked to more time spent on digital gadgets, has grown in recent years (Vedechkina & Borgonovi, 2021). The purpose of this study is to determine whether using digital art-based learning as an intervention may improve a child's working memory and attention span. In contrast to traditional learning approaches, the research attempts to explore the influence of digital art activities on cognitive development and evaluate the possible benefits of incorporating them into the educational curriculum. To provide insights into practical methods for enhancing learning settings for kids in the digital age, this study examines the impact of digital art-based learning on attention retention and memory recall.

According to a previous study, the overall message highlights the importance of having a thorough understanding of how the cognitive system and the digital environment interact. While acknowledging that the digital world may improve cognitive function, it also emphasises how crucial it is to consider digital characteristics and how they affect working memory and attention (Anufrieva & Gorbunova, 2021). Therefore, understanding digital art and children's attention and working memory should be done to study the correlation. According to a previous study, reaction time for working memory between boys and girls is different where boys are quicker than girls, but girls give more accurate answers compared to boys (Ibbotson & Roque-

Gutierrez, 2023). This can conclude that the attention span of girls is higher than boys however working memory reaction times are higher for boys.

However, for this study, the research gap is there is not much evidence shown about digital art with attention span and working memory. Art helps to engage the cognitive, emotive, visual, and kinesthetic worlds (Christensen & Gomila, 2018). However, according to a previous study, attention span has shrunk during this digital age as videos in social media have increased the duration and some of that causes people to have difficulty focusing on one job as they usually swipe the videos regularly and change the apps fastly cause people to stay focus on one thing have difficulty (Mills & Mark, 2023). Therefore, in this study, the connection between digital art-based learning in improving working memory and attention will be investigated.

1.3 Research Objectives

1.3.1 General Objective

To explore effectiveness digital art-based learning in improving attention and working memory among preschools

1.3.2 Specific Objectives

1. To compare the attention span between the physical art and digital art groups.
2. To compare working memory between the physical art and digital art groups.
3. To investigate the effectiveness of digital art-based learning toward attention span and working memory among preschool students.
4. To investigate the effectiveness of physical art-based learning toward attention span and working memory among preschool students.

5. To compare the attention span and working memory's reaction time between genders.

1.4 Research Questions

1. Is there any difference between attention span and digital art-based learning between the physical art and digital art groups?
2. Is there any difference between working memory between the physical art and digital art groups?
3. Does digital-art based learning improve attention span and working memory among preschool students?
4. Does physical-art based learning improve attention span and working memory among preschool students?
5. Is there any difference between attention span, working memory reaction time and gender?

1.5 Research Hypotheses

1. There is no significant difference between attention span between the physical art and digital art groups.
2. There is a significant difference between working memory between the physical art and digital art groups.
3. There is an impact of digital art- based learning toward attention span and working memory among preschool students.

4. There is an impact of physical art- based learning toward attention span and working memory among preschool students.
5. There is a significant difference between attention span, working memory reaction time and gender.

1.6 Conceptual Framework

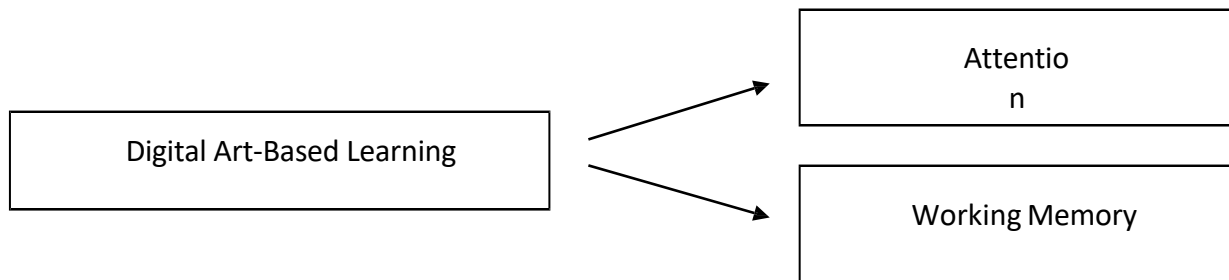


Figure 1: *Research Framework Investigate The Digital Art Impact on Attention and Working Memory*

1.7 Significance of Study

This study is important for parents and teachers to increase children's attention and working memory. Not only that but studying the effectiveness of digital art-based learning can be one of the mediums helping cognitive development for children. Therefore, with this study, teachers can use digital art to be part of the curriculum and activities in class for the children to help them have more fun learning class activities. This study is also important as to become a guide for future researchers to improvise this study for further research in this field. This research also can help the other ways for the further researcher and government to implementation and the way to use digital art as the based learning for the teachers and parents.

1.8 Definition of Terms

1.8.1 Digital Art

Conceptual Definition: art whose creation or presentation heavily depends on computer processing (Thomson-Jones & Moser, 2015).

Operational Definition: In this study, instruments use for digital art is stylus pen and tablet for preschool students to complete their mandala colouring.

1.8.2 Art-Based Learning

Conceptual Definition: the use of art as an educational tool to facilitate learning (Zakaria et al., 2019)

Operational Definition: In this study, digital coloring, colored pencils and mandala pattern will be used by preschool students.

1.8.3 Attention

Conceptual Definition: The capacity to avoid distractions and concentrate on a job (McCallum, 2019)

Operational Definition: The attention will be tested by using cognitive Stroop Test.

1.8.4 Working Memory

Conceptual Definition: a tiny quantity of knowledge that may be retained and applied when doing cognitive activities, as opposed to long-term memory, which is the enormous quantity of knowledge that is stored throughout a person's life (Cowan, 2014).

Operational Definition: The working memory in this research will be tested by using cognitive Stroop Test.

1.9 Limitation of study

One of the limitations for this research is, the data collected may not be enough to support all children from other regions or countries preschool students as the time for this data collection is limited. There is also not much information about the relationship between digital art and children working memory and attention which cause limited information for the researcher to go deep in the topic.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

In this chapter, the researcher will explain about past study regarding digital art-based learning, child's memory, and child's attention. The previous study was collected from different researchers, countries, and years.

2.1 Digital Art-Based Learning

In the classroom, teachers can apply art in their curriculum learning. Since art can be used by the students to express their emotions. Psychoanalytic Theory can be applied in this type of learning. According to psychoanalytic theory, art could be a form of self-defense. For the artist, the creative work may represent the fantasy or wish fulfillment of wants that are either forbidden by moral rules or rejected by the principle of reality (Thippawong, 2020). Therefore, art is a way to express and cope with a variety of psychological pressures. Through sublimation, the artist can transform his fantasy—a stand-in for fulfillment—into a form of art that is acceptable in society and that other people can appreciate (Caspersen, 2013). He transforms the private into something he can share with the world in his daydreams and desires. These ways can be applied to the students as they can cope with their negative emotions in the classroom through art.

The rapid growth in the 21st century toward science and technology has created the formation of new art which is digital art. Digital art is defined as the application of information technology and digital technology to the digitization, integration, design, and use of image, video, text, and voice. It includes online games, computer illustrations, video effects, digital

imaging, virtual reality, and digital music, among other interactive and online media (Yuanyuan, 2016). Art has been a source, a medium, and a means of expression for human development throughout human history. It plays a social role and represents communities as an essential component of both tangible and intangible culture. It is stressed that combining modern technologies with artistic expression can help people develop their socio-educational and creative abilities. The term "art" refers to any human endeavor that uses visual and material arts to convey a sensitive understanding of the world, real or imagined (González-Zamar & Abad-Segura, 2021). With art, people can communicate their perceptions, engage their senses, and establish a connection between their body and mind and the outside world (González-Zamar & Abad-Segura, 2021).

2.2 Attention

The term "attention" in psychology describes the deliberate focus on a certain occurrence to the exclusion of other stimuli (McCallum, 2019). It entails having a keen and focused awareness of the current moment. Early psychologists such as Edward Bradford Titchener held that the quality of conscious experience and the content of consciousness were significantly shaped by attention (McCallum, 2019). According to Tipper et al., the cognitive process of selectively focusing on some sensations or information while disregarding others is referred to as attention. It is essential to our capacity to notice, comprehend, and react to the environment we live in. We can effectively manage cognitive resources, prioritize crucial information, and filter out irrelevant or distracting inputs while we are paying attention.

Attention is important for humans as attention is used for everyday use as cognitive functioning. People use attention in learning, remembering, decision-making, and sustaining focused attention on tasks (Tipper et al., 1989). It makes it possible for humans to focus, take

in information, and do intricate cognitive tasks. Because it enables us to pay attention to and comprehend social signs, emotions, and intentions, attention is also important in social interactions (Tipper et al., 1989). In an education setting, teachers need to understand the mechanism of attention as attention is important for students to be able to concentrate, retrieve information and memorize the information in class (Tipper et al., 1989).

There are a few types of attention which are selective attention, sustained attention, divided attention, visual attention, auditory attention, executive attention, focused attention, joint attention, and involuntary attention. In this study, selective attention will be measured for the students. Selective attention is the cognitive process of selectively focusing on stimuli or information while disregarding others (Tipper et al., 1989). It entails having the capacity to go through and prioritize relevant information while excluding unnecessary or distracting stimuli (Tipper et al., 1989). With selective attention, we can focus on pertinent tasks or stimuli and efficiently use our cognitive resources. Since students have strong selective attention, they can focus on performing specific tasks and process the information given.

2.4 Working memory.

There are four fundamental processes of attention and working memory is one of the processes. Working memory is a dynamic form of memory that holds a limited amount of information for periods of seconds (Chai et al., 2018). The functions are to evaluate and manipulate information, make decisions, and plan complex behaviors (Knudsen, 2007). Working memory is to make basic decisions and to plan behavior (Knudsen, 2007). Working memory is primarily controlled by the prefrontal cortex, but other parts of the brain may also be involved depending on the type of information being processed (Knudsen, 2007). Working memory is like the brain's manager for attention (Knudsen, 2007). It carefully picks and checks

information before sending it for deeper thinking. It holds onto this chosen info temporarily, helping us think, decide, and plan our actions. Working memory decides which info gets attention based on how strong the signals are (Knudsen, 2007). It also manages signals that boost specific info, making it more likely to stay in working memory. Additionally, working memory guides where we look and how we pay attention, making the information we get clearer. To sum it up, working memory is crucial for choosing and ranking the information that grabs our attention, making it a key part of how we pay attention (Knudsen, 2007). There are researchers that state that working memory can be improved with learning and education (Chai et al., 2018).

