IMPROVING THE WORKING MEMORY OF STUDENTS WITH DOWN SYNDROME THROUGH A COGNITIVE INTERVENTION PROGRAM

SHAZNEE IRYANA BINTI YUSOFF

A thesis submitted in fulfilment of the
requirements for the award of degree of
Doctor of Philosophy (Educational Psychology)

Faculty of Education
Universiti Teknologi Malaysia

MARCH 2017

To my beloved family for their encouragement, patience and love during the completion of this thesis.

ACKNOWLEDGEMENT

During the preparation of this thesis, I met a lot of people, researchers, academicians and educators who have contributed towards my understanding and thoughts. First and foremost, I wish to express my earnest appreciation to my supervisor, Assoc. Prof. Dr. Yeo Kee Jiar, for her constant encouragement, guidance, advices; as well as critics and warm friendship throughout the journey of this thesis. Without her continuous support, this thesis would not be as it is presented here.

I am also indebted to all the teachers, parents and children who have shown their full commitment and support since the first until the last stage of this study. Without their assistance, such attempt would not be possible. I would also like to extend my utmost appreciation to Universiti Teknologi Malaysia (UTM) for funding my Ph.D. study. It did played a big part in helping me in completing my thesis.

Special thanks to my fellow colleagues and others who have provided suggestions, assistance and motivation during various occasions. Their insights and tips are definitely valuable.

Last but not least, I would like to express my deepest appreciation to my lovely parents, Hj Yusoff and Hjh Wan Alami; my supportive husband, Muhammad Ridhwan; and all my supportive close friends who encourage me at all times. It certainly gave me the audacity to move forward and completed my Ph.D. journey.

ABSTRACT

Individuals with Down syndrome (DS) experience delays in the development of their motor, social, personal, language, speech and cognitive skills. These individuals have the ability to perceive information accurately even though they have limited memory span, and are incapable of manipulating this information. These problems in their thinking and learning are related to mental abilities. These reflect incompetency in their working memory, and this gap exists in students with DS. Furthermore, teachers in special education classrooms in Malaysia do not emphasize the role of working memory to enhance learning. This study investigated the effectiveness of a cognitive intervention program designed as a more specific and systematic method of teaching to facilitate working memory in children and adolescents with DS. This study adopted a quasi-experimental research design with pre- and post-tests. Forty children and adolescents with DS, aged 6-14 years old from seven primary schools within Kuala Lumpur were selected and equally divided into experimental and control group. Pre- and post-tests given were based on the Automated Working Memory Assessment (AWMA). A 12 week cognitive intervention program of 30 minutes per day for 5 times per week was carried out by teachers at the respective schools for the experimental group. After the intervention, the mean scores of all AWMA components (Verbal Short Term Memory, Visuo-Spatial Short Term Memory, Verbal Working Memory and Visuo-Spatial Working Memory) in the experimental group increased. On the other hand, there was a slight decrease in the mean scores of Verbal Short Term Memory and Visuo-Spatial Short Term Memory of the control group. Wilcoxon signed-rank tests revealed that the experimental group showed significant improvement in all AWMA components after intervention in comparison to the control group. The findings of the cognitive intervention program have shown that it is effective in enhancing the working memory in children with DS. As a conclusion, the program can be used as a feasible working memory intervention within the national special education curriculum.

ABSTRAK

Individu Sindrom Down (SD) mengalami masalah perkembangan dalam kemahiran motor, sosial, personal, bahasa, pertuturan serta kognitif. Individu ini mempunyai keupayaan untuk mentafsir maklumat dengan tepat walaupun tempoh masa ingatan mereka adalah terhad dan tidak berupaya untuk memanipulasi maklumat tersebut. Masalah kemahiran berfikir dan pembelajaran ini adalah berkaitan dengan keupayaan mental. Ini menunjukkan ketidakcekapan dalam ingatan kerja mereka dan jurang ini wujud dalam kalangan pelajar SD. Tambahan pula, guru-guru pendidikan khas di Malaysia didapati tidak menekankan peranan ingatan kerja untuk meningkatkan kemahiran pembelajaran. Kajian ini mengkaji keberkesanan program intervensi kognitif yang direka sebagai kaedah pengajaran yang lebih khusus dan sistematik untuk memudahkan ingatan kerja dalam kalangan kanak-kanak dan remaja SD. Kajian ini mengguna pakai reka bentuk kajian kuasi-eksperimen dengan ujian pra dan pos. Seramai empat puluh orang kanak-kanak dan remaja SD, berusia 6-14 tahun dari tujuh buah sekolah rendah di Kuala Lumpur telah dipilih dan dibahagikan secara sama rata kepada kumpulan kajian dan kumpulan kawalan. Ujian pra dan pos yang dilaksanakan adalah berdasarkan *Automated Working Memory Assessment* (AWMA). Program intervensi kognitif yang dilaksanakan sepanjang 12 minggu selama 30 minit sehari, 5 kali seminggu telah dijalankan oleh guru-guru di sekolah masing-masing untuk kumpulan kajian. Selepas intervensi, skor min bagi semua komponen AWMA (Ingatan Jangka Pendek Verbal, Ingatan Jangka Pendek Visuo-Spatial, Ingatan Kerja Verbal dan Ingatan Kerja Visuo-Spatial) dalam kumpulan kajian meningkat. Namun, terdapat sedikit penurunan dalam skor min Ingatan Jangka Pendek Verbal dan Ingatan Jangka Pendek Visuo-Spatial bagi kumpulan kawalan. Ujian *Wilcoxon signed-rank* mendedahkan bahawa kumpulan kajian menunjukkan peningkatan yang ketara dalam semua komponen AWMA selepas intervensi berbanding dengan kumpulan kawalan. Hasil daripada program intervensi kognitif menunjukkan bahawa program tersebut efektif dalam meningkatkan ingatan kerja kanak-kanak SD. Kesimpulannya, program ini boleh digunakan sebagai intervensi ingatan kerja dalam kurikulum pendidikan khas negara.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AAS	-	Atlantoaxial Subluxation
ADDIE	-	Analysis of Needs, Design, Development, Implementation and Evaluation WMI Working Memory Index
ADHD	-	Attention Deficit and Hyperactive Disorder and Cultural Organization
ASD	-	Atrial Septal Defect
ASSURE	-	Analyze, State, Select, Utilize, Require, Evaluate
AWMA	-	Automated Working Memory Assessment Bermasalah Pembelajaran' test
BM	-	Bahasa Melayu
BPPDP	-	Bahagian Perancangan dan Penyelidikan Dasar Pendidikan.
CBCL	-	Child Behavior Checklist
CMS	-	Children's memory Scale
COM	-	Chronic Otitis Media
CRPD	-	Convention on the Rights of Persons with Disabilities
DOC	-	Direct Observation Checklist
DS	-	Down syndrome
DSW	-	The Department of Social Welfare
EIP	-	Early Intervention Program
EPRD	-	Educational Policy on Research and Planning, Ministry
ES	-	Effect Size
FBOs	-	Faith-based organisations
FX-O	-	Fragile X syndrome
FXS-ASD	-	Fragile X syndrome with autism spectrum disorder

IPP	-	Instrumen Penentuan Penempatan
JKM	-	Jabatan Kebajikan Masyarakat
K- ABC	-	Kaufman Assessment Battery for Children
KKBP	-	'Percubaan Alat Penilaian Kelas Khas
M	-	Mean
MA	-	Mental age
Mdn	-	Median
MOE	-	Ministry of Education
MOH	-	Ministry of Health
MWFCD	-	Ministry of Women, Family and Community Development
N	-	Number of samples
NECIC	-	National Early Childhood Intervention Council
NGO	-	Non-Govermental Organization
		of Education
OT	-	Occupational therapy
PDA	-	Patent Ductus Arteriosus
PDK	-	Pemulihan Dalam Komuniti
PSDKL	-	Persatuan Sindrom Down Kuala Lumpur
PWD	-	People with Disabilities
RPI	-	Rancangan Pendidikan Individu
SD	-	Standard Deviation
SEIP	-	Special Education Integrated Programs
SPSS	-	Statistical Package for the Social Sciences
TD	-	Typically developing
TMD	-	Transient Myeproliferative Disease
TSS	-	Teacher Satisfaction Survey
UNESCO	-	The United Nations Educational, Scientific
UNICEF	-	The United Nations Children's Fund
VSD	-	Ventricular Septal Defect
WISC-IV	-	The Wechsler Intelligence Scale for Children- Fourth Edition
WMRS	-	The Working Memory Rating Scale
WMRS	-	Working Memory Rating Scale
ZPD	-	Zone of Proximal Development

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Introduction

Down syndrome is a chromosomal disorder caused by an error in cell division that results in an extra 21st chromosome. There are three types of Down syndrome: trisomy 21 (nondisjunction), translocation and mosaicism. According to Reeves *et al.* (1995), Trisomy 21 or Down syndrome (DS) is the most common genetic cause of severe intellectual disability (ID). Down syndrome occurs in approximately 1 in 700 to 1 in 1000 live births, although it is difficult to make an accurate approximation in most countries (Wishart, 1998). With the presence of only one extra chromosome, an individual is born with an intellectual disability and specific physical traits, namely the Down syndrome.

Their features resemble those of Mongolian people, hence the 'Mongoloid' term that is often related to people with DS. However, The World Health Organization (WHO) dropped the term in 1965 after a request by the Mongolian delegate (Howard-Jones, Norman, 1979). Their distinctive features set them apart from others. Physical characteristics include an abnormally small chin, upward slanting eyes with skin folds on the inner corner of the eyes, poor muscle tone (hypotonia), a flat nasal bridge, a single fold in the palm of the hand, a protruding tongue (due to small oral cavity, and an enlarged tongue) a flat and broad face, a short neck and short fingers. They may have some or all of those physical characteristics. With an IQ ranging from mild (IQ 50-70) to moderate (IQ 35-50) in most individuals with DS, they usually learn and progress more slowly than other

children. However, this does not inhibit them from functioning like normal people. They have their own strengths and weaknesses. Individuals with DS usually have delayed development in speech, fine motor skills and often lag behind in gross motor skills which interfere with cognitive development.

The cognitive development is a reflection of an individual's intelligence and intelligent behaviour (Buckley, 1999). It entails the development of the mental abilities of thinking, talking, remembering and reasoning. Individuals with DS have delays in cognitive development, which translates to problems in thinking and learning which are related to mental abilities. They exhibit specific deficits in speech, language and auditory short-term or working memory. Mental abilities are an important aspect in understanding and controlling daily lives. Impairment in mental abilities impedes learning for individuals with DS. In order to learn, one has to understand, retain and store the information. The ability to remember what has been learned is a key indicator of learning.

Memory is one of the core features of deficits in cognitive development in DS. Although individuals with DS have the ability to perceive information accurately, they experience delays in being able to interpret and use this information. This is due to the deficit in their executive function, an attention control system responsible for manipulating information. Individuals with DS have extreme limitations in memory span especially in processing verbal information which contributes to poor language and learning (Byrne et al., 1995). Individuals with DS have been identified as having multiple deficits in the short-term memory, the peripheral systems of articulatory rehearsal as well as central systems that direct information processing (Hulme and Mackenzie, 1992).

Working memory is a cognitive system used for short-term storage and manipulation of information required for various cognitive tasks. Short-term memory holds both verbal and visual information, which is then transferred to the working memory which can manipulate information (Baddeley, 1992). This is due to the existence of the central executive (an attention control system) in working memory

system that regulates and manipulates information. Baddeley and Hitch (1974) introduced the renown working memory model which involves a central executive which is an attention control system responsible for manipulating information, a phonological loop for maintaining and rehearsing verbal information, and a visual-spatial sketchpad for storing visual–spatial information. Baddeley then revised this model to include an episodic buffer, which is thought to be a multi- modal system which integrates the memory across domains (visual, spatial, verbal, etc.) into scenes or episodes.

By improving the functioning of working memory, it leads to better learning skills in individuals with DS. The improving memory could have a positive impact on the speech, language and cognitive development of children and adults with DS. Consequently, this enables them to function better in terms of adaptive behaviour such as grooming, safety, cleaning, making friends and personal responsibility. The ability to function well in these activities require the use of memory-related tasks for the understanding, manipulation and use of information that they have learnt and put it into use.

