DESIGN AND DEVELOPMENT OF BASIC ARITHMETIC SKILLS (BAS) MODULE FOR PUPILS WITH DYSCALCULIA SYMPTOMS

YOONG SOO MAY

SULTAN IDRIS EDUCATION UNIVERSITY

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YOONG SOO MAY

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ABSTRACT

The purpose of this study is to design and develop the Basic Arithmetic Skills (BAS) Module for pupils with dyscalculia symptoms. BAS Module was designed and developed based on ADDIE Model. Five phases in ADDIE Model are analysis, design, development, implementation, and evaluation. The objectives of this study are to identify the needs and activities in BAS Module, to measure the validity, reliability and effectiveness of BAS Module. Quantitative approaches with quasi-experimental design were applied. Four instruments were needs analysis instrument, content assessment instrument for BAS Module, pre-test and post-test, and BAS Module. 384 Mathematics teachers were selected using random cluster sampling, whereas 120 pupils with dyscalculia symptoms were chosen using purposive sampling. The pupils were divided into treatment group (N = 61) and control group (N = 59). The results of needs analysis survey showed that there was a need to design and develop a module (M = 4.02, SD = 0.84). BAS Module achieved high validity (content validity coefficient = 0.88) and reliability ($p < 0.001$, $r = 0.602$). Dependent *t*-test showed that there was a significant increase in the achievement of treatment group from pre-test (M = 26.69, SD = 22.513) to post-test (M = 42.64, SD = 26.058), $t(60) = -6.194$, $p < 0.001$. The independent *t*-test showed that the achievement in post-test of treatment group (M = 42.64, SD = 26.058) is higher than the post-test of control group (M = 28.20, SD = 22.809), $t(118) = -3.225$, $p = 0.002$. In conclusion, a module specifically for pupils with dyscalculia symptoms has been successfully designed and developed. BAS Module is effective in improving the basic arithmetic skills among pupils with dyscalculia symptoms. This study implicated that BAS Module should be applied to the pupils with dyscalculia symptoms in Malaysia to improve their basic arithmetic skills.

REKA BENTUK DAN PEMBANGUNAN MODUL KEMAHIRAN ARITMETIK ASAS (KAA) BAGI MURID BERGEJALA DISKALKULIA

ABSTRAK

Tujuan kajian ini adalah untuk mereka bentuk dan membangunkan Modul Kemahiran Aritmetik Asas (KAA) kepada murid bergejala diskalkulia. Modul ini telah dibangunkan berpandukan Model ADDIE. Lima fasa dalam Model ADDIE adalah analisis, reka bentuk, pembangunan, pelaksanaan dan penilaian. Objektif kajian ini adalah untuk mengenalpasti keperluan dan aktiviti-aktiviti dalam Modul KAA, serta untuk mengukur kesahan, kebolehpercayaan dan keberkesanan Modul KAA. Pendekatan kuantitatif iaitu kuasi-eksperimen telah digunakan. Empat instrumen yang digunakan adalah instrumen analisis keperluan, instrumen penilaian kandungan bagi Modul KAA, ujian pra dan ujian pasca, serta Modul KAA. Seramai 384 guru Matematik telah dipilih menggunakan persampelan rawak kelompok, manakala 156 murid bergejala diskalkulia telah dipilih menggunakan persampelan bertujuan. Murid-murid ini telah dibahagikan kepada kumpulan rawatan (N = 61) dan kumpulan kawalan (N = 59). Dapatan tinjauan analisis keperluan menunjukkan bahawa terdapat keperluan untuk mereka bentuk dan membangunkan satu modul untuk kemahiran aritmetik asas bagi murid bergejala diskalkulia (M = 4.02, SD = 0.84). Modul KAA berjaya mencapai kesahan (indeks kesahan kandungan = 0.88) dan kebolehpercayaan ($p < 0.001$, $r = 0.602$) yang tinggi. Ujian-*t* bersandar menunjukkan bahawa terdapat peningkatan yang signifikan dalam pencapaian kumpulan rawatan daripada ujian pra (M = 26.69, SD = 22.513) kepada ujian pasca (M = 42.64, SD = 26.058), $t(60) = -6.194$, $p < 0.001$. Ujian-*t* tidak bersandar menunjukkan bahawa pencapaian kemahiran aritmetik asas dalam ujian pasca bagi kumpulan rawatan (M = 42.64, SD = 26.058) adalah lebih tinggi daripada ujian pasca bahawa bagi kumpulan kawalan (M = 28.20, SD = 22.809), $t(118) = -3.225$, $p = 0.002$. Kesimpulannya, satu modul khusus untuk murid-murid bergejala diskalkulia berjaya direka bentuk dan dibangunkan. Modul KAA adalah berkesan untuk meningkatkan kemahiran aritmetik asas dalam kalangan murid-murid bergejala diskalkulia. Implikasi kajian menunjukkan bahawa Modul KAA seharusnya diaplikasikan terhadap semua murid bergejala diskalkulia di Malaysia supaya dapat meningkatkan kemahiran aritmetik asas mereka.