According to Baddeley the foundation of working memory model there are 3 components of working memory which are the phonological loop (the verbal working memory), the visuospatial sketchpad (the visual-spatial working memory), the central executive (the attentional control system), and the episodic buffer (a short-term storage mechanism that combines and modifies various sensory data) (Chai et al., 2018). Baddeley also stated that working memory can change to long-term memory if short-term memory always be used and keep on memorizing and repeating the information (Chai et al., 2018).

2.5 Attention span and working memory's reaction time between genders.

In general pictures, there is a difference in terms of working memory as boys are quicker to respond but girls are more accurate from adult literature (Ibbotson & Roque-Gutierrez, 2023). Based on the previous study, there is no difference between attention span and working memory between genders however women were found to have slower reaction times (Grissom & Reyes, 2018).

2.6 Previous Finding

2.6.1 Art-based learning and attention

In a previous study, there is a relationship regarding art and attention (Loudon & Deininger, 2017). Based on the research done by Loudon & Deininger at Cardiff School of Art and Design, 22 participants have been involved in the experiment when they are required to do drawing on the paper and drawing tools given. According to the questionnaire done, participants give high attention to drawing on the paper. Their attention is also being tested by Stroop test and the results show that there is a correlation between art and attention. This research uses arousal theory as the guideline and to investigate the present of arousal theory between art and attention (Loudon & Deininger, 2017). According to this theoretical claim, people pay best attention when they are kept at a moderate arousal level, which avoids both extreme relaxation and hyperexcitation (Cherry, 2022). Works of art that can strike this balance, whether it is by carefully balancing known and unknown components or by delicately balancing complexity and simplicity, have the power to hold viewers' attention for extended periods of time (Alhassan & Osei (PhD), 2021). Therefore, when the participants start to draw, their mind can be more relaxed as they express their feeling toward the art and at the same time, the attention becomes high (Penn, 2019). However, there is not much information for digital art and attention from previous study.

2.6.2 Art-based learning and working memory.

In previous studies by Fernandes et al., art such as drawing can help to boost working memory. The picture-superiority effect is one of the key ideas, positing that words are not as well remembered as images. Prior studies have provided evidence in favor of this notion, demonstrating that images can be described using both verbal labels and visual characteristics, improving memory function (Forsberg et al., 2020). Drawing, which entails constructing visual

representations, is said by the researchers to activate this dual coding process and improve memory. In the research that has been done, dual coding theory has been used which suggests the idea of using several types of stimuli to help learners encode information in their brains more effectively, enabling it to be more easily retrieved later (Fernandes et al., 2018).

According to their research, experiments consistently demonstrated that sketching outperformed other encoding procedures, like writing, visualizing, and listing related features, in terms of memory performance. Multiple studies including younger adults have revealed similar findings by Wammes, Meade, & Fernandes, 2018. The effectiveness of sketching with new fictional phrases was tested, and the researchers also ran follow-up tests to account for participants' prior knowledge with the terms (Fernandes et al., 2018). Drawing still produced better memory performance in all scenarios. The drawing effect extended to longer explanations of academic terms, according to the researchers' additional investigation into the impact of drawing on the acquisition of academic vocabulary (Tecnológica et al., 2018). Furthermore, the advantages of using memory were noted in both typically aging people and those with dementia (Memory Problems, Forgetfulness, and Aging, n.d.). However, there is no further research regarding digital art and how the memory being improved compared to traditional art.

CHAPTER 3

METHODOLOGY

3.0 Introduction

This chapter covers the research methodology that is used in the study. This chapter gives an overall review of the research design, the sample and population detail, the instrument uses, pilot testing, data collection procedure and data analysis procedures consisting with descriptive data analysis and inferential data analysis.

3.1 Research Design

This study utilized a quantitative method, specifically employing a cross-sectional design. According to Bhandari (2020), quantitative research involves the collection and analysis of data in numerical form. The chosen research design for this study is a quasi-experimental design, characterized by its non-randomized nature and the incorporation of both pre- and post-study assessments. Non-randomized studies, as defined by Schmidt (2017), are trials in which the allocation of subjects is determined by the investigator and is not carried out randomly.

In the context of this research, participants were selected from kindergarten, and the specified age range for inclusion in the study is 6 years old students. Within the framework of the pre and post quasi-experimental design, subjects undergo testing both before and after the experimental procedure is administered and categorized as pre-post control group design. This design allows for the examination of potential changes or effects resulting from the intervention, providing valuable insights into the research questions at hand. The deliberate choice of a quasi-experimental approach aligns with the study's non-randomized nature and

facilitates a nuanced exploration of the selected variables within the context of the targeted age group. In this research also will have exclusion variables which is place setting that should be controlled as it will affected the experiment.

3.2 Population, and Sample

The research was conducted at a kindergarten school. Population is the whole number of individuals in an existing pool. The population is kindergarten students aged 6 years old. A sample can be defined as a small set of numbers in the population. The type of sample used in this study is non-probability sampling known as purposive sampling. This is because purposive sampling is the selected participants according to specific criteria and in this study, as for interior criteria the students chosen must be 6 years old. Not only that, for exclusion criteria they must also be healthy and not have any mental or physical problems to participate in this research, especially in terms of memory and attention problems. The sample for this experiment is 20 students, 10 students for the physical art group and 10 students for the digital art group. Based on the sample, it can be considered as small for experimental, however the sample can be considered but since the study is still new, it can be considered as starting point for the field.

3.3 Instruments

The research experimental tools will be conducted with the Stroop Test by using the Online Cognition Lab (CogLab). This test will be done two times which is for pre-test and post-test after participants draw with digital and traditional art.

3.3.1 Stroop Test

The Stroop Test was created by John Ridley Stroop in 1935. The main purpose of the Stroop Test is to measure cognitive ability, especially attention span of the participants. However, Stroop Test also can be used to measure working memory as the shorter time to answer the stronger the participants working memory (Pan et al., 2019). According to Basu's

(2022) study, has a high-reliability computerized version of the Stroop test between all items (Cronbach's Alpha is 0.74). Before beginning the task, the participants will be given instructions by the experimenter. For the beginning the task, A dark rectangle will be visible to participants. Before starting the lab, the participants will make sure they have a complete view of the area. The space bar was pressed to begin a trial. Look at the fixation dot that appears in the center of the window. In less than a second, a word in one of the three colours—RED, GREEN, or BLUE—will emerge on the screen and be printed in that colour. Regardless of the word itself, the objective is to rapidly classify the font's colour. They will be able to determine the font colour by hitting a key, and then they will get feedback indicating how accurate they were. The trial will be conducted again later in the experiment if they are wrong. At least 48 samples are included, 24 of which have various font colors and word names, and 24 of which have the same font colors and colour names (e.g., "RED" in red font colour).



Figure 2: *Example of computerized version Stroop Test*

3.3.2 Coglab

The CogLab system, built upon a modular online Executive program and equally modular utility functions, was designed for two primary purposes: controlling a high-speed phosphor CRT as a multi-channel tachistoscope and providing experimental stimuli to a human subject performing information processing tasks during a session. It is currently in operation on a Hewlett-Packard 2114 computer within my information processing laboratory (Taylor, 1972). Original Coglab is from 1999 by Greg Francis and Ian Neath and the Coglab has been modified by Cengage Learning in 2000s (Cengage Learning, n.d.). CogLab serves as a virtual laboratory platform for cognitive psychology, akin to its counterparts in biology, chemistry, and physics. It grants students unprecedented access to conduct classic and contemporary experiments spanning the diverse realms of cognition, all conveniently accessible through a web browser. Notably, upon completion of each experiment, students receive a comprehensive feedback report encompassing their individual results, their peers' average performance, and the global average of all past participants. This informative debriefing not only clarifies the experimental data but also elucidates its broader implications for our understanding of human cognitive processes (Cengage Learning, n.d.).

3.4 Procedures and Data Collection

The experiment's independent variables are digital art group and physical art group while the participants' attention spans and working memory is the dependent variables. For the first step doing the Stroop Test, the participants' data will include the amount of time they took and the total number of correct responses. This is considered the pre-test. Next, the participants will be divided into two groups randomly following the independent variables which is the physical art group which will be provided a paper sheet with a mandala pattern and colouring pencils and the second condition of independent variable which is the digital art group will be

provided with tabs and a pen stylus to complete the colouring of the same mandala pattern. After that, they will need to take the Stroop Test to record their results and reaction time. Using SPSS, the difference between the pre-and post-test results was examined together with the difference between the experiment and the control group.

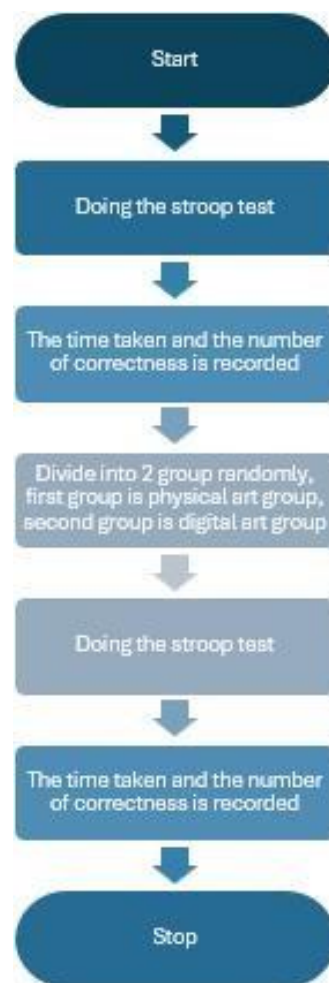


Figure 3: *Flowchart for procedure*

3.5 Pilot Study

A pilot study is characterized as a limited-scale investigation aimed at evaluating research protocols, data collection tools, sample recruitment approaches, and additional research methods in anticipation of a more extensive study. This preliminary study holds significance as a pivotal phase within a research project, aiming to pinpoint potential issues and shortcomings in research instruments and protocols before their full-scale implementation in the comprehensive study (Hassan et al., 2006). In this study, pilot study will be done 2 weeks before the actual experiment.