Any strategies or intervention to assist children with DS to learn or improve their memory should take into account the difficulty experienced by children with DS in processing significant amounts of verbal language, instructions, as well as any tasks which require auditory skills. Children with DS experience difficulty in retaining words and sounds, hence their memory quickly becomes overloaded, making it difficult to store much of the information in their memory. In view of these deficits, learning tasks should be structured and broken down into small steps so as to enhance understanding and memory.

To enhance memory in children with DS, rigorous rehearsal training was found to be effective in improving the mean memory span (Comblain, 1994). They have to be taught the right thing right from the start and the term ‘trial and error’ is not in their dictionary. Children with DS are “errorless learners” where they tend to repeat the mistakes done at the beginning and take a long time to correct them;

therefore, they should be taught the right thing right from the start. Errorless learning helps them to remember better since their mind is not loaded with mistakes and corrections. The experience of success and absence of the sense of incapacity in learning could get the children with DS to take responsibility for their learning and remember whatever they have learned.

With lower cognitive ability and difficulties in coping with multiple developmental skills, an intervention program should be implemented in order to make learning more effective. This is further supported by the Individuals with Disabilities Education Act (IDEA), 2004. It states that research-based intervention is fully supported and encouraged in order to help students with disabilities. A Free Appropriate Public Education (FAPE) program that prepares students in special education for further education, employment and independent living was elucidated by IDEA, 2005. Instructional methods and materials should be developed and tailored to cater for their unique needs.

Based on past studies of memory training, Laws, Buckley *et al*. (1995) observed that many children with DS are able to learn letter sounds just like children in the mainstream classes through the use of picture symbol systems which serve as visual supports for words and sentence building. Oelwin (1995) took a game-like approach, such as the word lotto, to help students with DS organize symbolic information for memory filing which showed promising early results. Broadley *et al.* (1994) planned an intervention study using two strategies; rehearsal and organization. In the rehearsal training, children were taught how to learn a list of items by rehearsing them aloud and in order while in the organization training, the children were taught how to group items into categories in order to help them to remember them. The children were able to use both strategies. The training significantly improved the children's visual and short-term memory spans. Various memory training studies indicate that it is possible to improve short-term memory skills of children with Down Syndrome (Conners *et al*., 2008).

This study seeks to investigate the ability of working memory in children with DS through an intervention program. The purpose of this study is to conduct a cognitive intervention involving students with DS from a few primary schools in the capital city of Malaysia that will then lead to more specific and systematic teaching tools for working memory in children and adolescents with DS. This research employed an experimental design in tackling issues regarding working memory in children with DS. Narratives and visuals are used to enhance the memory span in children with DS. It was anticipated that the result from this study would shed new insights and contribute towards more informed educational practices for children with disabilities.

This chapter begins with an overview of the context and background that frames the study. This is followed by the problem statement, the statement of purpose, objectives, and accompanying research questions. Also included in this chapter is a discussion of the research approach, the researcher's perspectives, and the researcher's assumptions. The chapter concludes with a discussion of the proposed rationale and significance of this research study as well as definitions of some of the key terminology used. Finally, the chapter concludes with a discussion of the scope and delimitations of this study.

The purpose of this study is to implement a cognitive intervention program that will lead to the use of more specific and systematic teaching tools for improving the working memory in children and adolescents with Down syndrome (DS). This chapter discusses the methods and procedures of the study. It provides information on the research design and instruments, sampling methods, intervention programs, pilot study, instrumentation, data collection and analysis.

This study adopts a quasi-experimental research design with pre-tests and post-tests for both the experimental and control groups. Forty children and adolescents with Down syndrome (DS), aged 6-14 years old were selected as the sample of this study. They were selected from 7 schools within Kuala Lumpur. The pre-test stage emphasized on assessing the level of working memory in children with

DS using the Automated Working Memory Assessment (AWMA) developed by Tracy Packiam Alloway (2007). After the pre-test stage, children and adolescents in the experimental group were given an intervention program which was based on the Working Memory Model (Baddeley, 2000) and Children's Memory Scales Assessment (CMS) to enhance their level of working memory. Lastly, during post-test, both children and adolescents in the experimental and control groups were assessed again with the use of AWMA.

1.2 Background of the Study

People with DS often have distinct physical characteristics, health issues, and variability in cognitive development. They experience delays in almost all areas of development, including motor skills, developmental areas in social, personal, language, speech and cognitive. Their delay in physical, social, and intellectual conditions varies among individuals. Generally, their development is slower than that of most children. They have their own profile of strengths and weakness, with some areas of their development being less affected than others. One of the more prominent and pertinent weaknesses in DS falls in the area of cognitive development particularly in information processing which affects their memory span, language development and reading development. Being the main component of cognition, memory plays an important part in cognitive development. Subdomains of memory include implicit/procedural (such as kicking a ball), explicit/declarative (consciously recalled memory), episodic, semantic (concept-based knowledge), and working memory.

The working memory is a cognitive system responsible for storing information for a brief period of time and provides the ability to manipulate it as much as is required for various cognitive tasks (Baddeley 1992). According to Rankin and Hood (2005), memory deficiencies in childhood can have negative effects on the development of literacy, language, personal relationships, social skills, and a sense of personal history. Moreover, Hitch and McAuley (1991) mentioned

that children who exhibit memory impairment during childhood years may have hampered academic performance, especially in arithmetic. Additionally, Alloway *et al*. (2009) allegedly said that it can eventually cause secondary deficits such as low self-esteem. Nevertheless, memory performance is likely to improve if interventions are performed during development resulting in improved cognitive skills.

Byrne et al. (1995) found that there are deficits in processing verbal information in people with Down syndrome which contribute towards poor language and learning outcomes. This shows that they have difficulties in understanding learning materials. Although they have the ability to perceive information accurately they have a delayed ability to interpret and manipulate the information. Weakness in their auditory short-term memory and auditory processing is found to be prevalent. They also have specific speech and language delay, with their receptive language being better than their expressive language. Some of them may also have shorter attention and concentration spans compared to their typically developing peers. The ease of distraction and difficulty in focusing on more than one task at a time are attributes which indicate a problem with processing and retaining information presented orally. Whenever there is speech and language deficiency, thinking and reasoning skills are affected. Thus, people with Down syndrome have a problem in transferring skills from one situation to another, making decisions and choices, grasping abstract concepts and problem-solving. However, they are believed to be more superior in visual processing and visual memory skills, thus making the visual teaching approach such as the use of concrete and practical materials an important aspect in teaching them. In order to reduce working memory loads, they should also be taught simple and smaller things (Gathercole and Alloway, 2008).

On the other hand, this does not mean that individuals with DS will forever be left behind. There is quite a handful of individuals with DS who have achieved a lot in their life and have become a source of inspiration to others. These remarkable people have participated in everything from acting to sports, from all backgrounds, education opportunities and circumstances.

One of them is Chris Burke, an actor of the famous ‘Life Goes On', an ABC-television series. After graduating in 1981, Chris Burke, the boy scout, musician and actor became the Goodwill Ambassador of the American Down Syndrome Society (NDSS). It is a necessity for actors to remember their lines, and this goes to show that if Chris Burke can do it, so can other people with Down syndrome, provided they work hard and have a ‘can do' attitude. His mother said that integration and inclusion had to be, and were accomplished in the social aspect of his life and in the community-based programs we sought out. Another accomplished Down syndrome figure is Sujeet Desai. He is an accomplished professional musician and self-advocate with Down syndrome from New York, USA. Sujeet plays 6 musical instruments including the Bb and Bass Clarinet, Alto Saxophone, Violin, Piano and Drums and has just started to learn his 7th, the trumpet. Sujeet graduated from High School in 2001 with honours, and from the Berkshire Hills Music Academy, Massachusetts in 2003. Due to his achievements in the area of music and self-advocacy, many awards have been given to him, including the "Honour and Pride" and the "Leaders Award". Sujeet also holds a 2nd dan black belt in Tae Kwan Do, is a "Sensei" martial arts teacher, and has won a number of awards in sports including a gold and silver medal for swimming at the 1999 Special Olympics World Summer Games. As quoted by Sujeet, "I was born with Down syndrome. Therefore I learn things slowly. I have worked very hard for so many years to learn what I love to do to overcome the limitations of my disability". This shows that it is not impossible for individuals with Down syndrome to achieve things in life even though they are slow learners. He managed to remember music notes (although not all) and be who he is today. Again, like Chris Burke; he had to train over and over again in order to perform better in his musical performances. This suggests that learning depends on the memory capabilities as one has to remember and manipulate information learned before it can be retrieved.

These individuals had the strong support of their families and had effective learning and training which optimized their information processing ability. This enhanced their memory resulting in their effective learning. In Malaysia, students with special educational needs are mostly placed in special education classes which are segregated from the mainstream. These children are taught by teachers who are

trained in special education but generally have little knowledge about the specific and appropriate methods for teaching these students (MOE, 2012). Moreover, teachers also lack the knowledge as well as skills to improve cognitive development of these special students, hence requiring the input of experts on ways to improve students learning (MOE, 2012). In regards to improving working memory, it has been argued whether working memory training yields generalized cognitive enhancement. Morrision and Chein (2011) argued that knowledge of the different impacts of specific working memory procedures could afford opportunities to combine training programs and thereby alter cognition on multiple levels.

Chris Burke and Sujeet Desai are the prime examples of successful individuals with DS. Their success was attributed to their ability to remember their learning sessions. Most individuals with DS do not have this capacity. Memory retention is one of the key concerns for individuals with DS (Nadel, 1999). They are generally poor in working memory which supports activities involve grasping and manipulating information (Jarold & Baddeley, 2001). Most of them find it hard to keep important information in mind while doing other cognitive tasks such as comprehension, thinking and acting. Jarold (2001) explained that the working memory model provides a framework for describing and explaining deficits in working memory function in individuals with developmental disorders. By characterizing working memory deficits in the individuals, not only can we identify deficits within each developmental disorders group, but we can also be able to make suggestions on ways memory abilities may be improved. Since learning and memory go hand in hand, it is important for educators to target the cognitive area since it is the essential tool for one's ability to think and act corresponding to what that has been learned (Nadel & O'Keefe, 1974). The special education classes in Malaysia are inadequate in accommodating the variability of cognitive levels of students with special educational needs mainly due to the fact that special education teachers are lacking in the knowledge and skills to improve cognitive development of Special Education Needs (MOE, 2012).

There are many acts that support special people in participating in the education system. In Malaysia, there is the OKU Acts. According to section 4,

number 28 (1) (2) (3), disabled people and children are not prohibited in taking part in the education system starting from preschool up until higher education. It also says that both government and private institutions should provide whatever is required in order to facilitate learning for disabled people. There is also The Education for All Handicapped Children Act (EHA) or Public Law 1975. It was legislated by the United States Congress in 1975. This act required all public schools accepting federal funds to provide equal access to education and one free meal a day for children with physical and mental disabilities. Four major goals of this law are; to ensure that special education services are available to children who need them, to guarantee that decisions about services to disabled students are fair and appropriate, to establish specific management and auditing requirements for special education and to provide federal funds to help the states educate disabled students. It was then revised and renamed as Individuals with Disabilities Education Act (IDEA) in 1990. IDEA 2005 clarifies that students in special education must be provided with Free Appropriate Public Education (FAPE) that prepares them for further education, employment and independent living. The use of research-based interventions is also proposed by IDEA 2004 to assist students with disabilities.

Support from global authorities is also attained. The United Nations Convention on the Rights of the Child (CRC) is a human rights treaty setting out the civil, political, economic, social, health and cultural rights of children. It defines a child as any human being under the age of eighteen unless the age of majority is attained earlier, as prescribed by a state's own domestic legislation. The Convention deals with the child-specific needs and rights. It requires that states act in the best interests of the child. The No Child Left Behind Act of 2001 (NCLB) is a United States Act of Congress that is responsible for reauthorization of the Elementary and Secondary Education Act. Free and accessible education for all children that was proposed by EHA 1975 was maintained in this act.