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LIST OF ABBREVIATION

ADHD	Attention Deficit Hyperactivity Disorder
ANOVA	Analysis of Variance
ASD	Autism Spectrum Disorder
BAS	Basic Arithmetic Skills
CVI	Content Validity Index
DSM-5	Diagnostic and Statistical Manual of Mental Disorder (Fifth Edition)
FDM	Fuzzy Delphi Method
IPS	Intraparietal Sulcus
IQ	Intelligence Quotient
KSSR	Primary School Standard Curriculum
MFG	Middle Frontal Gyrus
Pc	Probability of Chance Agreement
SK	Malay-medium National Schools
SJKC	National-type Chinese Primary Schools
SJKT	National-type Tamil Primary Schools
SPSS	Statistical Package of the Social Science
TIMSS	Trends in International Mathematics and Science Study
UNCRPD	United Nations Convention on the Rights of Persons with Disabilities
UPSI	Universiti Pendidikan Sultan Idris
UPSR	Primary School Achievement Test

WIAT-III	Wechsler Individual Achievement Test (Third Edition)
WISC-IV	Wechsler Intelligence Scale for Children (Fourth Edition)
ZAREKI-R	Neuropsychological Test Battery for Number Processing and Calculation in Children

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CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter explained briefly about the eleven sections in the study, namely; (1) background of the study; (2) problem statement; (3) rationale of the study; (4) purpose of the study; (5) research question; (6) hypothesis; (7) significance of the study; (8) limitation of the study; and (9) operational definition.

1.2 Background of the Study

The fourth goal for Sustainable Development Goals is Quality Education. Its aim is to ensure quality and inclusive education for all and to promote lifelong learning. Countries announced temporary school closures as the Covid-19 pandemic spread across the globe, affecting over 91 per cent of the students worldwide (United Nations, 2019a). Months of school closures due to Covid-19 can affect the educational outcomes.

In the longer term, absenteeism will increase the declining retention and graduation rates and worse learning outcomes, especially among the disadvantaged pupils, including those from poor families and pupils with learning or physical disabilities (United Nations, 2020). In this matter, teachers and pupils with special educational needs might endured more and different obstacles in distance learning than those without special educational needs (Maurer, Becker, Hilkenmeier, & Daseking, 2021).

Education enables upward socioeconomic progress. It is the key to getting out of poverty. After all, millions of pupils are still out of school and not all who do attend are learning (United Nations, 2019b). Based on the Sustainable Development Goals Report 2022, there are too many children lacked the fundamentals of numeracy and they are struggling with the crisis in learning (United Nations, 2022). This shows an urgent need that policy makers, educators, and teachers need to do something so that no child is left behind in our educational system, especially for special educational needs pupils. According to Kunwar and Sharma (2020), the number of pupils with dyscalculia symptoms might be one of the causes of this low proficiency in Mathematics.

Malaysia and other members of the United Nations Economic and Social Commission for Asia and the Pacific adopted the Incheon Strategy to Make the Right Real for Persons with Disabilities in Asia and the Pacific which comprises ten goals, 27 targets, and 62 indicators in November 2012 (Ruhiyati Idayu Abu Talib, Mohd Shahrizal Sunar, & Nikolic, 2018). Incheon Strategy to Make the Right Real for Persons with Disabilities in Asia and the Pacific placed emphasis on developments providing for people with intellectual and learning disabilities. According to this, great strides

have been made in attitudes to learning difficulties (Harrison, Busby, & O'Shaughnessy, 2018). Since the fifth goal of Incheon Strategy is to expand early intervention and education for pupils with disabilities, so modules for learning disabilities or difficulties among the pupils are crucial.