3.6 Data Analysis Procedures

3.6.1 Descriptive Data Analysis

The descriptive analysis in this study uses the descriptive analysis method from IBM Statistical Package for the Social Sciences (SPSS) version 27.0. The descriptive analysis will be used on the demographic profile of the participants which includes gender, and age. The demographic profiles will be displayed in terms of tables, graphs, and bar charts.

3.6.2 Inferential Data Analysis

The data analyses that were used for the outcome of the experiment were by using the independent sample t-test and paired sample T-Test IBM SPSS Statistics software version 27.0.

3.6.2.1 Independent sample T-test

The independent sample t-test is a common way to check for differences between two separate groups of participants. It is like a strong tool in statistics that helps compare the average scores of two groups that do not overlap. For example, if researchers want to see if there's a difference and sample T-Test, how effective something is for guys compared to girls, researchers can use this test. By running the scores through the t-test, researchers can figure

out if the differences are likely to be real or just random. This helps researchers understand better if there are any important gender-related distinctions in what we're studying. The independent sample t-test is a useful tool for finding subtle differences between different groups, making scientific analyses more detailed and accurate.

3.6.2.2 Paired Sample T-Test

The Paired-Samples T Test procedure goes beyond comparing simple means, delving into the dynamics within a single group by examining how paired observations for everyone differ. It systematically calculates these differences, then rigorously tests whether their average departs meaningfully from the null point of zero. This meticulous analysis not only reveals potential disparities between variable means but also automates the calculation of effect size, quantifying the practical significance of any observed difference.

Objectives	Hypothesis	Inferential Data Analysis
To compare the attention span among the physical art and digital art group	H1: There is no significant difference between attention span among the physical art and digital art group	Independent sample T-test
To compare working memory between the physical art and digital art groups.	H2: There is a significant difference between working memory among the physical art and digital art group	Independent sample T-test
To investigate the effectiveness of digital art-based learning toward attention span and working memory among preschool students.	H3: There is an impact of digital art-based learning toward attention span and working memory among preschool students	Paired sample T-Test

To investigate the effectiveness of physical art-based learning toward attention span and working memory among preschool students.	H4: There is an impact of physical art-based learning toward attention span and working memory among preschool students	Paired sample T-Test
To compare the attention span and working memory's reaction time between genders.	H5: There is a significant difference between attention span, working memory reaction time and gender.	Independent sample T-test

Table 1: *Summary of Technique Analysis*

3.7 Summary

In summary, the study was conducted utilising an experimental research design in a quantitative manner, and IBM SPSS Statistics was used for the analysis process. To make sure that the operation is carried out in the right steps, this chapter is essential.

CHAPTER FOUR

FINDINGS AND DISCUSSION

4.0 Introduction

This chapter will discuss the findings and data analysis from the data collection process. The study managed to collect samples of 20 students among 3 kindergartens. This chapter also includes the demographic information on the participants and the inferential statistics for the data that was collected for this study. The data collected was analysed using Statistical Package for Social Sciences (SPSS) version 27.0.

4.1 Demographic Data

4.1.1 Gender of Participants

<i>Gender</i>		Frequency	Percent
Valid	Male	12	60.0
	Female	8	40.0
	Total	20	100.0

Table 4.1.1(a) : *Frequency and Percentage of Participants' Gender*

This study successfully collected 20 participants to participate in the study. For the aspect of gender, the male students(n=12) made up most of the participants by a percentage of 60% while their female (n=8) counterparts had a percentage of 40%. Table 4.1.1(a) shows the gender of the participants.

4.2 Main Findings

4.2.1 To compare the attention span between the physical and digital art groups.

H0: There is no significant difference between attention span among the physical art and digital art group

<i>Group Statistics</i>				
	Participants	N	Mean	Std. Deviation
RT after experiment (ms)	Physical Art	10	2190.1000	630.82557
	Digital Art	10	2522.7566	598.28633

Table 4.2.1 (a): *Table of Mean and Standard Deviation.*

Independent Samples Test

		<u>Levene's Test for Equality of Variances</u>		<u>t-test for Equality of Means</u>		
		F	Sig.	t	df	Sig. (2- tailed)
RT after experiment (ms)	Equal variances assumed	.405	.533	-1.210	18	.242
	Equal variances not assumed			-1.210	17.950	.242

Table 4.2.1 (b): *Table of Independent Samples Test.*

The independent sample t-test that was conducted is shown in Table 4.2.2 (b) above. The independent t-test determines the mean difference between participant's reaction time in both physical art and digital art groups. The p-value for the Levene's Test shown is bigger than the selected significant value ($p = 0.533 > 0.05$), hence the equal variances assumed. The result of the t-test indicates that there is no significant difference in the mean of reaction time in answering the stroop test between physical art and digital art. The p-value is larger than the selected significant value ($p = 0.242 > 0.05$). Hence, the null hypothesis fails to be rejected. The study shows that **there is no difference of attention toward physical art and digital art groups.**

4.2.2 To compare working memory between the physical art and digital art groups.

H1: There is a significant difference between working memory among the physical art and digital art group.

<i>Group Statistics</i>				
	Participants	N	Mean	Std. Deviation
RT after experiment (ms)	Physical Art	10	2190.1000	630.82557
	Digital Art	10	2522.7566	598.28633

Table 4.2.2 (a): *Table of Group Statistics*

<i>Independent Samples Test</i>		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2- tailed)
RT after experiment (ms)	Equal variances assumed	.405	.533	-1.210	18	.242
	Equal variances not assumed			-1.210	17.950	.242

Table 4.2.2 (b): *Table of Independent Sample Test.*

The independent sample t-test that was conducted is shown in Table 4.2.2 (b) above. The independent t-test determines the mean difference between participant's reaction time in both physical art and digital art groups. The p-value for the Levene's Test shown is bigger than the selected significant value ($p = 0.533 > 0.05$), hence the equal variances assumed. The result of the t-test indicates that there is no significant difference in the mean of reaction time in answering the stroop test between physical art and digital art. The p-value is larger than the selected significant value ($p = 0.242 > 0.05$). Hence, the null hypothesis fails to be rejected. **The study shows that there is no difference between working memory toward digital art and physical art.**

4.2.3 To investigate the effectiveness of digital art-based learning toward attention span and working memory among preschool students.

H1: There is an impact of digital art- based learning toward attention span and working memory among preschool students.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	RT before experiment (ms)	2729.8000	10	876.28506	277.10567
	RT after experiment (ms)	2522.7566	10	598.28633	189.19475

Table 4.2.3 (a): Table of Paired Sample Statistics

Paired Samples Test

		Paired Differences							
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	RT before experiment (ms) - RT after experiment (ms)	207.04334	432.00443	136.61179	-101.99401	516.08069	1.516	9	.164

Table 4.2.3 (b): Table of Paired Sample Test

To investigate the effect of digital art impact on attention and working memory, a paired-sample t-test was conducted. Reaction time for participants to complete a stroop test before ($M = 2729.80$, $SD = 876.29$) and after doing digital art ($M = 2522.76$, $SD = 598.29$) was recorded. The results revealed there is no significant difference in reaction time, $t(1.5) = 9$, $p = 0.164$. Additionally, Cohen's d indicated a medium effect size ($d = 0.49$). Since the p -value = $0.164 > 0.005$, the null hypothesis failed to be rejected. This shows that, **there is no impact of digital art toward participant's attention and working memory.**

4.2.4 To investigate the effectiveness of physical art-based learning toward attention span and working memory among preschool students.

H1: There is an impact of physical art- based learning toward attention span and working memory among preschool students

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	RT(ms) before experiment	2863.5966	10	758.87137	239.97620
	RT(ms) after experiment	2190.1000	10	630.82557	199.48456

Table 4.2.4 (a): *Table of Paired Sample Statistics*

Paired Samples Test

		Paired Differences							
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	RT(ms) before experiment - RT(ms) after experiment	673.49660	644.27978	203.73916	212.60661	1134.38659	3.306	9	.009

Table 4.2.4 (b): *Table of Paired Sample Test*

To investigate the effect of physical art impact on attention and working memory, a paired- sample t-test was conducted. Reaction time for participants to complete a stroop test before ($M = 2863.60$, $SD = 758.87$) and after doing physical art ($M = 2190.10$, $SD = 630.83$) was recorded. The results revealed there is a significant difference in reaction time, $t(3.3) = 9$, $p = 0.009$. Additionally, Cohen's d indicated a medium effect size ($d = 0.49$). Since the p -value $= 0.009 < 0.05$, the null hypothesis is rejected. This shows that **there is an impact of physical art toward participant's attention and working memory.**

4.2.5 To compare the attention span and working memory's reaction time between genders.

H1: There is a significant difference between attention span, working memory reaction time and gender.

Group Statistics

	Gender	N	Mean	Std. Deviation	
RT after experiment for (ms)	Male	12	2360.4361	617.61520	178.29015
	Female	8	2350.4167	671.87088	237.54223

Table 4.2.5 (a): *Table of Group Statistics*

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
RT after experiment (ms)	Equal variances assumed	.079	.781	.034	18	.973
	Equal variances not assumed			.034	14.234	.974

Table 4.2.5 (b): *Table of Independent Samples Test.*

The independent sample t-test that was conducted is shown in Table 4.2.4 (b) above. The independent t-test determines the mean difference between participant's reaction time in both male and female students. Based on the result shown before, the variances of the data for reaction time between male and female students is assumed. The p-value for the Levene's Test shown is bigger than the selected significant value ($p=0.781>0.05$), hence the equal variances assumed. The result of the t-test indicates that there is no significant difference in the mean of reaction time in answering the Stroop test between male and female students. The p-value is larger than the selected significant value ($p=0.973>0.05$). Hence, the null hypothesis fails to be rejected. The study shows **that there is no difference toward attention and working memory between male and female after the experiments.**

4.3 Discussion

4.3.1 To compare the attention span between the physical and digital art groups.

Ho: There is no significant difference between attention span among the physical art group and digital art groups.