Other than that, the local government also has another act that supports special education needs which are the Education Acts 1996 (based on Penyata Razak 1961), under section 40 and 41 that states the rights for special education rehabilitation within the country's educational system. Special children can take part

in the schooling session until they are 19 years of age. One of the acts says that there is a need for the right technique or methods of teaching for different categories within special children themselves. This is in line with the purpose of this study which targets an intervention program specifically for children with Down syndrome. Moreover, this act is in response to The Slamanca Statement of 1994 which stressed on the idea that educational planning by governments should concentrate on education for all persons, in all regions of a country and in all economic conditions, through both public and private schools. This brings the notion of inclusive schools, a reflection of genuine equalization of opportunity. Experience in many countries demonstrates that the integration of children and youth with special educational needs is best achieved within inclusive schools that serve all children within a community. The core principle of the inclusive school is that all children should learn together, wherever possible, regardless of any difficulties or differences they may have.

However, inclusive classrooms in Malaysia generally face some issues that hinder the implementation of inclusive education. According to Zarin Ismail, Safani Bari and Soo Boon Seng (2004), social integration among special children and typically developing students is minimal. This may be due to the different recess hours which make it difficult for them to interact with each other. Additionally, the typically developing students tend to use vulgar labels on these special students which could affect their self-esteem. The separation that happens between special students and typically developing students in the same classroom (normal classroom) by teachers also defeats the purpose of the integration process. Teachers say that it is needed due to the harassment of the special students by their typically developing counterparts in the midst of teaching and learning. Teachers must realize that doing this further widens the gap between the special students and typically developing students. Moreover, significant declines were shown in the enrolment of children with disabilities in inclusive education programs (MOE, 2012). According to Norliah & Mohd Hanafi (2016), three out of five teachers are lacking in basic knowledge and skills in handling special students. They also lack the necessary experience. Hence, it is imperative to provide training for them. Even though typically developing students

seem to interact just fine with the special needs students, it is worth noting that those special students are the high ‘functioning ones' only.

Ministry of education in Malaysia has been conducting tests to assess students' achievement in literacy and numeracy since 2006 through KIA2M (Early Intervention Class on Reading and Writing) and replaced it with LINUS in 2010 (literacy and numeracy screening tests). These aspects are related to cognitive development which necessitates attention and the use of memory systems in the process of learning. Remedial classes and intensive training were provided for students who did not pass the minimum level. For most students, they managed to achieve the minimum level after less than three years of intervention but in the case of special education students, they fall behind their peers. One could possibly argue that it is too difficult for students with DS to process, manipulate and store the language learned. Without specific working memory training, it is difficult for students with DS to acquire language where they are generally born with deficits in language and logic (Van der Lely and Howard, 1993).

The purpose of the LINUS program is to assess and improve literacy and numeracy. During the first preliminary stage, the LINUS instrument that had been used in typically developing students is being modified to accommodate the special student. Other than that, most assessments that are being conducted on special students are mostly too general and wide. This is mainly because most of them are taken from outside sources (internationally) and do not cater for the difference in knowledge that Malaysian students have compared to international students. One of the factors that might cause that is the difference in the environment. Different environments will directly impact the knowledge and adaptive skills of these special students. The lack of appropriate tools during assessment might also create speculations in the validity of that assessment. Monthly tests are also given to these special students according to the ‘Yearly Teaching Program' (*Rancangan Pengajaran Tahunan, RPI*). This is considered to be an inappropriate approach given that each special student has a different level of knowledge and thereby should be given tests according to their level of knowledge instead of following the school’s

general approach. This will eventually give the wrong verdict on one's true achievement.

Persatuan Sindrom Down Malaysia (PSDM), a non-governmental organization that supports the growth and development of Down syndrome community in Malaysia reported that the current scenario of environment for DS is much better compared to that of 20 to 30 years ago. They have also been exposed to information regarding advancements in research both locally and internationally. According to Dr. Sharifah Zainiyah (2015), currently, achievements of DS students are not at the point where much has been accomplished, instead, most of them are still being supported by their family and cannot seem to be able to live independently. However, she also stressed that DS children have the potential to be trained from infancy. They can be more independent if they were trained with the appropriate intervention. Dr. Sharifah Zainiyah believes that every child with DS has their own potential and limitation; hence a more specific approach has to be taken for each child.

On the other hand, the quality of education of children with DS is generally poor due to certain factors. Firstly, the awareness among parents themselves is low. This can be seen clearly especially for those who live in the suburban areas. There are parents who do not believe that their children can gain access to a balanced and better education. There are also those who do not know the importance of teaching adaptive skills to their children as they do not trust their children to be independent; especially when it comes to things such as sewing and cooking. This is due to the fact that they are worried about their children's safety and are always pessimistic when it comes to their special child. Other than that, the society's stigma about children with DS also plays an important part in the quality of life for children with DS. There are still some negative associations to children with DS which linger on till now. Students with DS are often ridiculed by other typically developing students (in schools that have an inclusive program) and even by those teachers who are not special education teachers.

Furthermore, even the school principal tends to think that they are incompetent and cannot contribute anything towards the school, thus making them the second priority in everything compared to those typically developing students. Funds allocation for special students is often neglected, making any chances for access to a better source of education, whether it is with regards to the facilities or the quality of education.

According to Aliza Alias and Mohd Mohktar Tahar (2007), only a handful of special education teachers has a background in learning disability. Cases like these occur mostly due to the inability of that teacher to get a decent job after finishing their studies thus this is a ‘scapegoat' option for them. Moreover, in this case, no specific training or program has been given to assist teachers who taught Down syndrome at schools. Not all special students have the same needs as other special students. The need for a specialized program for students with Down syndrome is crucial. Based on literature review, memory in Down syndrome is one of the big factors that impedes learning in them. This has triggered the researcher to look into an intervention program to overcome this problem.

1.3 Statement of the Problem

The developmental profile of children with Down syndrome suggests that working memory delay is a central issue affecting the progress of children with DS. The working memory of children with DS is particularly poor, with auditory working memory being worse than visual WM. Working memory which is also called short-term memory, is a temporary processing and storage system which holds and process information ‘in mind’ for short periods of time. It supports all learning and cognitive activity, hence it is critical in daily cognitive activities. In view of this, there is a strong need to find effective and practical interventions targeted at improving working memory in individuals with DS.

Nadel (1986) suggest that late developing brain structures and its functions are particularly impaired in individuals with DS. The neurobiological findings in DS showed that decrease in brain volume such as the prefrontal cortex, hippocampus and cerebellum are seen in 3-5 months of age. According to Baddeley (1986), the prefrontal cortex is responsible for directing attention, hold it and organizing a limited amount of new information so that it can be immediately be put into use, or otherwise stored in long-term memory. The prefrontal cortex also retrieves information from long-term memory so it can be briefly held and manipulated to perform some complex tasks.

Overall, the study of neuropathology suggests that there is some developmental impairment in specific brain regions of individuals with DS, namely the temporal lobe, the hippocampal formation (Wisniewski *et al*. 1986), the prefrontal cortex and the cerebellum. According to Frangou *et al*. (1997), children with DS also experience deficits in verbal working memory due to a smaller planum temporal (auditory cortex). It is important to note, however, that the relationship between the planum temporal volume deficit and cognitive-linguistic functioning in DS remains unclear (Frangou *et al*., 1997).

Studies suggest that the processing and recall of spoken information are improved when they are supported by relevant picture material. This information has led to educators stressing the importance of using visual supports such as pictures, signs which are printed out and used in teaching children with DS. This approach has proven to be effective as it makes full use of their stronger visual memory skills.

This results in the notion of implementing an intervention program which is in line with the IDEA 2004, which states that the use of research-based interventions is encouraged to assist students with disabilities. Intervention is the act of inserting one thing between others, interrupting the current course of something. As in this study, a cognitive intervention program is a systematic program of teaching and learning that disrupts the current course of teaching and learning for a certain period of time to remediate the learning and memory in DS. Consequently, this leads to a

question on what intervention should be implemented. What intervention would be effective in improving their memory?

Children with DS are over learners, thus making rehearsal training a possible solution to help them remember better. This is shown in the effects of a short training in the use of rehearsal strategy by Laws, MacDonald & Buckley (1996). Findings showed a small but significant improvement in memory spans for children at schools who were trained by teachers or teaching assistants using the rehearsal strategy.

According to Hoerl (2007), the notion of narratives is trying to provide a causal understanding for remembering an event which then develops a particular kind of ‘cognitive contact' that requires knowledge and experience. This results in ‘conscious awareness' for a typically developing individual. Using narratives could be one of the possible solutions of an intervention program. Kay Raining Bird *et al*. (2004) said that children with DS exhibited lower gist and verbatim recall than mental–age matched controls when retelling verbally presented stories with minimal visual support. It was reported that few children with DS below 12 years of age recalled any of the stories’ content in theses verbally presented narratives, showing that the ability to recall the gist of the narrative increases substantially with age.

A study by Broadley *et al*. (1994) which used two strategies: the rehearsal and organization strategy showed that the children were able to use both strategies and training significantly improved both their visual and auditory short-term memory spans. Moreover, a significant gain in comprehension of grammar was presented in the trained group. As visual learners, children and adolescents with DS will gain more if the teaching materials are presented visually. This is aligned with the finding of a study by Miles, Sindberg, Bridge & Chapman (2006) that showed that visual support increases the amount of narrative information recalled by individuals with DS. Since they have limitations in their memory span, Gathercole & Alloway (2008) suggested that in order to reduce working memory loads, they should also be taught simple and smaller things.

In the special education classrooms in Malaysia, teachers apply various methods to improve the language skills and other areas of development among children with DS. Much of these strategies do not emphasize the role of working memory to enhance learning. There is an inadequacy among special education teachers in knowledge and skills to enhance WM of these children.

This leads to the purpose of this study; which is to implement an intervention program for children and adolescents with DS in primary school. Hopefully, the finding of this intervention program will then lead to more specific and systematic teaching tools for children and adolescents with DS.

1.4 Objectives of the Study

This study aims to achieve the following objectives:

1.4.1 To design and develop a cognitive intervention program to enhance working memory in children with Down syndrome.

1.4.2 To determine the level of verbal short-term memory, visuo-spatial short-term memory, verbal working memory and visuo-spatial working memory in the experimental and control groups before and after the adapted and improvised cognitive intervention program.

1.4.3 To identify the effectiveness of verbal short-term memory, visuo-spatial short-term memory, verbal working memory and visuo-spatial working memory in the experimental and control groups before and after the adapted and improvised cognitive intervention program.

1.4.4 To investigate the perception of students, teachers and parents of the adapted and improvised intervention program for improving the verbal short-term memory, visuo-spatial short-term memory, verbal working memory and visuo-spatial working memory of children with Down syndrome.

1.5 Research Questions

This study is basically conducted to answer the following research questions:

1.5.1 What is the level of verbal short-term memory, visuo-spatial short-term memory, verbal working memory and visuo-spatial working memory in experimental and control groups before and after the adapted and improvised intervention program?

(1a) What is the level of verbal short-term memory, visuo-spatial short-term memory, verbal working memory and visuo-spatial working memory in the experimental group before the intervention program?

(1b) What is the level of verbal short-term memory, visuo-spatial short-term memory, verbal working memory and visuo-spatial working memory in the experimental group after the intervention program?

(1c) What is the level of verbal short-term memory, visuo-spatial short-term memory, verbal working memory and visuo-spatial working memory in the control group before the intervention program?

(1d) What is the level of verbal short-term memory,

visuo-spatial short-term memory, verbal working memory and visuo-spatial working memory in the control group after the intervention program?

1.5.2 Is the adapted and improvised intervention program effective in improving the verbal short-term memory, visuo-spatial short-term memory, verbal working memory and visuo-spatial working memory of Down syndrome children?

2a) Is there any significant difference in the rankings of verbal short-term memory, visuo-spatial short-term memory, verbal working memory and visuo-spatial working memory in the experimental group before and after the intervention program?

2b) Is there any significant difference in the rankings of verbal short-term memory, visuo-spatial short-term memory, verbal working memory and visuo-spatial working memory in the control group before and after the intervention program?

2c) What is the median and mean rankings of verbal short-term memory, visuo-spatial short-term memory, verbal working memory and visuo-spatial working memory between experimental and control groups before the intervention program?

2d) Is there any significant difference in the rankings of verbal short-term memory, visuo-spatial short-term memory, verbal working memory and visuo-spatial working memory between experimental and control groups before the intervention program?

2e) What is the median and mean rankings of verbal short-term memory, visuo-spatial short-term memory, verbal working memory and visuo-spatial working memory between experimental and control groups after the intervention program?