The signing of the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD) marked national recognition of the rights for people with disabilities because it represents the social adoption, rather than a medical, model of disability (Njelesani, Siegel, & Ullrich, 2018). Article 24, paragraph 2(d) in the UNCRPD stated that persons with disabilities should receive the support they need within the system of general education to support their education effectively (United Nations, 2006). Support can be expressed in many ways, but individual needs should always be considered. In this regard, all teachers must acquire the necessary competencies and skills to work in an environment with pupils having a diverse range of abilities (Fina, Cera, & Palmisano, 2020). Thus, the teachers should give proper intervention to the symptomatic pupils with dyscalculia symptoms in the classroom so that the educational needs of these pupils are fulfilled.

Zero Reject Policy enforces the education of pupils with learning disabilities and difficulties. However, it does not specifically address how state and local education authorities must enforce the zero reject rule. Agencies often begin their implementation with an evaluation to determine if the pupil has a disability and needs special education (Meral & Turnbull, 2014). In Malaysia, Ministry of Education introduced Zero Reject Policy in phases to guarantee that special needs pupils have access to education without adequate paperwork. Since the implementation Zero Reject Policy, teachers are

expected to be able to cater to all the pupils with special needs, including the pupils with learning difficulties (Marlissa Omar & Dayana Farzeeha Ali, 2019). Hence, pupils with specific learning difficulties should be given suitable interventions or activities in accordance with their level of cognitive development.

The first shift in the Malaysia Education Blueprint 2013-2025 is to allow equal access to quality education at the international level. In this matter, our government has increased investment in physical and instructional resources for pupils with specific needs. Consequently, Ministry of Education Malaysia has ensured that specific needs students, such as students with special needs, indigenous and other minority students like Orang Asli and Penan, gifted students, and students in under-enrolled schools have the opportunity to get an education that is relevant to their needs. There are six categories of pupils with special needs, included pupils with; (1) visual impairment; (2) hearing impairment; (3) speech difficulties; (4) physical disabilities; (5) multiple disabilities; and (6) learning disabilities such as autism spectrum disorder (ASD), Down's Syndrome, attention deficit hyperactivity disorder (ADHD), and dyslexia (Ministry of Education Malaysia, 2013). However, the term dyscalculia did not appear even once in Malaysia Education Blueprint 2013-2025 (Yoong & Ahmad, 2020b).

The services for learning difficulties pupils are in charged by three ministries, namely Ministry of Education Malaysia, Ministry of Women, Family and Community Development, and Ministry of Health (Noor Aini Ahmad, 2018a). Ministry of Education provides the educational services for these pupils. Legislatively, only doctors and paramedical personnel are entitled to certify an individual as being special

educational needs (Haniz Ibrahim, Siti Eshah Mokshein, Ardzulyna Anal, & Syamsinar Abd. Jabar, 2014).

In year 2022, there is a total of 105,785 special needs pupils in our country, and this amount does not include those who have not registered. Figure 1.1 shows the number of special educational needs pupils based on categories of disability. There are 6,937 physical disabilities pupils, 3,539 multiple disabilities pupils, 3,713 hearing impairment pupils, 2,559 visual impairment pupils, 919 speech difficulties pupils, and 88,118 learning disabilities pupils (Ministry of Education Malaysia, 2022). This data shows that pupils with learning disabilities occupied around 83 per cent among the population of pupils with disabilities.