This study found that there is no significant difference between attention span and working memory among the physical art and digital art groups. This shows that between participants who colouring mandala in digital form and those colouring mandala physically there is no statistically significant difference.

The previous studies have shown that there is a correlation between attention span, working memory and art (Alhassan & Osei (PhD), 2021; Penn, 2019; Tecnológica et al., 2018), however, not much research has been done to compare digital art and physical art. From this study can be seen that there is no significant difference between the two types of art that might be caused by individual differences react toward the art. In past studies, factors such as Haptic-Kinesthetic Differences, Visual Presentation and Cognitive Processing are how children respond to these mediums and influence the results (Vasylets et al., 2022).

Haptic-Kinesthetic Differences are distinct sensory modalities that contribute to our understanding of the physical world. Haptic perception involves touch, relying on skin receptors for texture, temperature, and pressure (Jones, 2009). Kinesthesia focuses on body movement and position, using muscle, tendon, and joint receptors for orientation and motion (Reed & Ziat, 2018). As for Visual Presentation is the way information is presented through sight, using images, text, and other visual elements (McCrudden & Rapp, 2015). Lastly Cognitive Processing is the mental activities involved in understanding, remembering, and thinking about information (Cherry, 2023). For example, in terms of cognitive preference students with more visual learners benefit from traditional colouring's physical interaction with materials. Others might be more kinesthetics learners who prefer the digital tools' interactivity.

These individual styles could influence how each person responds to the colouring methods, leading to inconclusive group-level results.

4.3.2 To compare working memory between physical art and digital art groups.

H0: There is no significant difference between working memory among the physical art group and digital art groups.

Both art forms necessitate the use of working memory to retain information essential for successful creation. This includes details like color palettes, chosen composition techniques, and various artistic methods specific to the medium being used. Furthermore, both physical and digital art require the application of similar core cognitive skills. These skills encompass spatial awareness, which allows artists to conceptualize the relationships between objects and figures within the artwork (Thippawong, 2020). Visual processing is another crucial skill, enabling artists to analyze and interpret visual elements that will be incorporated into the piece (Anastasiia, 2023). Finally, both art forms necessitate planning, as artists envision the final product and strategize the steps necessary to achieve their artistic goals.

While there is a significant overlap in the cognitive demands of physical and digital art, there are also some distinctions to consider. Physical art creation emphasizes hand-eye coordination due to the manipulation of physical materials. Artists must coordinate visual input with precise movements of the hand to execute brushstrokes, sculpting techniques, or other actions specific to their chosen medium (Thippawong, 2020). In contrast, digital art introduces a distinct challenge in the form of software management. Artists must not only possess the core artistic skills but also have a working knowledge of the digital tools and software they are using (Langdon, 2014). Navigating software interfaces, applying software-specific techniques, and troubleshooting technical hurdles become additional cognitive

demands unique to digital art creation.

Despite these divergences, the core cognitive processes underlying artistic creation remain remarkably consistent across both physical and digital mediums. Both art forms necessitate the strategic use of working memory, a variety of visual and spatial reasoning skills, and meticulous planning. While the tools and materials may differ, the fundamental cognitive foundation that allows artists to translate their ideas into visual forms remains strikingly similar.

4.3.3 To investigate the effectiveness of digital art-based learning toward attention span and working memory among preschool students.

H0: There is no impact of physical art-based learning toward attention span and working memory among preschool students.

This study found that there is no impact toward attention span and working memory by digital art-based learning. This shows that between participants that colouring mandala in digital form does not effectively affect the attention span and working memory.

From the previous study, some studies haven't found a connection between screen time and thinking skills in young children from stable home environments (Wang et al., 2023). These skills include focusing attention, remembering things, and switching between tasks. However, other research suggests that frequent screen use might be linked to weaker thinking skills and reduced brain activity in some areas (Wang et al., 2023). The study that has been done in Türkiye that involved 34 children aged 5 years old (17 female and 17 male), found that children with high screen time spent less time on educational activities and had difficulty focusing (Sapsağlam & Birak, 2023). This included problems like losing their place in worksheets, mixing up instructions, missing visual cues, and struggling to find specific colour while painting. Their attention spans and engagement in activities were also shorter (Sapsağlam & Birak, 2023).

According to Gary W. Small (2020), while the exact cause of the connection between technology use and attention difficulties remains under investigation, researchers suspect that a key factor could be the constant switching of focus and juggling of multiple tasks that often comes with using digital devices. This repetitive attentional shifting and multitasking can potentially weaken our executive functioning. Executive functioning refers to a set of cognitive skills that are crucial for managing our thoughts and actions effectively. These skills include focusing attention, filtering out distractions, planning and organizing tasks, and staying on track to complete goals. When we are constantly bombarded with notifications, alerts, and the temptation to switch between apps or programs, it may strain these executive functions, leading to difficulties in focusing on a single task for sustained periods (Small, 2020).

Even though screen exposure might be helping to provide benefit toward children's cognitive development, however, too much exposure by spending a lot of time with screen-based activities, such as watching TV, playing computer games, and using touchscreens, may hinder the development of motor skills in young children (Li et al., 2020). This can be link with digital colouring toward the children as in this study shows that digital art has not effectively improved attention and working memory and since the participants colouring in digital mandala, it might not be affective since digital medium might be giving negative impact toward the students. However, according to other studies, literature and speech of the students can be improved with the right amount of screen time and under parents' guidance (Veraksa et al., 2021).

4.3.4 To investigate the effectiveness of physical art-based learning toward attention span and working memory among preschool students.

H1: There is an impact of physical art- based learning toward attention span and working memory among preschool students.

This study found that there is an impact toward attention span and working memory by using physical art-based learning. This shows that colouring mandala in physical form effectively affects the attention span and working memory. This study consistent with past studies that support that physical art can improved attention span and working memory.

Study that has been done in Indonesia state that the study observed an interesting pattern in children with strong attention skills. Initially, their focus while looking at a picture sketch was only around 40%. However, after engaging in the colouring activity (cycle I), their attention rose to 60%. This focus continued to improve in cycle II, reaching a high of 93%. This suggests that colouring picture sketches may have the potential to enhance children's attention, particularly for those who already demonstrate strong attention skills (Rahma & Rizki, 2023).

Another study also found that the study that has been done with 11 kindergarten students has shown that there is increasing in attention and working memory when the activity colouring shows the results of the study were particularly encouraging (Marhaeniet al., 2022). Post-test scores revealed a significant improvement in the average level of students' fine motor skills. According to Klupp et al., (2021) state that, based on Piaget's Theory fine motor skills are intricately intertwined with cognitive functions, particularly attention and working memory. The execution of precise motor movements necessitates sustained attention to visual cues and task demands, thereby engaging attentional resources. Moreover, the planning and coordination of fine motor actions require the manipulation and retention of information in working memory, as individuals must simultaneously consider desired outcomes, ongoing movements, and sensory

feedback (Klupp et al., 2021). The finding suggests that the act of colouring children's drawings may be a valuable tool for training these skills. By requiring children to grasp and manipulate colouring tools, the activity strengthens the muscles in their hands and fingers. This improved hand strength translates to better control over writing instruments, laying a strong foundation for future writing development (Marhaeni et al., 2022).

From this study can be concluded that physical art can be helping to improved student's attention span and working memory and aligned with the past studies as the result shows that physical art is significantly different for the students before done the colouring and after the colouring done.

4.3.5 To compare the attention span and working memory's reaction time between genders.

H0: There is no significant difference between attention span, working memory reaction time and gender.

This study found that there is no significant difference between attention span and working memory's time reaction between genders. This shows that between male and female, there is no different for attention span and working memory's reaction time. This study does not align with past studies that shows that there is different in attention span and working memory's reaction time for genders (Ibbotson & Roque-Gutierrez, 2023).

According to past studies, around the ages of 5 and 6, both boys' and girls' brains are in a period of dynamic development (ALghamdi et al., 2021). This means crucial areas like the prefrontal cortex, which plays a central role in working memory and attention, are still undergoing significant maturation. As a result, any potential gender-based differences in these cognitive skills might not be readily apparent at this stage. It's likely that these differences, if they exist, may become more pronounced as the brain continues to develop and specialize throughout childhood and adolescence (ALghamdi et al., 2021).

The research that has been explored offers some compelling insights into why studies might not reveal significant differences in attention span and working memory between boys and girls in kindergarten. While kindergarten-aged children might not show significant gender differences in attention and working memory, some studies suggest this could change as we move into adolescence and adulthood. This shift might be due to a few factors. Firstly, the brain continues to develop dramatically during these later stages (ALghamdi et al., 2021). Unlike in kindergarten, where both boys' and girls' brains are still maturing along similar trajectories, the environment and the skills learned throughout childhood might start to influence brain development in more individualized ways. As their brains continue to develop in adolescence, the learning experiences might shape the structure and function of their brains differently, potentially leading to some variation in cognitive skills.

Secondly, hormonal changes during this period can play a significant role in how cognitive skills develop in males and females. These hormonal influences might contribute to some of the observed gender differences in attention and working memory that emerge in later stages of life (Ibbotson & Roque-Gutierrez, 2023). Finally, the tests used to assess attention and working memory in young children might not be sensitive enough to pick up subtle variations that might exist between genders (Voyer et al., 2016). More sophisticated tools might be needed to reveal these nuances at this early stage. While these studies suggest minimal gender differences in kindergarten, it does not negate the possibility of variations emerging later in life as the brain continues to develop and is influenced by a wider range of factors.

Objectives	Hypothesis	Findings
To compare the attention span among the physical art and digital art group	H1: There is no significant difference between attention span among the physical art and digital art group	HA rejected. H0 accepted.
To compare working memory between the physical art and digital art groups.	H2: There is a significant difference between working memory among the physical art and digital art group	HA rejected. H0 accepted.
To investigate the effectiveness of digital art-based learning toward attention span and working memory among preschool students.	H3: There is an impact of digital art-based learning toward attention span and working	HA rejected. H0 accepted.
To investigate the effectiveness of physical art-based learning toward attention span and working memory among preschool students.	H4: There is an impact of physical art-based learning toward attention span and working memory among preschool students.	HA accepted.
To compare the attention span and working memory's reaction time between genders.	H5: There is a significant difference between attention span, working memory reaction time and gender.	HA rejected. H0 accepted.