2f) Is there any significant difference in the rankings of verbal short-term memory, visuo-spatial short-term memory, verbal working memory and visuo-spatial working memory between the experimental and control groups after the intervention program?

1.5.3 What is the perception of students, teachers and parents of the adapted and improvised intervention program in improving the verbal short-term memory, visuo-spatial short-term memory, verbal working memory and visuo-spatial working memory of children with Down syndrome?

1.6 Research Hypotheses

Based on the research questions, the null hypotheses were formulated as follows:

H O1: There is no significant difference in the rankings of verbal short-term memory, visuo-spatial short-term memory, verbal working memory and visuo-spatial working memory in the experimental group before and after the intervention program.

H O2: There is no significant difference in the rankings of verbal short-term memory, visuo-spatial short-term memory, verbal working memory and visuo-spatial working memory in the control group before and after the intervention program.

HO3: There is no significant difference in the rankings of verbal short-term memory, visuo-spatial short-term memory, verbal working memory and visuo-spatial working

memory between the experimental and control groups before the intervention program.

H O4: There is no significant difference in the rankings of verbal short-term memory, visuo-spatial short-term memory, verbal working memory and visuo-spatial working memory between the experimental and control groups after the intervention program.

1.7 Importance of the Study

According to Jarold (2001), some of the specific memory problems that arise from certain developmental and learning disorders can be justified by using the working memory as the baseline predictors. Thus, this will ultimately favour those who suffer from developmental and learning disorders, as they will benefit from studies that use working memory as the framework in the intervention program. Generally, sufficient intervention of working memory would definitely bring positive effects not only to those who suffer from developmental and learning disorders but also to parents and the educational practice as a whole.

1.7.1 Children with Down syndrome (DS)

First of all, the findings of this study will benefit individuals with DS in so many ways especially in understanding their developmental aspects. Each individual with DS is very different from another as they have varying levels of impairment and any studies are crucial in helping them to improve their memory functions.

1.7.2 Parents

Without a doubt, parents stand to benefit the most from this study's findings. Parents will be relieved to learn that the study's findings will provide the opportunity for their children with DS to excel in life in every possible way. This will instill confidence in the parents on their DS children's capability to live independent lives.

1.7.3 National Special Education Department

The findings of this study will, in turn, benefit the National Special Education Department as it is specific to the DS community. This is important as it will improve awareness about this community and draw attention to the need for more studies on the people with special needs in order to understand and help them live in our community.

1.7.4 Government

The findings of this study will also help the government to construct rules and regulations that could benefit the community, especially in Malaysia. As we know, there are just a few regulations that have been implemented to enable the DS community.

1.8 Theoretical Framework

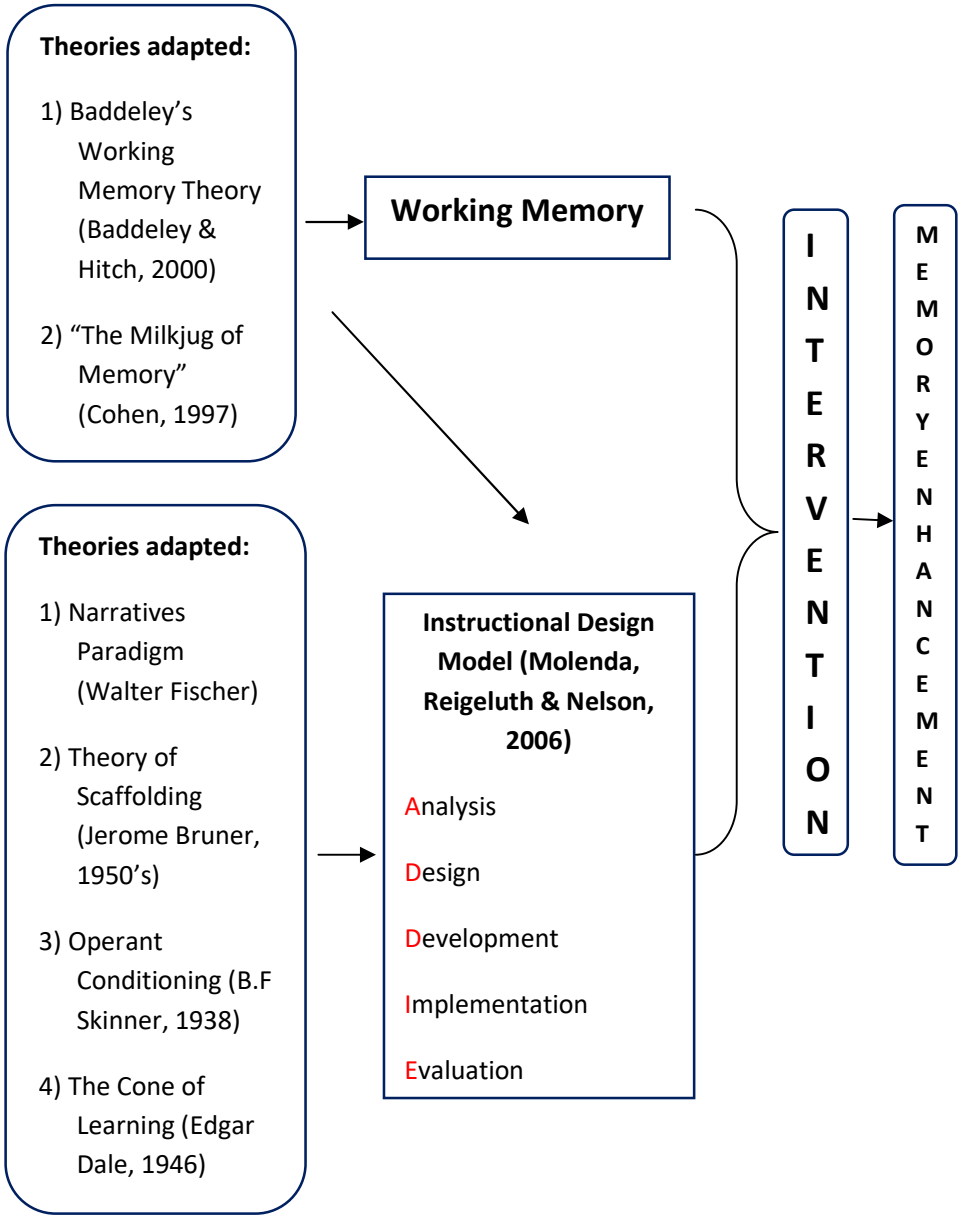

Figure 1.1 Theoretical Framework

The main theory that is being used for the cognitive intervention content is the working memory model that was introduced by Baddeley and Hitch (2000). It is best to make it the core theory in this study since this study aims at identifying the working memory in children with Down syndrome. Working memory is a cognitive system that stores and manipulates information for brief periods of time. It is different from short-term memory as it can also manipulate the information, in

addition to holding it for a certain period of time. Short-term memory systems, on the other hand, are specialized purely for the purpose of temporary storage of material within particular informational domains (Baddeley, 2000; Baddeley and Hitch, 1974; Baddeley and Logie, 1999).

The working memory model consists of the central executive which is an attention control system responsible for manipulating information, a phonological loop for maintaining and rehearsing verbal information, and a visual-spatial sketchpad for storing visual–spatial information. Baddeley then revised this model by including the episodic buffer which is thought to be a multi-modal system that integrates memory across domains into scenes or episodes.

The second main theory that was used is the one behind the Children's Memory Scale (CMS), (Cohen, 1997). It is a comprehensive learning and memory assessment instrument designed to evaluate learning and memory functioning in individuals aged 5 through 16 years. As it has been stated in the CMS manual, the development of CMS began in 1985 with 5 primary goals with one of them being to develop an instrument that would be compatible with the current theoretical models of learning and memory. This is one of the main reasons why the researcher uses this assessment as the basis of this study's intervention program. Each of the three domains; auditory/verbal learning and memory (verbal), visual/nonverbal learning and memory (visual) and attention/concentration are covered by the nine CMS subtests. Each domain is assessed through two core subtests (stories, word pairs, word lists, dot learning, faces and family pictures) and one supplemental subtest. Each subtest in both auditory/verbal and visual/nonverbal domains contains both an immediate memory and a delayed memory portion. The CMS uses the ‘The Milkjug of Memory' model which consists of short-term memory, working memory and long-term memory. It is definitely in line with the working memory model which has the phonological loop (verbal), visuo-spatial sketchpad (visual), central executive and episodic buffer.

One of the essential elements used for the instructional approach is narratives. The researcher has adopted a social interactionist viewpoint whereby narratives provide a distinct kind of cognitive framework for remembering events (Nelson, 1996). This is in line with the episodic buffer within the working memory model that holds and integrates memory in all domains (within working memory model) into scenes or episodes.

According to Baddeley and Andrade (2000), the clarity of visual and auditory images in earlier research proved that retrieval from the buffer occurred through conscious awareness. Due to the fact that it uses verbal, visual and attention as its core, the researcher decided to improvise it with an additional feature of narratives. By adapting this assessment into an intervention, narratives are being added to assist the episodic buffer system. The theory of narrative paradigm by Walter Fisher believed that each person is a storyteller and experiences life as a chain of ongoing narratives. Individuals with DS are definitely not an exception. They still experience life just like others and can relate to it in an easier manner.

Moreover, other theories like scaffolding, operant conditioning (reinforcement) and Dale's Cone of Learning had also been integrated into this intervention program. The theory of scaffolding was first introduced by Jerome Bruner in the 1950's and is popular within the education system. Sufficient support is being encouraged to promote learning by first introducing the concept and skills and then gradually taking them away. The teacher acts as an assistant in the process of learning by providing appropriate support. Furthermore, Skinner's operant conditioning plays a very crucial part in this intervention program. Positive reinforcement works well with children with DS as they tend to crave attention and warmth from others. When they are praised or given prizes, they tend to be more compliant. Last but not least, Dale's Cone of Learning also justified the need for the use of visual representation (pictures, flashcards), animation, the act of reading out loud and demonstration during intervention sessions. Overall, this study attempts to carry out a cognitive intervention program that has been adapted and improvised

with narratives based on the Children's Memory Scale assessment in order to improve working memory in children and adolescents with DS.

These theories were integrated into the ADDIE instructional design which is the framework for the procedures of this research, namely analysis, design, development, implementation and evaluation. ADDIE is the acronym of the five steps in this model. The letter 'A' stands for **Analysis.** This is the first phase that is vital to determining the direction of this study. The instructional problem is recognized, the instructional objectives are established and the current learning environment, as well as learner's existing knowledge and skills, are also identified.

The next phase is 'D' which stands for **Design**. The design phase covers the learning objectives, assessments of the instruments, subject matter content analysis, activities, lesson planning and media selection. The next 'D' stands for the **Developmen**t phase which encompasses the development of module and intervention props according to the design in the previous phase. The 'I' stands for **Implementation**. This phase involves the development of systematic procedures for training teachers and implementing the program. Finally, the 'E' stands for Evaluation. This phase consists of formative and summative evaluations. Each phase of the ADDIE process has formative evaluations while summative evaluations consist of tests designed for specific criterion-related referenced items.