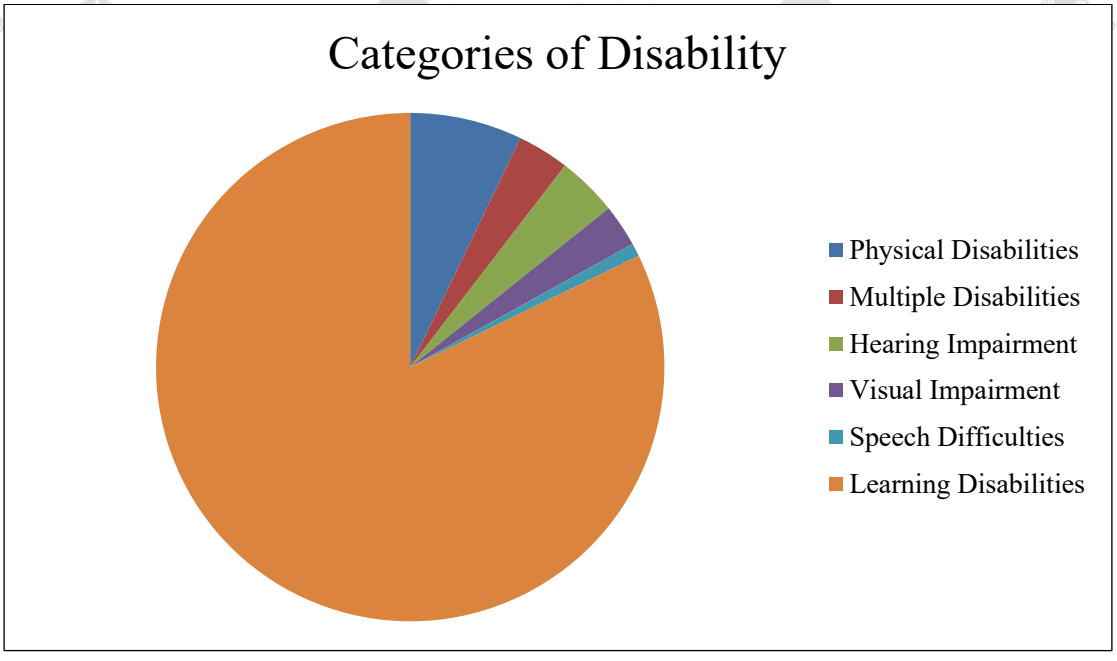


Figure 1.1. Number of Special Educational Needs Pupils based on Categories of Disability. Adapted from Special Education Data, 2022.

In year 2019, there are 16.87 per cent of the Primary School Achievement Test (UPSR) candidates failed in the subject of Mathematics. This is to say that there is a number of 72,812 out of 431,610 Year Six Pupils obtained an E for Mathematics subject in their UPSR exam (Ministry of Education Malaysia, 2019a). This is a very serious problem as Mathematics is a compulsory subject in Malaysian primary and secondary school curricula. Despite being an important and necessary subject in daily life, many pupils, especially pupils with dyscalculia symptoms who faced difficulties in Mathematics subject, are afraid of this subject (Yoong, 2020).

It was estimated that four to six per cent of the pupils among the population are having the learning difficulties of dyscalculia (Bird, 2017b). Dyscalculia affects between four to seven per cent of children (Butterworth, 2019). The presence of dyscalculia can impair the typical pupils' Mathematics performance. This learning difficulty in Mathematics happens among people across the whole Intelligence Quotient (IQ) range. The estimated prevalence of dyscalculia range is between three and six per cent of the population. Previous study found out that 5.5 per cent of the primary school pupils in Sabah are suffering from dyscalculia (Chin, Pang, Wong, Tan, & Lee, 2014). Study showed that most teachers have limited strategies to support pupils with dyscalculia symptoms (Chin & Fu, 2021).

In short, it is a global concern to provide appropriate and suitable teaching to every pupil, especially pupils with disabilities. The category of pupils with learning disabilities or difficulties is critical as they occupy the largest portion among pupils with disabilities. Many pupils have not reached the minimum proficiency in Mathematics even though it is the core subject in our education system. This is more

critical among pupils with dyscalculia symptoms. Proper teaching and learning strategies and techniques are needed in order to support the pupils with dyscalculia symptoms.

In this study, Basic Arithmetic Skills (BAS) Module was designed and developed in order to improve the basic arithmetic skills among pupils with dyscalculia symptoms in primary schools. The content in BAS Module includes basic arithmetic skills of addition, subtraction, multiplication, and division. These skills were selected as they are the basic foundation to learn other higher order skills and they are needed in our daily life. Creative ways were created based on the cognitive development of pupils with dyscalculia symptoms so that they are able to learn Mathematics more effectively.

1.3 Problem Statement

Pupils with dyscalculia symptoms are a hundred times less likely to receive an official diagnosis of that disorder if compare to pupils with dyslexia. It is crucial for them to obtain the specialist educational support (Morsanyi, van Bers, McCormack, & McGourty, 2018). Some people with learning disabilities may never obtain an evaluation and go through life, never knowing why they are struggling in their studies, or why they may be consuming problems in their work, or facing problems when they are socializing with family and friends (Rajivsureshkumar, Malarvizhi, & Deebanchakkarawarthi, 2019). Data of Special Education shows that there are six categories of learning disability in Malaysia, namely specific learning difficulties,

intellectual disability, autism, ADHD, down syndrome, and others. In this matter, the category of specific learning difficulties includes of dyslexia, dyscalculia, and dysgraphia (Ministry of Education Malaysia, 2022).