Table 4.3 *Summary of The Finding*

CHAPTER FIVE

LIMITATION, IMPLICATION, RECOMMENDATION

5.0 Introduction

This chapter will discuss the summary of the findings, the limitations, recommendation, and the conclusion for the study.

5.1 Limitation of Study

This study holds valuable insights, but it's important to acknowledge some limitations. Firstly, the research focused solely on kindergartners in Sarawak. This geographic restriction prevents generalizing the findings to all 6-year-olds in Malaysia, as cultural and educational experiences might differ across regions like Peninsula Malaysia and Sabah. Additionally, the sample size of only 20 participants is quite small. With such a limited group, the results might not accurately reflect the true connection between digital art activities and working memory or attention in the broader population of young children. A larger, more geographically diverse sample could provide more robust and generalizable data.

Another limitation of the study lies in the potentially distracting environment of the kindergarten setting. The designated room's accessibility from outside could have easily disrupted the participants' focus whenever the door opened. Furthermore, external noise levels might have also played a significant role in distracting the children. This lack of a controlled environment could have impacted the validity of the results, as it's difficult to isolate the effects of digital art on working memory and attention from external distractions.

The study was limited by the short data collection timeframe of only four months. This compressed schedule restricted the researchers' ability to gather more comprehensive data and potentially identify long-term trends. Additionally, relying solely on a single instrument to assess both attention and working memory presents a potential limitation. While the chosen instrument may have been effective in one domain, it might not have fully captured the complexities of both cognitive functions. A more multifaceted approach, incorporating a wider range of instruments or extending the data collection period, could have yielded richer insights and a more robust understanding of the relationship between attention and working memory. A more structured timeline with increased funding and a longer period of intervention, potentially including multiple sessions of mandala coloring, could have yielded more accurate results. This extended timeframe would have allowed for a more robust assessment of how digital art might influence these cognitive functions over time, providing a clearer picture of its effectiveness as a tool for development.

5.2 Implications of Study

This study has highlighted the effectiveness of digital art in helping with attention and working memory. Since the question regarding the effectiveness of digital art in boosting attention and working memory is still new, this study has provided the answer to the questions. Since the study is not aligned with past studies that state digital art can help with children's cognitive, it become one of the new findings toward the future. This study can become a guide for the new researcher to do further research for this study.

Furthermore, these findings can serve as valuable guidelines for educators and parents in creating engaging learning environments for students. Given that the study suggests a potential advantage for physical art activities, it can also raise awareness among teachers and parents about the importance of physical art in promoting students' attention and working memory. By incorporating a variety of both physical and digital art experiences into the learning process, educators and parents can potentially foster a more well-rounded development of cognitive skills in children.

5.3 Recommendations

Future researchers aiming to replicate this study should meticulously plan their data collection procedures to guarantee robust and valid findings. Increased funding and dedicated time would allow for a more elaborate timeframe and a more meticulous approach between the pre-test and post-test stages. This could involve extending the intervention period, incorporating multiple digital art sessions, and employing a more structured timeline. Furthermore, researchers should ensure their data collection methods directly address the study's objectives. Utilizing rigorous techniques and potentially triangulating data from various sources, such as standardized tests, teacher observations, and student self-reports, could significantly enhance the validity of the collected data. This comprehensive approach would provide a clearer picture of the true impact of digital art on working memory and attention in young children.

To minimize external distractions and enhance focus, future studies should prioritize controlled environments. This could involve utilizing dedicated rooms with restricted access to prevent interruptions during testing. Additionally, researchers should ensure a comfortable

setting with optimal temperature to maximize participant well-being and concentration. By prioritizing a suitable environment, researchers can mitigate the influence of external factors and internal discomfort on participant performance, leading to more reliable data that accurately reflects the true relationship between digital art and cognitive functions like working memory and attention.

While this study provided valuable insights into the effects of digital art on children's cognitive development, further investigation could yield a more comprehensive understanding. Expanding the research sample to include a wider range of children from diverse backgrounds would allow for a more representative picture of how digital art impacts this population. Additionally, extending the study duration would enable researchers to delve deeper into the long-term effects of digital art exposure, exploring its influence beyond just attention and working memory. Incorporating a variety of assessment tools would offer a more nuanced perspective on the phenomenon. By employing a broader range of tests, researchers could gain a clearer picture of how digital art interacts with different aspects of children's cognitive function. This multifaceted approach would provide a more thorough understanding of the potential impact of digital art on the developing brain

REFERENCE

- Alhassan, B., & Osei (PhD), M. (2021). Integrating Drawing in Teaching English Language at Yumba Special School for Children with Intellectual Disabilities. *Journal for Learning through the Arts: A Research Journal on Arts Integration in Schools and Communities*, 16(1). <https://doi.org/10.21977/d916142462>
- ALghamdi, R., Crewther, S., Peters, J., Murphy, M. J., & Nahal Goharpey. (2021). Where to next? A Systematic Review identifying the gaps in the Cognitive Literature regarding Attention and Working Memory in Early Childhood. *OSF Preprints (OSF Preprints)*.
<https://doi.org/10.31219/osf.io/fu82w>
- Anastasiia. (2023, September 28). *Visual Memory: Unlocking the Power of Remembering with Images*. A Simplified Psychology Guide. <https://psychology.tips/visual-memory/>
- Anufrieva, A., & Gorbunova, E. (2021). Cognitive Functions In The Digital Environment: Working Memory And Attention Under Real And Digital Conditions. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.3974610>
- Banisudha, B. (n.d.). The Implications of the Performing Arts in Higher Education in India: An Analytical Study. *IJFMR - International Journal for Multidisciplinary Research*, 5(1). <https://doi.org/10.36948/ijfmr.2023.v05i01.1549>
- Basu, S. (2022). Examining the reliability and validity of computerized stroop test in children aged 5-13 years: a preliminary study. *Quality & Quantity*, 57. <https://doi.org/10.1007/s11135-022-01376-y>
- Bhandari, P. (2020, June 12). *What Is Quantitative research? | definition, Uses and Methods*. Scribbr. <https://www.scribbr.com/methodology/quantitative-research/>
- Bull, R., & Scerif, G. (2001). Executive Functioning as a Predictor of Children's Mathematics Ability: Inhibition, Switching, and Working Memory. *Developmental Neuropsychology*, 19(3), 273–293. https://doi.org/10.1207/s15326942dn1903_3

- Caspersen, S. G. (2013). Art & Psychoanalysis by Walsh Maria. London, I.B. Tauris, 2013, 176 pp., \$25.00. *American Journal of Psychiatry*, 170(12), 1500–1501. <https://doi.org/10.1176/appi.ajp.2013.13060733>
- Chai, W. J., Abd Hamid, A. I., & Abdullah, J. M. (2018). Working Memory From the Psychological and Neurosciences Perspectives: A Review. *Frontiers in Psychology*, 9(1). <https://doi.org/10.3389/fpsyg.2018.00401>
- Cherry, K. (2022, May 6). *The Arousal Theory and Our Individual Behaviors*. Verywell Mind. <https://www.verywellmind.com/the-arousal-theory-of-motivation-2795380>
- Cherry, K. (2023, April 18). Cognition in Psychology. Verywell Mind. <https://www.verywellmind.com/what-is-cognition-2794982>
- Christensen, J. F., & Gomila, A. (2018, January 1). Introduction: Art and the brain: From pleasure to well-being (J. F. Christensen & A. Gomila, Eds.). ScienceDirect; Elsevier. <https://www.sciencedirect.com/science/article/abs/pii/S0079612318300323?via%3Di> [hub](https://www.sciencedirect.com/science/article/abs/pii/S0079612318300323?via%3Di)
- Cowan, N. (2014). Working memory underpins cognitive development, learning, and education. *Educational Psychology Review*, 26(2), 197–223. <https://doi.org/10.1007/s10648-013-9246-y>
- Delage, H., & Frauenfelder, U. H. (2019). Syntax and working memory in typically-developing children. *Language, Interaction and Acquisition*, 10(2), 141–176. <https://doi.org/10.1075/lia.18013.del>
- Ferent, P., & Turda, E.-S. (2021). The Importance of Art Therapy In Preschoolers Personal Development. *The European Proceedings of Social and Behavioural Sciences*, 104, 481–490. <https://doi.org/10.15405/epsbs.2021.03.02.49>
- Fernandes, M. A., Wammes, J. D., & Meade, M. E. (2018). The Surprisingly Powerful Influence of Drawing on Memory. *Current Directions in Psychological Science*, 27(5), 302–308. <https://doi.org/10.1177/0963721418755385>

- Forsberg, A., Johnson, W., & Logie, R. H. (2020). Cognitive aging and verbal labeling in continuous visual memory. *Memory & Cognition*, 48(7), 1196–1213. <https://doi.org/10.3758/s13421-020-01043-3>
- Gaitas, S., & Alves Martins, M. (2016). Teacher perceived difficulty in implementing differentiated instructional strategies in primary school. *International Journal of Inclusive Education*, 21(5), 544–556. <https://doi.org/10.1080/13603116.2016.1223180>
- González-Zamar, M.-D., & Abad-Segura, E. (2021). Digital Design in Artistic Education: An Overview of Research in the University Setting. *Education Sciences*, 11(4), 144. <https://doi.org/10.3390/educsci11040144>
- Hassan, Z. A., Schattner, P., & Mazza, D. (2006). Doing A Pilot Study: Why Is It Essential? *Malaysian Family Physician: The Official Journal of the Academy of Family Physicians of Malaysia*, 1(2-3), 70–73. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4453116/#:~:text=A%20pilot%20study%20can%20be>
- Hurley, R. (2006). A steady eye. *BMJ : British Medical Journal*, 333(7574), 923. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1626296/>
- Ibbotson, P., & Roque-Gutierrez, E. (2023). The Development of Working Memory: Sex Differences in Accuracy and Reaction Times. *Journal of Cognition and Development*, 24(4), 581–597. <https://doi.org/10.1080/15248372.2023.2178437>
- Jones, L. A. (2009). Haptics. *Springer EBooks*, 1808–1811. https://doi.org/10.1007/978-3-540-29678-2_2140
- Klupp, S., Möhring, W., Lemola, S., & Grob, A. (2021). Relations between fine motor skills and intelligence in typically developing children and children with attention deficit hyperactivity disorder. *Research in Developmental Disabilities*, 110, 103855. <https://doi.org/10.1016/j.ridd.2021.103855>
- Knudsen, E. I. (2007). Fundamental Components of Attention. *Annual Review of Neuroscience*, 30(1), 57–78. <https://doi.org/10.1146/annurev.neuro.30.051606.094256>