1.9 Conceptual Framework

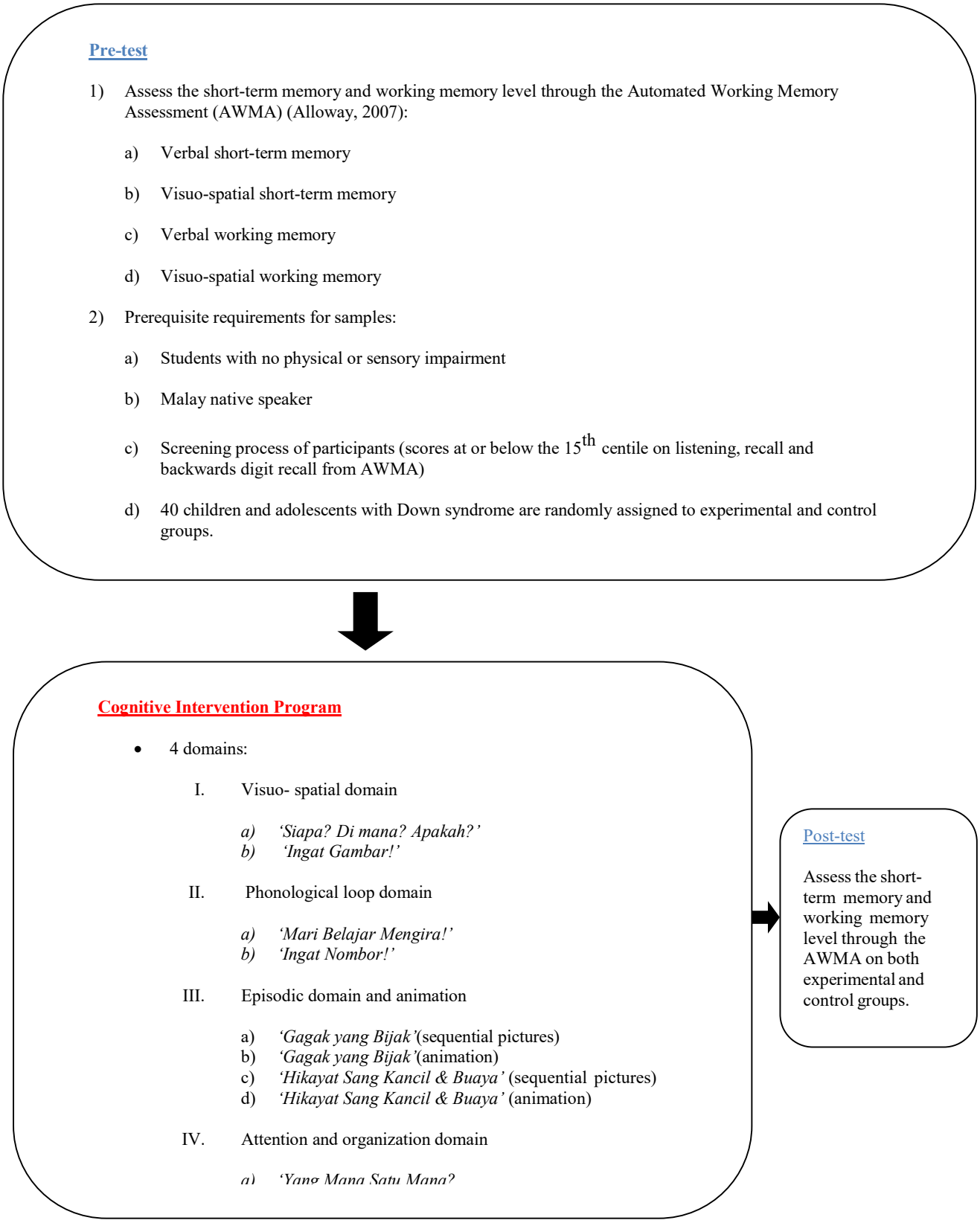

Figure 1.2 Conceptual Framework

This study largely surrounds the basic pre-test and post-test experimental design with an intervention in between to allow for comparison between the two groups, namely the experimental group and the control group. The control group serves as the basis for comparison, to determine whether the performance of participants within the experimental group would be better, worse or the same as that of those who were not exposed to any experimental manipulation.

During the pre-test stage, the researcher uses the Automated Working Memory Assessment (AWMA) to assess the level of short-term memory and working memory of participants. This includes the verbal and visuo-spatial part of both short-term and working memory. Some prerequisites are also vital during this stage, namely students who participate in this study must have no sensory and physical impairments, and also the student should be a native Malay speaker. In addition, only those students who score at or below the 15th centile on listening, recall and backwards digit recall (two subtests from AWMA) (Holmes *et al*., 2009) can participate in this study. Lastly, a total number of 40 children and adolescents with DS aged between 6 and 14 years who meet the research requirements are assigned randomly into experimental and control groups.

Next, the intervention program consists of a few domains. There is the visuo-spatial domain, phonological loop domain, episodic domain and animation and last but not least, the attention and organization domain. The visuo-spatial domain contains two activities: *'Siapa? Di mana? Apakah?'* and *'Ingat Gambar!'* while the phonological loop domain contains activities such as *'Mari Belajar Mengira!'* and *'Ingat Nombor!'*. On the other hand, the episodic domain and animation consist of four activities that use two mediums. These include *'Gagak yang Bijak'* (sequential pictures), *'Gagak yang Bijak'*(animation), *'Hikayat Sang Kancil & Buaya'* (sequential pictures) and *'Hikayat Sang Kancil & Buaya'* (animation). Finally, the attention and organization domain only consists of one activity which is *'Yang Mana Satu Mana?'* Lastly, during the post-test stage, the AWMA is used to assess the level of short-term memory and working memory of participants after the intervention sessions.

1.10 Definition of Key Terms

Definitions are provided for key variables in this study, namely Down syndrome, students with Down syndrome, special students, special education needs, short-term memory, working memory, cognitive intervention program, narratives, Automated Working Memory Assessment and Children's Memory Scale. The conceptual and operational definitions for all the study variables and most related key terms are provided below.

1.10.1 Down Syndrome

Down syndrome is a chromosomal disorder caused by an error in cell division that results in an extra 21st chromosome. This extra chromosome carries extra genes that can directly interrupt the normal development of individuals causing the attributes of DS, impairments and limitations in intellectual abilities and the risk of health problems associated with this condition. Christianson *et al*. (2006) said that there are more than 200,000 reported incidents of DS recorded each year worldwide. Down syndrome in this study refers to children with Down syndrome, individuals with Down syndrome and the Down syndrome community that suffer from a chromosomal disorder that results in an extra 21st chromosome.

1.10.2 Students with Down Syndrome

Students with Down syndrome are children who suffer from chromosomal disorder that result in an extra 21st chromosome. They are primary school students between six to twelve years of age.

1.10.3 Special Students

Special children comprise of children with learning difficulties either from physical or/and mental impairment. They usually need assistance from others to complete a task. These special children include children with Down syndrome,

Attention Deficit and Hyperactive Disorder (ADHD), Dyslexia, Specific Language Impairments, Autistic Spectrum Disorder, Developmental Coordination Disorder and Developmental Dyscalculia, Cerebral Palsy as well as hearing and vision impairments. On another note, there are also students who are gifted and have more superior performance compared to their peers. These gifted students also need special attention and a specialized method of teaching in order to optimize their capability.

In this study, special children refer to students that are different from the normal students. They usually have difficulties resulting either from physical or/and mental impairment and need assistance from others to complete a task. They mostly comprise of children with a learning disability such as children with Down syndrome, Attention Deficit and Hyperactive Disorder (ADHD), Dyslexia, Specific Language Impairments, Autistic Spectrum Disorder and Developmental Coordination Disorder and Developmental Dyscalculia.

1.10.4 Special Education Needs

Special education needs refer to a program that has been developed mainly to accommodate various needs of special students. The teaching and learning process used is deemed to be the most appropriate technique that works for them including using the right sources and learning tools. According to Hallahan and Kauffman (2005), special education is a form of education designed to fulfil the needs of children with special needs. On the other hand, Gargiulo (2003) said that special education is a specialized teaching programme developed to assist the needs of special students, adding that it may need certain learning tools and specific teaching methods. Additionally, Friend (2006) mentioned that special education is a teaching programme intended to address the learning needs of disabled children. This type of education is conducted either in the classroom, home, hospital or other institutions.

Meanwhile, Mansor (2005) stated that the special education program in Malaysia is a continuous effort to encourage a person's optimal development as a

competent, devoted, independent individual who is able to plan and manage their life as well as realize their potential as an individual and as part of the community; being well balanced and productive in line with the national educational philosophy. In this study, special education needs mean a program that has been developed mainly to accommodate various needs of special students. The teaching and learning process used are deemed to be the most appropriate techniques that work for them, in addition to using the right sources and learning tools.

1.10.5 Short-Term Memory

Short-term memory is the ability to hold a certain amount of information, either verbal or visual information for a short period of time.

1.10.6 Working Memory

Working memory is the ability to store information, both visually and verbally and then manipulate that information (Baddeley, 1992). It is made up of the phonological loop, visuo-spatial sketchpad, central executive and episodic buffer. The phonological loop provides brief storage and rehearsing of verbal information while the visuo-spatial sketchpad maintains and manipulates visual and spatial representations. On the other hand, the central executive is in charge of choosing relevant information and managing cognitive processes when tasks are performed. It is also responsible for administering the integration of information and coordinating slave systems (phonological loop and visuo-spatial sketchpad). Additionally, the episodic buffer is a multi-modal system that binds information and integrates memory across domains (visual, spatial, verbal, etc.) into scenes or episodes.

In this study, the cognitive system is used for short-term storage and manipulation of information required for various cognitive tasks. Short-term memory holds both verbal and visual information, only then would it be transferred to the working memory which can manipulate the information. It consists of the phonological loop, visuo-spatial sketchpad, central executive and episodic buffer.

1.10.7 Cognitive Intervention Program

The cognitive intervention program is an organized program of teaching and learning that interferes with the current course of teaching and learning for a certain duration of time in order to enhance learning and memory capacity in Down syndrome.

1.10.8 Narratives

A narrative is a story (long or short; of past, present or future; factual or imagined; told for any purpose and with or without much detail) that is created in a constructive format (as a work of speech, writing, song, film, television, video games, photography or theatre) that describes a sequence of fictional or non-fictional events.

This study defines narratives as a story (short; of past, present or future; factual or imagined; told for any purpose) that is created in a constructive format (as a work of speech, writing, animation and flashcards) that portrays a sequence of fictional or non-fictional events.

1.10.9 Automated Working Memory Assessment (AWMA)

Automated Working Memory Assessment is a cognitive-based, computerized measure of working memory. It was developed by Alloway (2007) to assist teachers, educators and parents to detect working memory deficits in individuals with between 4-22 years of age. In this study, it is used as a tool to assess the level of working memory in children and adolescents with Down syndrome. The AWMA consists of 12 subtests that can be categorized into 4 components which are verbal short-term memory, visuo-spatial short-term memory, verbal working memory and visuo-spatial working memory. The AWMA provides three measures for each of the verbal and visuo-spatial aspects of short-term memory and working memory.

Verbal short-term memory momentarily holds in verbal information for a short period of time while verbal working memory briefly holds in verbal information for a short period of time and manipulates it. On the other hand, visuo-spatial short-term memory momentarily holds verbal information for a short period of time while visuo-spatial working memory briefly holds verbal information for a short period of time and manipulates it.

For the verbal short-term memory, subtests such as digit recall, word recall and nonwords recall are used. Subtests such as dot matrix and block recall are used to test the visuo-spatial short-term memory domain. On the other hand, tasks involving simultaneous storage and processing of information are used to tap into the verbal and visuo-spatial working memory. More complex tasks have been designed to measure the central executive or the attentional control aspect of working memory. It includes the counting recall whereas the participant counts the number of target items in each of a series of successive arrays and then recalls the totals for each array in the original sequence (Case, Kurland, & Goldberg, 1982). Tests such as recalling locations of images are designed to tap into the visuo-spatial working memory.

1.10.10 Children's Memory Scale (CMS)

The Children's Memory Scale (CMS) (Cohen, 1997) is a comprehensive learning and memory assessment instrument designed to evaluate learning and memory functioning in individuals between 5 and 16 years old. The nine CMS subtests assess functioning in each of the three domains; auditory/ verbal learning and memory (verbal), visual/ nonverbal learning and memory (visual) and attention/ concentration. Each domain is assessed through two core subtests (stories, word pairs, word lists, dot learning, faces and family pictures) and one supplemental subtest. Each subtest in both auditory/verbal and visual/nonverbal domains contains both an immediate memory and a delayed memory portion. The CMS uses the 'The Milkjug of Memory' model which consists of short-term memory, working memory and long- term memory.

In this study, The Children's Memory Scale (CMS) is used as the reference in developing the working memory intervention program. It is one of the sources used in the development of this study's intervention program.

1.11 Scope of the Study

A total of five special education teachers and 40 children and adolescents with Down syndrome from the schools in the Keramat and Sentul region within the Kuala Lumpur district were involved in this study. This study will look into the results of an adapted and improvised intervention program based on the Working Memory Model by Baddeley and Hitch (1974) and the Children's Memory Scale (CMS) that uses the 'The Milkjug of Memory' model in improving the phonological loop, visuo-spatial sketchpad, central executive and episodic buffer of children with Down syndrome. The samples used in the study are comprised of primary school students of 6-14 years old. Their mother tongue is the Malay Language. Special education teachers will deliver the intervention program within the school's setting and will carry out the activities in a small group.