- Kolb, B., Mychasiuk, R., Muhammad, A., Li, Y., Frost, D. O., & Gibb, R. (2012). Experience and the developing prefrontal cortex. *Proceedings of the National Academy of Sciences*, 109(Supplement_2), 17186–17193. <https://doi.org/10.1073/pnas.1121251109>
- Langdon, M. (2014). *The Work of Art in a Digital Age: Art, Technology and Globalisation*. Springer New York. <https://doi.org/10.1007/978-1-4939-1270-4>
- Leung, Y., & Choi, K. (2023). Teachers' perceptions of technical affordances in early visual arts education. *European Early Childhood Education Research Journal*, 1–20. <https://doi.org/10.1080/1350293x.2023.2227367>
- Li, C., Cheng, G., Sha, T., Cheng, W., & Yan, Y. (2020). The Relationships between Screen Use and Health Indicators among Infants, Toddlers, and Preschoolers: A Meta-Analysis and Systematic Review. *International Journal of Environmental Research and Public Health*, 17(19). <https://doi.org/10.3390/ijerph17197324>
- Lindsay, G. W. (2020). Attention in psychology, neuroscience, and machine learning. *Frontiers in Computational Neuroscience*, 14(29). <https://doi.org/10.3389/fncom.2020.00029>
- Liu, X. (2020). Design of Educational Art Activities for Preschoolers. *Lifelong Education*, 9(3), 57. <https://doi.org/10.18282/le.v9i3.853>
- Loudon, G. H., & Deininger, G. M. (2017). The Physiological Response to Drawing and Its Relation to Attention and Relaxation. *Journal of Behavioral and Brain Science*, 07(03), 111–124. <https://doi.org/10.4236/jbbs.2017.73011>
- Mahone, E. M., & Schneider, H. E. (2012). Assessment of Attention in Preschoolers. *Neuropsychology Review*, 22(4), 361–383. <https://doi.org/10.1007/s11065-012-9217-y>
- Marhaeni, B., Septriana, I., & Suci, S. W. (2022). Fine Motor Stimulation of Children Through Coloring Activities in Early Childhood. *TEMATIK: Jurnal Pemikiran Dan Penelitian Pendidikan Anak Usia Dini*, 8(1), 51. <https://doi.org/10.26858/tematik.v8i1.27550>

McCallum, W. C. (2019). Attention | psychology. In *Encyclopædia Britannica*.
<https://www.britannica.com/science/attention>

McCrudden, M. T., & Rapp, D. N. (2015). How Visual Displays Affect Cognitive Processing. *Educational Psychology Review*, 29(3), 623–639. <https://doi.org/10.1007/s10648-015-9342-2>

McRae, K., Hughes, B., Chopra, S., Gabrieli, J. D. E., Gross, J. J., & Ochsner, K. N. (2010). The Neural Bases of Distraction and Reappraisal. *Journal of Cognitive Neuroscience*, 22(2), 248–262. <https://doi.org/10.1162/jocn.2009.21243>

Memory Problems, Forgetfulness, and Aging. (n.d.). National Institute on Aging.
<https://www.nia.nih.gov/health/memory-loss-and-forgetfulness/memory-problems-forgetfulness-and-aging#:~:text=Forgetfulness%20can%20be%20a%20normal>

Mischel, W., Shoda, Y., & Rodriguez, M. (1989). Delay of gratification in children. *Science*, 244(4907), 933–938. <https://doi.org/10.1126/science.2658056>

Mills, K., & Mark, G. (2023, February). *Speaking of Psychology: Why our attention spans are shrinking, with Gloria Mark, PhD*. Apa.org.
<https://www.apa.org/news/podcasts/speaking-of-psychology/attention-spans>

Moula, Z. (2020). A systematic review of the effectiveness of art therapy delivered in school-based settings to children aged 5–12 years. *International Journal of Art Therapy*, 25(2), 88–99. <https://doi.org/10.1080/17454832.2020.1751219>

Penn, L. R. (2019). Room for monsters and writers: Performativity in children's classroom drawing. *Contemporary Issues in Early Childhood*, 146394911881945. <https://doi.org/10.1177/1463949118819456>

Rahma, R., & Rizki, S. (2023). EFFORTS FOR CHILDREN'S FINE MOTOR DEVELOPMENT THROUGH COLORING SCHEDULE MEDIA IN GROUP B CHILDREN AT TKN PERMATA HATI. *Early Childhood Research Journal (ECRJ)*, 5(2), 24–28. <https://doi.org/10.23917/ecrj.v5i2.20653>

Reed, C. L., & Ziat, M. (2018). *Proprioception and Kinesthesia - an overview* | *ScienceDirect Topics*.

Www.sciencedirect.com. <https://www.sciencedirect.com/topics/neuroscience/proprioception-and-kinesthesia>

Sapsağlam, Ö., & Birak, E. (2023). Examining the Effect of Increased Screen Usage Time on Preschoolers' Cognitive Process Skills During Covid 19 Period. *Malaysian Online Journal of Educational Technology*, 11(2), 108–126. <https://doi.org/10.52380/mojet.2023.11.2.466>

Schmidt, W.-P. (2017). Randomised and non-randomised studies to estimate the effect of community-level public health interventions: definitions and methodological considerations. *Emerging Themes in Epidemiology*, 14(1). <https://doi.org/10.1186/s12982-017-0063-5>

Singh, A. (2021). Quasi Experimental Design in Scientific Psychology. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.3793568>

Sapsağlam, Ö., & Birak, E. (2023). Examining the Effect of Increased Screen Usage Time on Preschoolers' Cognitive Process Skills During Covid 19 Period. *Malaysian Online Journal of Educational Technology*, 11(2), 108–126. <https://doi.org/10.52380/mojet.2023.11.2.466>

Taylor, R. L. (1972). COGLAB: A computer system designed for human research. *Behavior Research Methods & Instrumentation*, 4(2), 94–95. <https://doi.org/10.3758/bf03209322>

Tecnológica, U., Pereira, D., De, F., Artes, B., & Humanidades, Y. (2018). THE USE OF VISUAL ARTS AS A STRATEGY TO TEACH VOCABULARY IN SECOND GRADE AT THE PUBLIC SCHOOL LA JULITA, SEDE PROVIDENCIA PAOLA ANDREA RIVAS BALLESTEROS NATALIA TORRES FLÓREZ LUISA FERNANDA VALENCIA GARCÍA. <https://repositorio.utp.edu.co/server/api/core/bitstreams/d7f6f0c5-8c7c-44f5-b8c1-4fd9283089d0/content>

- Thippawong, L. (2020, December 4). *Art Theory: Freudian Psychoanalysis*. Arts Help. <https://www.artshelp.com/art-theory-freudian-psychoanalysis/>
- Thomson-Jones, K., & Moser, S. (2015). *The Philosophy of Digital Art (Stanford Encyclopedia of Philosophy)*. Stanford.edu. <https://plato.stanford.edu/entries/digital-art/>
- Tipper, S. P., Bourque, T. A., Anderson, S. H., & Brehaut, J. C. (1989). Mechanisms of attention: A developmental study. *Journal of Experimental Child Psychology*, 48(3), 353–378. [https://doi.org/10.1016/0022-0965\(89\)90047-7](https://doi.org/10.1016/0022-0965(89)90047-7)
- Vasylets, O., Mellado, M. D., & Plonsky, L. (2022). The role of cognitive individual differences in digital versus pen-and-paper writing. *Studies in Second Language Learning and Teaching*, 12(4), 721–743. <https://doi.org/10.14746/ssllt.2022.12.4.9>
- Veraksa, N., Veraksa, A., Gavrilova, M., Bukhalenkova, D., Oshchepkova, E., & Chursina, A. (2021). Short- and Long-Term Effects of Passive and Active Screen Time on Young Children's Phonological Memory. *Frontiers in Education*, 6. <https://doi.org/10.3389/feduc.2021.600687>
- Vedechkina, M., & Borgonovi, F. (2021). A Review of Evidence on the Role of Digital Technology in Shaping Attention and Cognitive Control in Children. *Frontiers in Psychology*, 12. <https://doi.org/10.3389/fpsyg.2021.611155>
- Voyer, D., Voyer, S. D., & Saint-Aubin, J. (2016). Sex differences in visual-spatial working memory: A meta-analysis. *Psychonomic Bulletin & Review*, 24(2), 307–334. <https://doi.org/10.3758/s13423-016-1085-7>
- Wang, C., Qian, H., Li, H., & Wu, D. (2023). The status quo, contributors, consequences and models of digital overuse/problematic use in preschoolers: A scoping review. *Frontiers in Psychology*, 14. <https://doi.org/10.3389/fpsyg.2023.1049102>
- Wagovich, S. A., Anderson, J. D., & Hill, M. S. (2020). Visual exogenous and endogenous attention and visual memory in preschool children who stutter. *Journal of Fluency Disorders*, 66, 105792. <https://doi.org/10.1016/j.jfludis.2020.105792>

Zakaria, Z., Setyosari, P., Sulton, S., & Kuswandi, D. (2019). The Effect of Art-Based Learning to Improve Teaching Effectiveness in Pre-Service Teachers. *Journal for the Education of Gifted Young Scientists*, 7(3), 579–592. <https://doi.org/10.17478/jegys.606963>

APPENDIX A

Statistics		
Gender		
N	Valid	20
	Missing	0

Gender			
		Frequency	Percent
Valid	Male	12	60.0
	Female	8	40.0
	Total	20	100.0

```

T-TEST GROUPS=Participants(0 1)
/MISSING=ANALYSIS
/VARIABLES=A_namefontdifferent
/ES DISPLAY(TRUE)
/CRITERIA=CI(.95).