This study will concentrate on improving the visuo-spatial domain, the phonological loop domain, the episodic domain and the attention and organization domain of the working memory model that had been introduced by Baddeley and Hitch (1974). This is in line with the intervention program which consists of 4 domains, each based on the working memory component; the visuo-spatial domain, the phonological loop domain, the episodic domain and the attention and organization domain. Each domain except for the attention and organization domain consists of 2 activities that tap onto both short-term memory and working memory. The visuo-spatial domain consists of family pictures and picture location; the phonological loop domain consists of counting and numbers; the episodic domain consists of the same topic but with a different medium, which uses sequential pictures and animation; and last but not least the attention and organization domain which centralized on themes. Seven topics are repeated throughout the 12-week

program. A fixed topic that taps onto the central executive is progressively added each week.

Teaching aids and other supplementary materials such as flashcards, stimulus cards, sequential pictures, audio-visual material (animation), manual and modules have been provided by the researcher to facilitate activities in the intervention program.

1.12 Delimitations

Since this is an experimental design study, some inherent delimitations are unavoidable (Wiersma, 2000). One of the most feared delimitations is with regards to ethical issues. Ethical issues between the researcher and students, researcher and teachers, researcher and schools, researcher and the government, researcher and experts should be taken seriously and studied meticulously by the researcher. There might also be no full cooperation from students (due to the behavioural state of DS), teachers (lazy to carry out the research), and parents (feel ashamed and disgraced).

Moreover, the delimitation in the sample size will obviously not reflect the national population. This research is only carried out in 7 schools within the Keramat and Sentul regions. Thus the findings do not represent other areas with different demographic characteristics. Other than that, the length of the cognitive intervention program is just 12 weeks. If the length were to be extended, the findings would probably be different from the findings in this study.

During the screening stage, only those who scored at or below the 15^{th} centile on listening recall and backwards digit recall (AWMA subtests) were eligible to take part in this study. This shows that this study does not represent all children and adolescents with DS, thus neither does the finding. With the prerequisite criteria for selecting only native Malay speakers, generalization is not applicable to individuals

REFERENCES

Alias, A. dan Mokhtar, M. T. (2007). *Penempatan Guru di Program Integrasi Pendidikan Khas Masalah Pembelajaran*. Fakulti Pendidikan, Universiti Kebangsaan Malaysia.

Alloway, T. P., Gathercole, S. E., Adams, A. M., and Willis, C. (2005). Working Memory Abilities in Children with Special Educational Needs. *Educational and Child Psychology*, 22(4), 56-67.

Alloway, T. P., Gathercole, S. E., Pickering S. J. (2006). Verbal and Visuo-Spatial Short-Term Memory and Working Memory in Children: Are They Separable? *Child Development,* 77, 1698-1716.

Alloway, T. P. (2007). Working Memory, Reading and Mathematical Skills in Children with Developmental Coordination Disorder. *Journal of Experimental Child Psychology*, 96, 20-36.

Alloway, T. P., Gathercole, S. E., Kirkwood, H., and Elliott, J. (2008). Evaluating the Validity of the Automated Working Memory Assessment. *Educational Psychology*, 28(7), 725-734.

Alloway, T. P., Gathercole, S. E., Kirkwood, H. J. and Elliott, J. (2008-*a*). The Cognitive and Behavioral Characteristics of Children with Low Working Memory. *Child Development*, 80(2), 606-621.

Alloway, T. P., Gathercole, S. E., Kirkwood, H. J. and Elliott, J. (2008-b). Evaluating the Validity of the Automated Working Memory Assessment. *Educational Psychology,* 28(7), 725-734.

Alloway, T. P., Gathercole, S. E., Kirkwood, H. and Elliott, J. (2009). The Cognitive and Behavioral Characteristics of Children with Low Working Memory. *Child Development*, 80(2), 606-621.

Amar-Singh, H. S. S. (2013). *Screening and Diagnosing Learning Disabilities*. Forum on the Right of Education for Children with Learning Disabilities. Human Rights Commission of Malaysia (SUHAKAM).

Archibald, L. M. and Gathercole, S. E. (2006). Short-Term and Working Memory in Children with Special Language Impairments. *International Journal of Language and Communication disorders,* 41, 675-93.

Archibald, L. M. and Alloway, T. P. (2008). Comparing Language Profile: Children with Specific language Impairment and Developmental Coordination Disorder. *International Journal of Communication and Language Disorders,* 43, 165-180.

Atkinson, R. C. and Shiffrin, R. M. (1968). Human Memory: A Proposed System and Control Processes. In Spence, K. W. and Spence, J. D. (Eds.) *The Psychology of Learning and Motivation, Vol. 2* (pp. 89-195). New York: Academic Press.

Baddeley, A. D., Grant, S., Wright, E., Thompson, N. (1973). Imagery and Visual Working Memory. In Rabbit, P. M. A., Dornic, S. (Eds.) *Attention and Performance*. London: Academic Press.

Baddeley, A. D. and Hitch, G. J. (1974). Working Memory. In Bower, G. (Ed.) *The Psychology of Learning and Motivation, Vol. VIII* (pp. 47-90). New York: Academic Press.

Baddeley, A. D., Thompson, N. and Buchanan, M. (1975). Word Length and The Structure of Short-Term Memory. *Journal of Verbal Learning and Verbal Behaviour*, 9, 176-89.

Baddeley, A. D. (1986). *Working Memory*. New York: Oxford University Press.

Baddeley, A. D. (1992). Exploring the Central Executive. *Quarterly Journal of Experimental Psychology*, 49A, 5-28.

Baddeley, A. D. (1992). Working Memory: The Interface between Memory and Cognition. *Journal of Cognitive Neuroscience,* 4(3), 281-288.9888

Baddeley, A. D. (1996). The Concept of Working Memory. In Gathercole, S. E. (Ed.) *Models of Short-Term Memory* (pp. 1-27). Hove, UK: Psychology Press.

Baddeley, A. D. and Logie, R. H. (1999). In Miyake, A. and Shah, P. (Eds.) *Models of Working Memory: Mechanisms of Active Maintenance and Executive Control* (pp 28-61). New York: Cambridge University Press.

Baddeley, A. (2000). The Episodic Buffer: A New Component of Working Memory? *Trends Cognitive Science,* 4(11), 417-423.

Baddeley, A. D. and Hitch, G. J. (2000). Development of Working Memory: Should the Pascual-Leone and the Baddeley and Hitch Models be Merged? *Journal of Experimental Child Psychology,* 77, 128-37.

Barnes, E., Roberts, J., Long, S. H., Martin, G. E., Berni, M. C., Mandulak, K. C. and Sideris, J. (2009). Phonological Accuracy and Intelligibility in Connected Speech of Boys with Fragile X Syndrome or Down Syndrome. *Journal of Speech, Language and Hearing Research,* 52, 1048-1061.

Belleville, S., Gilbert, B., Fontaine, F., Gagnon, L., Ménard, E., Gauthier, S. (2006). Improvement of Episodic Memory in Persons with Mild Cognitive Impairment and Healthy Older Adults: Evidence from a Cognitive Intervention Program. *Dement Geriatr Cogn Disord,* 22, 486-499.

Berninger, V. W., Abott, R. D., Thomson, J., Wagner, R., Swanson, H. L., Wijsman, E. M. and Raskind, W. (2006). Modelling Phonological Core Deficits within a Working Memory Architecture in Children and Adults with Developmental Dyslexia. *Scientific Studies of Reading,* 10(2), 165-198.

Best, J. W., and Khan, J. V. (1998). *Research in Education.* (8th ed.) Boston: Allyn and Bacon.

Bird, E. K. R., Cleave, P. L., White, D., Pike, H. and Helmkay, A. (2008). Written and Oral Narratives of Children and Adolescents with Down Syndrome. *Journal of Speech, Language, and Hearing Research*, 51(2), 436-450.

Bloom, B. S. (1968). Learning for mastery. *Evaluation Comment.* 1(2), 1-12.

Boudreau, D. and Chapman, R. (2000). The Relationship between Event Representation and Linguistic Skill in Narratives of Children and Adolescents with Down Syndrome. *Journal of Speech, Language, and Hearing Research*, 43, 1146–1159.

Broadley, I. and MacDonald, J. (1993). Teaching Short-Term Memory Skills to Children with Down's Syndrome. *Down's Syndrome: Research and Practice*, 1, 56- 62.

Broadley, I., MacDonald, J. and Buckley, S. (1994). Are Children with Down's Syndrome Able to Maintain Skills Learned from a Short-Term Memory Training Programme? *Down's Syndrome: Research and Practice*, 2, 116-122.

Brock, J. and Jarrold, C. (2004). Language Influences on Verbal Short-Term Memory in Down Syndrome: Item and Order Recognition. *Journal of Speech Language and Hearing Research,* 47, 1334-1346.

Brock, J. and Jarrold, C. (2005). Serial Order Reconstruction in Down Syndrome: Evidence for a Selective Deficit in Verbal Short-Term Memory. *Journal of Child Psychology and Psychiatry,* 46, 304-316.

Buckley, S. (1999). Improving the Speech and Language Skills of Children and Teenagers with Down Syndrome. *Down Syndrome News and Update.* 1(3), 111-128.

Byrne, A., Buckley, S., MacDonald, J. and Bird, G. (1995). Investigating the Literacy Language and Memory Skills of Children with Down's Syndrome. *Down Syndrome Research and Practice*, 3(2), 53-58.

Campbell, D. T. (1959). "Convergent and Discriminant Validation by the Multitrait-Multimethod Matrix". *Psychological Bulletin,* 56, 81–105.

Carlesimo, G. A., Marotta, L. and Vicari, S. (1997). Long-term Memory in Mental Retardation: Evidence for a Specific Impairment in Subjects with Down's syndrome. *Neuropsychologia,* 35, 71-79.

Case, R., Kurland, D. M. and Goldberg, J. (1982). Working Memory Capacity as Long Term Activation: An Individual Differences Approach. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 19, 1101-1114.

Chafe, W. L. (1980). *The Pear Stories: Cognitive, Cultural and Linguistic Aspects of Narrative Production,* Norwood. NJ: Ablex.

Chapman, R. S., Hesketh, L. J. and Kistler, D. J. (2002). Predicting Longitudinal Change in Language Production and Comprehension in Individuals with Down Syndrome: Hierarchical Linear Modeling. *Journal of Speech, Language, and Hearing Research*, 45, 902–915.

Chapman, R. S. (2003). Language and Communication in Individuals with Down Syndrome. *International Review of Research in Mental Retardation,* 27, 1-34.

Chein, J. M. and Morrison, A. B. (2011). Does Working Memory Training Work? The Promise and Challenges of Enhancing Cognition by Training Working Memory. *Psychonomic Bulletin and Review*, 18(1), 46-60.

Christianson, A., Howson, C. P. and Modell, B. (2006). "March of Dimes Global Report on Birth Defects: The Hidden Toll of Dying and Disabled Children". *March of Dimes Birth Defects Foundation* (pp. 98). White Plains, NY.

Cohen, M. J. and Squire, L. R. (1980). Preserved Learning and Retention of Pattern-Analyzing Skill in Amnesia: Dissociation of Knowing How and Knowing That. *Science, New Series,* 210(4466), 207-210.

Cohen, M. J., (1997). *Children's Memory Scales*. San Antonio, TX: Psychological Corporation.

Cohen, L., Manion, L. and Morrison, K. (2007). *Research Methods in Education*. (6th ed.). London: Routledge Falmer.

Comblain, A. (1994). Working Memory in Down's Syndrome: Training the Rehearsal Stratergy. *Down's Syndrome: Research and Practice,* 2, 123-126.

Conners, F. A., Rosenquist, C. J. and Taylor, L. A. (2001). Memory Training for Children with Down Syndrome. *Down Syndrome Research and Practice,* 7(1), 25-33.

Conners, F. A., Rosenquist, C. J., Arnett, L., Moore, M. S., and Hume, L. E. (2008). Improving Memory Span in Children with Down Syndrome. *Journal of Intellectual Disability Research*, 52(3), 244-255

Cook, T. D., and Campbell, D. T. (1979). *Quasi-Experimentation: Design and Analysis Issues for Field Settings.* Boston, MA: Houghton Mifflin Company.

Cresswell, J. W. (2008). *Educational Research: Planning, Conducting and Evaluating Quantitative and Qualitative research.* (3rd ed.). Upper saddle River, NJ: Merrill Prentice Hall.

Department of Social Welfare. (2013). *TASKA*.

Fidler, D. J., Hepburn, S. and Rogers, S. (2006). Early Learning and Adaptive Behavior in Toddlers with Down Syndrome: Evidence for an Emerging Behavioural Phenotype? *Down Syndrome Research and Practice,* 9(3), 37-44.

Field, A. P. (2009). *Discovering Statistics Using SPSS.* (3rd ed.) London, England: SAGE.

Fowler, A. (1990). Language Abilities in Children with Down Syndrome: Evidence for a Specific Syntactic Delay. In Cicchetti, D. and Beeghly, M. *Children with Down Syndrome: A Developmental Perspective*. Cambridge.

Frangou, S., Sharma, T., Sigmudsson, T., Barta, P., Pearlson, G., and Murray, R. M. (1997). Small Planum Temporale Volume in Down Syndrome: A Volumetric MRI Study. *Am. J Psychiatry*, 154 (1997), 1424-1429.

Frenkel, S., and Bourdin, B. (2009). Verbal, Visual and Spatio-Sequential STM Assessment. *Journal of Intellectual Disability Research*, 53(2), 152-160.

Friend, M. (2006). IDEA 2004 Update Edition: Special Education. New Jersey.

Gargiulo, R. M. (2003). *Special Education in Contemporary Society: An Introduction to Exceptionality*. Belmont, C. A.: WADSWORTH, Thomson Learning, Inc.

Gathercole, S. E. and Alloway, T. P. (2008). *Working Memory and Learning. A Practical Guide for Teachers.* London, UK: Sage.

Geary, D. C., Hoard, M. K., Bryd-Craven, J., Nugent, L. and Numtee, C. (2007). Cognitive Mechanisms Underlying Achievement Deficits in Children with Mathematical Learning Disability. *Child Development*, 78(4), 1343-1359.

Green, S. B. and Salkind, N. J. (2008). *Using SPSS for Windows and Macintosh: Analyzing and Understanding Data.* (6th ed.) Upper Saddle River, NJ: Pearson/Prentice Hall.

Hallahan, D. P. and Kauffman, J. M. (2005). *Special Education*. New Jersey:

Hashim, S., Hashim, S., Yaakub, R., Ahmad, M. Z., Yaakub, R., dan Ahmad, M. Z. (2007). *Pedagogi: Strategi dan teknik mengajar dengan berkesan*. Kuala Lumpur: PTS Professional Publishing Sdn. Bhd.

Heinich, R., Molenda, M., Russell, J. D., and Smaldino, S. E. (1999). *Instructional Media and Technologies for Learning.* Upper Saddle River, NJ: Prentice-Hall.

Hill-Karrer. J., Karrer, R., Bloom, D., Chaney, L. and Davis, R. (1998). Event-Related Brain Potentials during an Extended Visual Recognition Memory Task Depict Delayed Development of Cerebral Inhibitory Processes among 6-Month Old Infants with Down Syndrome. *International Journal of Psychophysiology,* 29, 167-200.

Hitch, J. G., McAuley, E. (1991). Working Memory in Children with Specific Arithmetical Learning Difficulties. *British Journal of Psychology,* 82(3), 375-386.

Hodapp, R. M., Leckman, J. F., Dykens, E. M., Sparrow, S. S., Zelinsky, D. G. and Ort, S. I. (1992). K-ABC Profiles of Children with Fragile X Syndrome, Down

Syndrome and Non-Specific Mental Retardation. *American Journal on Mental Retardation,* 97, 39-46.

Hoerl, C. (2007). Episodic Memory, Autobiographical Memory, Narratives: On Three Key Notions in Current Approaches to Memory Development. *Philosophical Psychology*, 20, 621-640.

Holmes, J., Gathercole, S. E., and Dunning, D. L. (2009). Adaptive Training Leads to Sustained Enhancement of Poor Working Memory in Children. *Journal of Developmental Science,* 12(4), 9-15.

Hook, E. G., Lindsjo, A. (1978). Down Syndrome in Live Births by Single Year Maternal Age. *Am J Hum Gene,* 30(1), 19-27.

Howard-Jones, Norman (1979). On the Diagnostic Term "Down's Disease". *Medical History.* 23(1), 102–04.

Hughes, J. (2006). Developing Working Memory Skills for Children with Down Syndrome. *Down Syndrome News and Update,* 6(2), 57-61.

Hulme, C. and Mackenzie, S. (1992). *Working Memory and Severe Learning Difficulties*. Hove, UK: Lawrence Erlbaum Associates Ltd.

Jacob, S. A. and Ferguson, S. P. (2012). Writing Interview Protocols and Conducting Interviews: Tips for Students New to the Field of Qualitative Research. *The Qualitative Report,* 17(42), 1-10.

Jaeggi, S. M., Buschkuehl, M., Jonides, J., and Priti Shah. (2011). Short- and Long-Term Benefits of Cognitive Training. *PNAS*, 108 (25), 10081-10086.

Jarold, C. and Baddeley, A. D. (1997). Short- Term Memory for Verbal and Visuo-Spatial Information in Down's Syndrome. *Cognitive Neuropsychiatry*, 2, 101-122.

Jarrold, C., and Baddeley, A. (1997). Short-Term Memory for Verbal and Visuo-Spatial Information in Down's Syndrome. *Cognitive Neuropsychiatry*, *2*, 101-122.

Jarrold, C., and Baddeley, A. D. and Phillips, C. (1999). Down Syndrome and the Phonological Loop: The Evidence for, and Importance of, a Specific Verbal Short-Term Memory Deficit. *Down Syndrome Research and Practice*, 6, 61-75.

Jarrold, C., Baddeley, A. D., and Hewes, A. K. (1999). Verbal Short-Term Memory Deficits in Down Syndrome: A Consequence of Problems in Rehearsal? *Journal of Child Psychology and Psychiatry*, 40(20), 233-244.

Jarrold, C., Baddeley, A. D., and Hewes, A. K. (2000). Verbal Short-Term Memory Deficits in Down Syndrome: A Consequence of Problems in Rehearsal? *Journal of Child Psychology and Psychiatry*, 40(20), 233-244.

Jarrold, C., and Baddeley, A. D. (2001). Short-Term Memory in Down Syndrome: Applying the Working Memory Model. *Down Syndrome Research and Practice*, 7(1), 17-23.

Jarrold, C., Nadel, L. and Vicari, S. (2008). Memory and Neuropsychology in Down Syndrome. *Down Syndrome Research and Practice*. Retrieved July 23 , from http://www.down-syndrome.org/reviews/2068/.

Kamaruzaman, Nurulziha. (2009). *Kesesuaian Pelaksanaan Program Pendidikan Khas di Politeknik Johor Bahru.* Masters Thesis, Universiti Teknologi Malaysia, Skudai.

Kay-Raining, B. E., Chapman, R. S. and Schwartz, S. (2004). Fast Mapping of Words and Story Recall by Individuals with Down Syndrome. *Journal of Speech, Language, and Hearing Research*, 47, 1287–1300.

Kay-Raining Bird, E., Cleave, P. L., White D., Pike, H., & Helmkay, A. (2008). Written and Oral Narratives of Children and Adolescents with Down Syndrome. *Journal of Speech, Language, and Hearing Research*, 51, 436–450.

Kipp, K. H., Mohr, G. (2008). Remediation of Developmental Dyslexia: Tackling a Basic Memory Deficit. *Cognitive Neuropsychology*, 25(1), 38-55.

Kittler, P. M., Krinski-McHale, S. J. and Devenny, D. A. (2008). Dual-Task Processing as a Measure of Executive Function: A Comparison between Adults with Williams and Down Syndrome. *American Journal on Mental Retardation,* 113, 117-132.

Klein, B. P. and Mervis, C. B. (1999). Contrasting Patterns of Cognitive Abilities of 9-and 10-year-olds with Williams Syndrome or Down Syndrome. *Developmental Neuropsychology*, 16, 177–196.

Klingberg, T., Fernell, E., Olesen, P. J., Johnson, M., Gustafsson, P., Dahlstrom, K., Gillberg, C. G., Forssberg, H., Westerberg, H. (2005). Computerized Training of Working Memory in Children with ADHD-A Randomized, Controlled Trial.

Journal of the American Academy of Child & Adolescent Psychiatry, 44(2), 177-186.

Klingberg, T., Forssberg, H., Westerberg, H. (2002). Training of Working Memory in Children with ADHD. *Journal of Clinical and Experimental Neuropsychology*, 24(6), 781-791.

Lanfranchi, S., Cornoldi, C. and Vianello, R. (2002). Working Memory Deficits in Individuals with and Without Mental Retardation. *Journal of Cognitive Education and Psychology,* 2, 301-312.

Lanfranchi, S., Cornoldi, C. and Vianello, R. (2003). Retardo Mentale Per Cause Genetiche: Carenze Specifiche Nella Memoria Di Lavoro? *Giornale Italiano delle Disabilitia,* 3, 28-46.

Lanfranchi, S., Cornoldi, C. and Vianello, R. (2004). Verbal and Visuo-Spatial Working Memory Deficits in Children with Down Syndrome. *American Journal of Mental Retardation*, 109, 456-66.

Lanfranchi, S., Jerman, O. and Vianello, R. (2009). Working Memory and Cognitive Skills in Individuals with Down Syndrome. *Child Neuropsychology: A Journal on Normal and Abnormal Development in Childhood and Adolescence,* 15(4), 397-416.

Lecas, J. F., Mazaud, A. M., Reibel, E. and Rey, A. (2011). Using Visual Strategies to Support Verbal Comprehension in an Adolescent with Down Syndrome. *Child and Language Teaching Therapy*, 27, 84-96.

Laws of Malaysia (2013). *Regulations (Special Education)*.

Laws, G., MacDonald, J., Bukley, S. and Broadley, I. (1995). Long-Term Maintenance of Memory Skills Taught to Children with Down's Syndrome. *Down's Syndrome: Research and Practice,* 3, 103-109.

Laws, G., MacDonald, J. and Buckley, S. (1996). The Effects of a Short Training in the Use of a Rehearsal Strategy on Memory for Words and Pictures in Children with Down Syndrome. *Down's Syndrome: Research and Practice,* 4, 70-78.

Lodico, M. G., Spaulding, D. T. and Voegtle, K. H. (2006). *Methods in Educational Research. From Theory to Practice.* CA: Jossey Bass.

Loomes, C., Rasmussen, C., Pei, J., Manji, S., Andrew, G. (2008). The Effect of Rehearsal Training on Working Memory Span of Children with Fetal Alcohol Spectrum Disorder. *Research in Developmental Disabilities*, 29(2), 113-124.

Mahzan, A. (2008). *Pendidikan Literasi Bahasa Melayu: Strategi Perancangan dan Pelaksanaan.* Kuala Lumpur: Utusan Publications.

Marcell, M. M. and Armstrong, V. (1982). Auditory and Visual Sequential Memory of Down Syndrome and Non-Retarded Children. *American Journal of Mental Deficiency*, *52*, 524-5.

Marcell, M. M., and Weeks, S. L. (1988). Short-term Memory Difficulties and Down's syndrome. *Journal of Intellectual Disability Research*, 32(2), 153-162.

Marcell, M. M., Harvey, C. F. and Cothran, L. P. (1988). An Attempt to Improve Auditory Short-Term Memory in Down's Syndrome Individuals through Reducing Distractions. *Research in Developmental Disabilities,* 9(4), 405-417.

Marcell, M. M. and Cohen, S. (1992). Hearing Abilities of Down Syndrome and Other Mentally Handicapped Adolescents. *Research in Developmental Disabilities, 15*, 533-551.

Miles, S., Sindberg, H., Bridge, C. and Chapman, R. S. (2006). *Journal of Speech, Language and Hearing Research,* 49, 325-337.

Miller, J. F. (1999). Profile of Language Development in Children with Down Syndrome. In Miller, J. F., Leddy M. and Leavitt L. A. (Eds.) *Improving the Communication of People with Down Syndrome* (pp. 11-39). Baltimore: Brookes.

Ministry of Education (2001). *Malaysia's Curriculum Conceptual Model for Special Education (1997).* Curriculum Development Centre.