```

Raw Output for Frequency Kindergarten Student

Group Statistics				
	Participants	N	Mean	Std. Deviation
RT after experiment for nfd (ms)	0	10	2190.1000	630.82557
	1	10	2522.7566	598.28633

Independent Samples Test						
		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
RT after experiment for nfd (ms)	Equal variances assumed	.405	.533	-1.210	18	.242
	Equal variances not assumed			-1.210	17.950	.242

Independent Samples Effect Sizes					
		Standardizer ^a	Point Estimate	95% Confidence Interval	
RT after experiment for nfd (ms)	Cohen's d	614.77127	-.541	-1.428	.360
	Hedges' correction	641.96060	-.518	-1.367	.345
	Glass's delta	598.28633	-.556	-1.454	.370

Raw Output for Difference between Digital Art and Physical Art toward Attention

Group Statistics

	Participants	N	Mean	Std. Deviation
RT after experiment for nfd (ms)	0	10	2190.1000	630.82557
	1	10	2522.7566	598.28633

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
RT after experiment for nfd (ms)	Equal variances assumed	.405	.533	-1.210	18	.242
	Equal variances not assumed			-1.210	17.950	.242

Independent Samples Effect Sizes

		Standardizer ^a	Point Estimate	95% Confidence Interval	
				Lower	Upper
RT after experiment for nfd (ms)	Cohen's d	614.77127	-.541	-1.428	.360
	Hedges' correction	641.96060	-.518	-1.367	.345
	Glass's delta	598.28633	-.556	-1.454	.370

*Raw Output for Difference between Digital Art and Physical Art toward Working Memory***Paired Samples Correlations**

	N	Correlation	Sig.
Pair 1 RT before experiment for nfd (ms) & RT after experiment for nfd (ms)	10	.896	<.001

Paired Samples Test

		Paired Differences							
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
Pair 1	RT before experiment (ms) - RT after experiment (ms)	207.04334	432.00443	136.61179	-101.99401	516.08069	1.516	9	.164

Paired Samples Effect Sizes

		Standardizer ^a	Point Estimate	95% Confidence Interval	
				Lower	Upper
Pair 1 RT before experiment for nfd (ms) - RT after experiment for nfd (ms)	Cohen's d	432.00443	.479	-.189	1.125
	Hedges' correction	451.11057	.459	-.181	1.077

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

Raw Output for Difference in Digital Art for Attention and Working Memory Before and After Experiment

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	RT(ms) before experiment & RT(ms) after experiment	10	.584	.077

Paired Samples Test

		Paired Differences							
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
Pair 1	RT(ms) before experiment - RT(ms) after experiment	673.49660	644.27978	203.73916	212.60661	1134.38659	3.306	9	.009

Paired Samples Effect Sizes

		Standardizer ^a		Point Estimate	95% Confidence Interval	
		Cohen's d			Lower	Upper
Pair 1	RT(ms) before experiment - RT(ms) after experiment		644.27978	1.045	.246	1.809
		Hedges' correction	672.77417	1.001	.236	1.732

a. The denominator used in estimating the effect sizes.
Cohen's d uses the sample standard deviation of the mean difference.

*Raw Output for Difference in Physical Art for Attention and Working Memory Before and After Experiment***Group Statistics**

	Gender	N	Mean	Std. Deviation
RT after experiment for nfd (ms)	Male	12	2360.4361	617.61528
	Female	8	2358.4187	671.87088

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
RT after experiment for nfd (ms)	Equal variances assumed	.079	.781	.034	18	.973
	Equal variances not assumed			.034	14.234	.974

Independent Samples Effect Sizes

		Standardizer ^a		Point Estimate	95% Confidence Interval	
		Cohen's d			Lower	Upper
RT after experiment for nfd (ms)	Cohen's d		639.26204	.016	-.879	.910
	Hedges' correction		667.53451	.015	-.842	.872
	Glass's delta		671.87088	.015	-.880	.909

Raw Output for Difference between gender for Attention and Working Memory

APPENDIX B

Fakulti Sains Kognitif dan Pembangunan Manusia
Faculty of Cognitive Sciences and Human Development


UNIVERSITI MALAYSIA SARAWAK

UNIMAS/NC-16.03/04-13/04 Jld.2 (46)

3 April 2024

Sylvia Thomas Salang
Pengetua
Tadika Brilliant Smart Reader Kids
Taman Desa Ilmu Kota Samarahan
No 9, Lorong Desa Ilmu 22N2
Taman Desa Ilmu
94300 Kota Samarahan
Sarawak

YBhg Datin,

Permohonan Menjalankan Kajian/Soal Selidik Bagi Projek Tahun Akhir

Dengan segala hormatnya perkara di atas dirujuk,

Dengan ini disahkan bahawa pelajar **Raja Nur Batrisya binti Raja Zairul Hafizam (81020)** adalah pelajar Program Psikologi, Fakulti Sains Kognitif dan Pembangunan Manusia, Universiti Malaysia Sarawak (UNIMAS). Beliau sedang menjalankan kajian untuk menyiapkan Projek Tahun Akhir bagi memenuhi syarat bergraduasi program tersebut.

Maklumat lanjut tentang pelajar dan kajian adalah seperti berikut:

Tajuk Kajian	: "Attention & Memory Makeover: Unveiling The Power Of Digital Art In Preschool"
Tempoh Kajian	: 1 hari (1 jam 30 minit)
Penyelia	: Puan Ros Azura Binti Zahit
No. Telefon Penyelia	: +66 7759 863507
E-mel Penyelia	: rrazura@unimas.my
No. Telefon Pelajar	: 011-65152002
E-mel Pelajar	: 81020@siswa.unimas.my

Sehubungan itu, sukacita kiranya pihak datin, dapat memberikan kerjasama kepada pelajar berkenaan untuk mendapatkan maklumat yang diperlukan. Segala maklumat yang diperolehi akan hanya digunakan untuk tujuan akademik semata-mata dan dijamin akan kerahsiaannya.

Kerjasama yang diberikan oleh pihak datin didahului dengan ucapan terima kasih.

Sekian.

Yang benar,


Ros Azura Binti Zahit
Penyelia
Projek Tahun Akhir

s.k - Penolong Pendaftar Kanan, FSKPM

94300 Kota Samarahan, Sarawak, MALAYSIA
Tel + 60 82 581 578

Community Driven University For a Sustainable World

 CamScanner

 Scanned with CamScanner

Example permission letter from faculty for kindergarten

Fakulti Sains Kognitif dan Pembangunan Manusia
Faculty of Cognitive Sciences and Human Development
UNIMAS/NC-16.03/04-13/04 Jld.2 (47)



3 April 2024

Janice Entaba
Pengetua
Tadika iKindy Kota Samarahan
777, Lorong Uni Central 5B
Taman Uni Central
94300 Kota Samarahan
Sarawak

Puan,

Permohonan Menjalankan Kajian/Soal Selidik Bagi Projek Tahun Akhir

Dengan segala hormatnya perkara di atas diujuk,

Dengan ini disahkan bahawa pelajar **Raja Nur Batriesya binti Raja Zairul Hafizam (81020)** adalah pelajar Program Psikologi, Fakulti Sains Kognitif dan Pembangunan Manusia, Universiti Malaysia Sarawak (UNIMAS). Beliau sedang menjalankan kajian untuk menyiapkan Projek Tahun Akhir bagi memenuhi syarat bergraduasi program tersebut.

Maklumat lanjut tentang pelajar dan kajian adalah seperti berikut:

Tajuk Kajian	: "Attention & Memory Makeover: Unveiling The Power Of Digital Art In Preschool"
Tempoh Kajian	: 1 hari (1 Jam 30 minit)
Penyelia	: Puan Ross Azura Binti Zahit
No.Telefon Penyelia	: +44 7759 863507
E-mel Penyelia	: rzazura@unimas.my
No.Telefon Pelajar	: 011-65152002
E-mel Pelajar	: 81020@siswa.unimas.my

Sehubungan itu, sukacita kiranya pihak puan, dapat memberikan kerjasama kepada pelajar berkenaan untuk mendapatkan maklumat yang diperlukan. Segala maklumat yang diperolehi akan hanya digunakan untuk tujuan akademik semata-mata dan dijamin akan kerahsiaannya.

Kerjasama yang diberikan oleh pihak puan didahului dengan ucapan terima kasih.

Sekian.

Yang benar,


Ross Azura Binti Zahit
Penyelia
Projek Tahun Akhir

s.k - Penolong Pendaftar Kanan, FSKPM

94300 Kota Samarahan, Sarawak, MALAYSIA
Tel + 60 82 581 578

Community Driven University For a Sustainable World



Example permission letter from faculty for kindergarten

QALF5J4

Fakulti Sains Kognitif dan Pembangunan Manusia
Faculty of Cognitive Sciences and Human Development
UNIMAS/NC-16.03/04-13/04 Jld.2 (41)



8 Mac 2024

Nur Farahiah Binti Ibrahim
Pengurus
Tadika Aktif Ceria 2
No 150, Lorong 22
Taman Desa Ilmu
94300 Kota Samarahan

Puan,

PERMOHONAN MENJALANKAN KAJIAN/SOAL SELIDIK BAGI PROJEK TAHUN AKHIR

Dengan segala hormatnya perkara di atas dirujuk.

Dengan ini disahkan bahawa pelajar **Raja Nur Batriesya binti Raja Zairul Hafizam (81020)** adalah pelajar **Program Psikologi**, Fakulti Sains Kognitif dan Pembangunan Manusia, Universiti Malaysia Sarawak (UNIMAS). Beliau sedang menjalankan kajian untuk menyiapkan Projek Tahun Akhir bagi memenuhi syarat bergraduat program tersebut.

Maklumat lanjut tentang pelajar dan kajian adalah seperti berikut:

Tajuk Kajian	: <i>"Attention & Memory Makeover: Unveiling The Power Of Digital Art In Preschool"</i>
Penyelia	: Puan Ross Azura Binti Zahit
No.Telefon Penyelia	: +447759 863507
E-mel Penyelia	: zrazura@unimas.my
No.Telefon Pelajar	: 011-65152002
E-mel Pelajar	: 81020@siswa.unimas.my

Sehubungan itu, sukacita kiranya pihak puan dapat memberikan kerjasama kepada pelajar berkenaan untuk mendapatkan maklumat yang diperlukan. Segala maklumat yang diperolehi akan hanya digunakan untuk tujuan akademik semata-mata dan dijamin akan kerahsiaannya.