Ministry of Education (2001). *Malaysia's Educational Philosophy.* Curriculum Development Centre.

Ministry of Education (2011). *Modul Pendidikan Khas 2010, Pengenalan Kepada Pendidikan Khas.* Institut Pendidikan Guru (IPG), Kementerian Pelajaran Malaysia.

Ministry of Education (2012). *Enrolment in Special Education Integration Program by Level, 2010-2012.*

Ministry of Education (2012). *Enrolment in Special Education Schools by Level and Gender, 2010-2012.*

Ministry of Education (2013). *Malaysia Education Blueprint 2013-2025 Preliminary Report*.

Molenda, M., Reigeluth, C. M. and Nelson, L. M. (2006). Instructional Design. *Encyclopedia of Cognitive Science*, 2, 574-578.

Moore, D. G., Goodwin, J. E. and Oates, J. M. (2008). Modified Bayley Scales. *Journal of Intellectual Disability Research*, 52, 554-561.

Muketova-Ladinska, E., Harrington, C., Roth, M. and Wischik, C. (1995). Distribution of Tau Protein in Down Syndrome: Quantitative Differences from Alzheimer's Disease. *Developmental Brain Dysfunction*, 7, 311-329.

Myers, A., and Hansen, C. (2006). *Experimental Psychology. (6th ed.)* CA: Thomson Wadsworth.

Nadel, L. and O' Keefe, J. (1974). The Hippocampus in Pieces and Patches: An Essay on Modes of Explanation in Physiological Psychology. In Bellairs, R., Gray, E. G. (Eds.) *Essays on the Nervous System*. A Festschrift for Young J. Z. Oxford: The Clarendon Press.

Nadel, L. (1986). Down Syndrome in Neurobiological Perspective. In Epstein, C. J. (Ed.) *The Neurobiology of Down syndrome* (pp. 239-51). New York: Raven Press.

Nadel, L. (1999). Learning and Memory in Down Syndrome. In Rondal, J., Perera, J. and Nadel, L. (Eds.) *Down Syndrome: A review of Current Knowledge*. London: Whurr Publishers Ltd.

Naess, K. A. B., Lyster, S. A. H., Hulme, C., and Melby-Lervag, M. (2011). Language and Verbal Short-term Memory Skills in Children with Down Syndrome: A Meta-analytic Review. *Research in Developmental Disabilities*, 32(6), 2225-2234.

NECIC. (2012). *Inclusive Education as National Policy for Children with Special Needs*.

Nelson, T. O. (1996). Consciousness and Metacognition. *American Psychologist, 5*, 102-116.

Norliah Mohd. Amin and Mohd Hanafi Mohd Yasin. (2016). Pelaksanaan Program Pendidikan Inklusif Murid Berkeperluan Khas dalam Pelan Pembangunan Pendidikan Malaysia 2013-2015. *International Conference On Special Education In Southeast Asia Region 6th Series 2016.*

Norusis, M. J. (2005). *SPSS 14.0 Advanced Statistical Procedures Companion*. Prentice Hall.

Oelwein, P. L. (1995). Teaching Reading to Children with Down Syndrome: A Guide for Parents and Teachers. *Topics in Down Syndrome*. Bethesda, MD: Woodbine House.

Pennington, B. F., Moon, J., Edgin, J., Stedron, J. and Nadel, L. (2003). The Neuropsychology of Down Syndrome: Evidence for Hippocampal Dysfunction. *Child Development*, 74(1), 75-93.

Pickering, S. J., Gathercole, S. E. and Hall, M. (2001). Development of Memory for Pattern and Path: Further Evidence for the Fractionation of Visual and Spatial Short-Term Memory. *The Quarterly Journal of Experimental Psychology*, 54A, 397-420.

Pueschel, S., Gallagher, P., Zartler, A. and Pezzulo, J. (1987). Cognitive and Learning Processes in Children with Down Syndrome. *Research in Development Disabilities*, 8, 21-37.

Rankin, P. M. and Hood, J. (2005). Designing Clinical Interventions for Children with Specific Memory Disorders. *Pediatric Rehabilitation*, 8(4), 283-297.

Reeves, R. H., Irving, N., Moran, T., Wohn, A., Kitt, C., Sisodia, S., Schmidt, C., Bronson, R. and Davisson, M. (1995). A Mouse Model for Down Syndrome Exhibits Learning and Behavior Deficits. *Nature Genetics*, 11, 177–184.

Roberts, E. M., English, P. B., Grether, J. K., Windham, G. C., Somberg, L. and Wolff, C. (2007). Maternal Residence Near Agricultural Pesticide Applications and Autism Spectrum Disorders Among Children in the California Central Valley. *Environmental Health Perspectives*, 115(10), 1482-1489.

Rojas, G. J., Villar, V., Iturry, M., Harris, P., Serrano, C. M., Herrera, J. A. and Allegri, R. F. (2013). Efficacy of a Cognitive Intervention Program in Patients with Mild Cognitive Impairment. *International Psychogeriatrics*, 25(5), 825–831.

Rowe, J., Lavender, A., and Turk, V. (2006). Cognitive Executive Function in Down's Syndrome. *British Journal of Clinical Psychology*, 45(1), 5-17.

Saye, J. W. and Brush, T. (2002). Scaffolding Critical Reasoning About History and Social Issues in Multimedia-supported Learning Environments. *Educational Technology Research and Development*, 50(3), 77-96.

Seung, H. K. and Chapman, R. (2004). Digit Span in Individuals with Down Syndrome and in Typically Developing Children: Temporal Aspects. *Journal of Speech, Language and Hearing Research*, 43, 609-620.

Sharifah, Z. (2011) *Kajian Tindakan Kualiti Pengajaran Down Syndrome Melalui Pendekatan Pengajaran dan Pembelajaran dalam Kumpulan*. Pendidikan Khas Kementerian Pelajaran Malaysia.

Sharifah, Z. (2015). *Keperluan Khas dan Pendidikan Anak-anak dengan Down Syndrome.* Jabatan Kesihatan Komuniti, Fakulti Perubatan dan Sains Kesihatan, Uinversiti Putra Malaysia.

Shaughnessy, J., Zechmeister, E., and Zeichmeister, J. (2006). *Research Methods in Psychology*, (7th ed.) NY: McGrawHill.

Sherman, S. L., Allen, E. G., Bean, L. H. and Freeman, S. B. (2007). Epidemiology of Down Syndrome. *Mental Retardation and Developmental Disabilities Research Reviews*, 13, 221-227.

Sjo, N. M., Spellerberg, S., Weidner, S., Kihlgren, M. (2010). Training of Attention and Memory Deficits in Children with Acquired Brain Injury. *Acta Paediatrica*, 99(2), 230-236.

Skinner, B. F. (1938). *The Behavior of Organisms: An Experimental Analysis*. New York: Appleton-Century-Crofts.

Smith, E. E. and Kosslyn, S. M. (2009). *Cognitive Psychology: Mind and Brain*. New Jersey: Pearson Education.

Special Education Department (2005).

Stoel-Gammon, C. (1997). Phonological Development in Down Syndrome. *Mental Retardation and Developmental Disabilities Research Reviews*, 3, 300-6.

Struwe, F. (1929). Histopathologisch untersuchungen uber Enstehung und Wesen der senilen plaques. *Zeitschrift fur die Gesamte Neurologie und Psychiatrie*, 122, 291-307.

Swanson, H. L. and Ashbaker, M. H. (2000). Working Memory, Short-Term Memory, Speech Rate, Word Recognition and Reading Comprehension in Learning Disabled Readers: Does the Executive System have a Role? *Intelligence*, 28(1), 1-30.

Swanson, H. L. and Sache-Lee, C. (2001). A Subgroup Analysis of Working Memory in Children with Reading Disabilities: Domain General or Domain-Specific Deficiency? *Journal of Learning Disabilities*, 34, 249-263.

Swanson, H. L. and Kim, K. (2007). Working Memory, Short-Term Memory and Naming Speed as Predictors of Children's Mathematical Performance. *Intelligence*, 35, 151-168.

Swanson, H. L., Kehler, P., Jerman, O. (2010). Working Memory, Strategy Knowledge, and Strategy Instruction in Children with Reading Disabilities. *Journal of Learning Disabilities,* 43(1), 24-47.

Thase, M. E., Tigner, R., Smeltzer, D. J. and Liss, L. (1984). Age-Related Neuropsychological Deficits in Down's Syndrome. *Biological Psychiatry*, 19(4), 571-585.

Thorndike, E. L. (1905). *The Elements of Psychology*. New York: Seiler AG.

Turner, M. L. and Engle, R. W. (1989). Is Working Memory Capacity Task Dependent? *Journal of Memory and Language*, 28, 127-154.

UNICEF (2014). *Children with Disabilities in Malaysia: Mapping the Policies, Programmes, Interventions and Stakeholders.* United Nations Children's Fund.

Van Bysterveldt, A. K., Gillon, G. T. and Moran, C. (2006). Enhancing Phonological Awareness and Letter Knowledge in Preschool Children with Down's Syndrome. *International Journal of Disability, Development and Education*, 53, 5-17.

Van der Lely, H. K. J. and Howard, D. (1993). Children with Specific Language Impairment: Linguistic Impairment or Short-Term Memory Deficit? *Journal of Speech and Hearing Research*, 36, 1193-1207.

Van't Hooft I, Norberg, A. L. (2010). SMART Cognitive Training Combined with a Parental Coaching Programme for Three Children Treated for Medulloblastoma. *Neurorehabilitation*, 26(2), 105-113.

Vellutino, F. R., Schatschneider, C. (2011). Experimental and Quasi-Experimental Design in Literacy Research. In N. Duke and M. Mallett (Eds.) *Literacy Research Methods*. (2nd ed.) (pp. 155-187). Guilford Press: New York, NY.

Vianello, R. (2006). Sindrome di Down. *Sviluppo Psicologico e Integrazione Dalla Nascita all'eta Adulta*. Bergamo: Edizioni Junior.

Vicari, S., Carlesimo, A. and Caltagirone, C. (1995). Short-Term Memory in Persons with Intellectual Disabilities and Down's Syndrome. *Journal of Intellectual Disability Research*, 39(6), 532-537.

Vicari, S., Brizzola, D., Carlesimo, G. A., Pezzini, G. and Volterra, V. (1996). Memory Abilities in Children with Williams Syndrome. *Cortex*, 32, 503-514.

Vicari, S. (2001). Implicit versus Explicit Memory Function in Children with Down's and Williams Syndrome. *Down's Syndrome Research and* Practice, 7(1), 35-40.

Wang, P. P. and Bellugi, U. (1994). Evidence from Two Genetic Syndromes for a Dissociation Between Verbal and Visual-Spatial Short-Term Memory. *Journal of Clinical and Experimental Neuropsychology*, 16, 317-322.

Wiersma, W. (2000). *Research Methods in Education: An Introduction.* (Vol 1). Ally and Bacon.

Wishart, J. G. (2007). Socio-Cognitive Understanding: A Strength or Weakness in Down's Syndrome? *Journal of Intellectual Disability Research*, 51(12), 996-1005.

Wisniewski, K., Kida, E. and Brown, W. (1996). Consequences of Genetic Abnormalities in Down's Syndrome on Brain Structure and Function. In Rondal, J. A., Perera, J., Nadel, L., Comblain, A. (Eds.) *Down's Syndrome: Psychological, Psychobiological and Socio-educational Perspectives*. London: Whurr.

Wood, D., Bruner, J., and Ross, G. (1976). The Role of Tutoring in Problem Solving. *Journal of Child Psychology and Psychiatry*, 17, 89–100.

Yeo, K. J. (2006). *Effectiveness of Intervention on Reading Readiness among Kindergarten Children.* PhD thesis, Universiti Teknologi Malaysia.

Zarin, I., Safani, B. dan Boon, S. S. (2004). Integrasi Sosial Murid Berkeperluan Khas Bermasalah Pendengaran dalam Program Inklusif. Dalam Zamri Mahamod (Ed) *Prosiding Seminar Pendidikan Khas*. Bangi: Fakulti Pendidikan Universiti Kebangsaan Malaysia.

Zelazo, P. D., Frye, D. and Rapus, T. (1996). An Age-Related Dissociation between Knowing Rules and Using Them. *Cognitive Development,* 11, 37-63.