Kerjasama yang diberikan oleh pihak puan didahului dengan ucapan terima kasih.

Sekian.

Yang benar, Dr Voon Siok Ping
Lecturer
Faculty of Cognitive Sciences and Human Development
Universiti Malaysia Sarawak
Dr Voon Siok Ping
Penyelaras
Program Psikologi

s.k – Penolong Pendaftar Kanan, FSKPM

94300 Kota Samarahan, Sarawak, MALAYSIA
Tel : 60 82 581 578

Community Driven University For a Sustainable World

INFORMATION SHEET ON STUDY


UNIMAS
 UNIVERSITI MALAYSIA SARAWAK

Raja Nur Batriesya Binti Raja Zairul Hafizam
81020@siswa.unimas.my
 +60 1165152002

Title of study: Attention & Memory Makeover: Unveiling the Power of Digital Art In Preschool

I would like to invite your child to take part in our study. Before you decide, it is important that you understand why the study is done and what you will need to do. Please take time to read this information. If there is anything that is not clear, or if you would like more information, please ask us.

What is the purpose of the study?

The purpose of this study is to understand the effectiveness of digital art-based learning in improving attention and working memory among preschool children. This research is necessary to improve the understanding of the use of digital art for children and aims to harness the benefits of digital art to capture students' interest in learning.

Why have my child been invited?

The expected number of participants is 20 participants of kindergarten students. If your child is 6 years old, your child is invited to participate in the study on the effect of digital art-based learning in improving attention and working memory among preschool children.

Does my child have to take part?

Your child's participation in this study is voluntary. He or she does not have to be in this study if he or she does not want to. They may also refuse to answer any questions they do not want to answer. If he or she volunteers to be in this study, he or she may withdraw from it at any time. If he or she withdraws, any data collected from his or her up to his or her withdrawal will still be used for the study. His or her refusal to participate or withdraw will not affect any benefits to which he or she is otherwise entitled.

What will taking part involve?

It is important that your child answer all the questions honestly and completely which will take about 30 minutes of his or her time. He or she is also required to adhere to the given instructions during the experiment. He or she has 48 attempts to answer the provided questions. He or she also needs to follow the researcher's instructions.

Are there any possible disadvantages or risks of taking part?

The risk is minimal. Your child is free to decline to answer any of the questions that he or she feels uncomfortable with.

CS Scanned with CamScanner

Example Consent Form for Parents

What are the possible benefits of taking part?

There may or may not be any benefits to your child. Information obtained from this study will help to create a conceptualisation of the meaning to assist in understanding the relation between feedback, inspiration for the project and impact of the project on the community.

Will my child taking part in the study be kept confidential?

All your child's information obtained in this study will be kept and handled in a confidential manner, in accordance with applicable laws and/or regulations. When publishing or presenting the study results, your identity will not be revealed without your expressed consent. Individuals involved in this study, qualified monitors and auditors, and governmental or regulatory authorities may inspect the study data, where appropriate and necessary.

What will happen to the results of this study?

The findings of this study will be disseminated to the public. However, all respondent-related information will remain confidential and will not be disclosed.

What if there is a problem?

If you wish to complain about any aspect of the way in which your child have been approached or treated, or how your child's information is handled during the course of this study, you should contact, Raja Nur Batriesya binti Raja Zairul Hafizam, (Email:81020@siswa.unimas.my / 011-65152002) or you may contact the Jawatankuasa Etika Penyelidikan Manusia (Bukan Perubatan), Universiti Malaysia Sarawak, hrec@unimas.my

Who is organising and funding the study?

No external funding for this study.

Participation in future research

In future studies, you might be contacted again to collect more data. However, your contact details will be kept separately in password-protected files in Google Drive which could only be accessed by the researcher.

We appreciate your consideration of participation in the study.

Example Consent Form for Parents

PARTICIPANT INFORMATION SHEET

CONSENT FORM

Attention & Memory Makeover: Unveiling the Power of Digital Art in Preschool
Raja Nur Batriesya binti Raja Zairul Hafizam

If you agree to let your child participate in the study, please tick the boxes.

	Yes
1. I have read the information sheet dated _____ for this study. I have had the opportunity to consider the information, ask questions, and have these answered satisfactorily.	
2. I understand that my child's participation is voluntary and that he or she is free to withdraw at any time without giving any reason, and without his or her legal rights being affected.	
3. (If appropriate) <i>I agree to the [interview/focus group] being audio/video recorded.</i>	
4. I understand that all data my child provides will be kept confidential and stored securely in password-protected files. Only the researchers will have access to this.	
5. I understand that my child's data will remain anonymous at all times, including when the results of the study are disseminated in conferences, published articles, and/or _____ (state other platforms, if any).	
6. I have been provided with details of whom I should contact about the study.	
7. I agree to let my child take part in this study.	

Name of Parent

Date

Signature

Example Consent Form for Parents

X PARTICIPANT INFORMATION SHEET

CONSENT FORM

Attention & Memory Makeover: Unveiling the Power of Digital Art in Preschool
Raja Nur Batrisya binti Raja Zairul Hafizam

If you agree to let your child participate in the study, please tick the boxes.

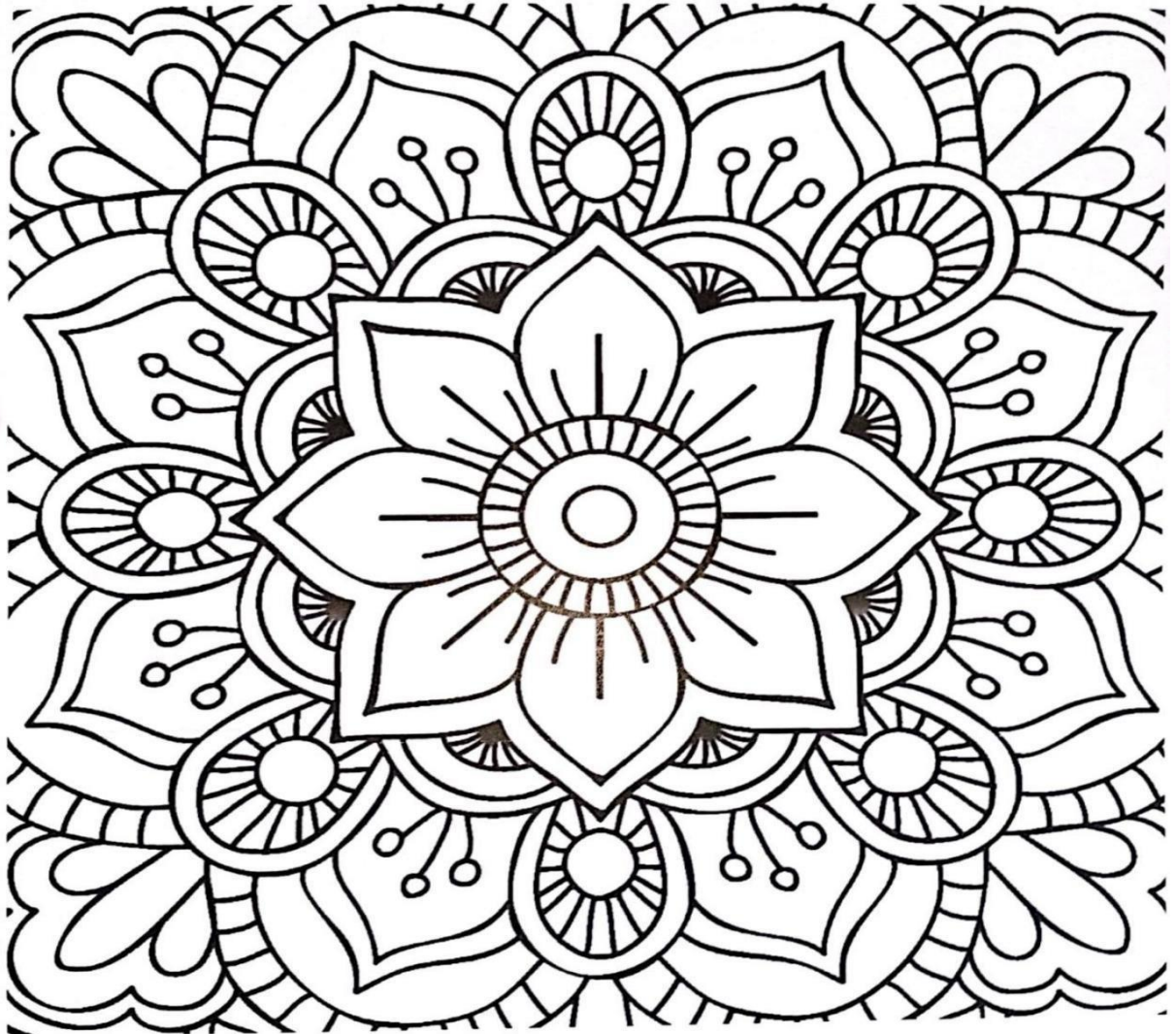
	Yes
1. I have read the information sheet dated <u>28 Nov 2024</u> for this study. I have had the opportunity to consider the information, ask questions, and have these answered satisfactorily.	/
2. I understand that my child's participation is voluntary and that he or she is free to withdraw at any time without giving any reason, and without his or her legal rights being affected.	/
3. (If appropriate) <i>I agree to the [interview/focus group] being audio/video recorded.</i>	
4. I understand that all data my child provides will be kept confidential and stored securely in password-protected files. Only the researchers will have access to this.	/
5. I understand that my child's data will remain anonymous at all times, including when the results of the study are disseminated in conferences, published articles, and/or (state other platforms, if any).	/
6. I have been provided with details of whom I should contact about the study.	/
7. I agree to let my child take part in this study.	/

Dys Khayrunnisa binti
Ranigal
 Name of Parent

27/8/2024
 Date

[Signature]
 Signature

Example Consent Form that has been signed by Parents



Scanned with ACE Scanner

CS Scanned with CamScanner

Mandala Pattern used in the experiment



Coloured pencil used in the experiment for the students