Table 1.1 shows special educational needs pupils based on categories of learning disabilities. Based on the table, there were seven categories of learning disabilities, whereas three types of learning difficulties were dyslexia, dyscalculia, and dysgraphia. However, the data shows that the total number of dyscalculia is none! Previous studies show that the range of prevalence rate of pupils with dyscalculia symptoms are 2.27 per cent to 7.4 per cent (Espina, Marban, & Maroto, 2022; Li, Zhang, & Zhang, 2022; Santos, Rebeiro, Dias-Piovezana, Primi, Dowker, & von Aster, 2012). More researches are needed on intervention and the current situation in Malaysia's dyscalculia cases in order to meet the needs of pupils with dyscalculia symptoms (Mohammad Amimul Ihsan Aquil & Mazeyanti Mohd. Ariffin, 2020a).

Table 1.1

Special Educational Needs Pupils based on Categories of Learning Disabilities

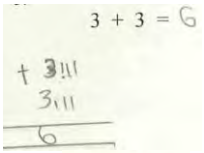
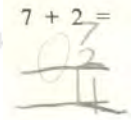
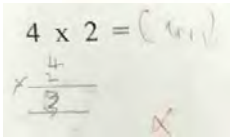
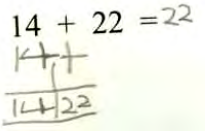
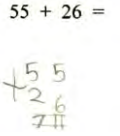
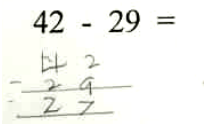
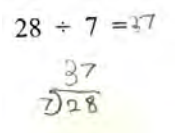
No.	Learning Disabilities	Total
1	Down Syndrome	5,159
2	ADHD	7,669
3	Autism	20,755
4	Intellectual Disability	35,059
5	Specific Learning Difficulties (Dyslexia)	15,118
	Dyscalculia	0
	Dysgraphia	0
6	Others	4,358
	Total	88,118

Note. Adapted from Special Education Data, 2022.

Pupils with dyscalculia face difficulties in learning and retaining basic arithmetics (Chinn, 2020). Table 1.2 shows difficulties of pupils with dyscalculia in arithmetic skills. Example one shows that these pupils rely on visualisation in counting. They also faced difficulties to perform simple calculation, recall number facts automatically, align vertical numbers in columns, regroup numbers, make borrowing errors, and reach unreasonable answer.

Table 1.2

Difficulties of Pupils with Dyscalculia in Arithmetic Skills

No.	Difficulties of Pupils with Dyscalculia	Example
1	Rely on visualisation in counting.	
2	Perform simple calculation.	
3	Recall number facts automatically.	
4	Align vertical numbers in columns.	
5	Regroup numbers.	
6	Make borrowing errors.	
7	Reach unreasonable answers.	

Previous researches on dyscalculia intervention were limited, especially in the context of Malaysia (Mohammad Amimul Ihsan Aquil & Mazeyanti Mohd Ariffin, 2020a). Based on the literature reviews, the interventions of dyscalculia included an assistive tool named Mathelete from India (Dhingra, Aggarwal, Garg, Pujari, & Yadav, 2022), a process-based executive function intervention from Iran (Somayeh Nazari, Farnaz Hakiminejad, & Saeid Hassanzadeh, 2022), Sketchnote technique from Jordan (Ziadat, 2022), Reconnecting Learning from Malaysia (Chin & Fu, 2021), a teaching aid named [Kantong Bilangan] from Indonesia (Islamyati, Sunardi, Yuwono, & Widyastono, 2021), and interactive video from Indonesia (Widodo, Prihatiningsih, & Taufiq, 2021).

Also, there were interventions such as abacus course from China (Lu, Ma, Chen, & Zhou, 2020), computerized apple-collecting game from China (Cheng et al., 2019), visual based augmented reality learning application (V-ARA-Dculia) from Malaysia (Miundy, Halimah Badioze Zaman, Aliimran Nordin, & Ng, 2019), a mobile application named Calculic Kids from Malaysia (Mazeyanti Mohd Ariffin, Fiqa Azureen Abd Halim, & Sugathan, 2018), a computer play pedagogy intervention from Malaysia (Nor Elleeiana Mohd Syah, Nur Azah Hamzaid, Murphy, & Lim, 2015), and a multimedia courseware named DyscalCo from Malaysia (Amirah Khairul Anuar, 2011). However, there was no systematic module specifically designed for pupils with dyscalculia symptoms in order to learn arithmetic.

Table 1.3 shows the interventions for pupils with dyscalculia. Based on the table, six out of twelve interventions used technology tools such as mobile application, computer courseware and game. Meanwhile, one intervention used interactive video, one applied augmented reality, one used teaching media, two used teaching techniques, and another used abacus course. However, there is no module designed specifically for pupils with

dyscalculia. Among these interventions, four out of twelve focused on arithmetic. The content of other interventions included early numeracy skills, word solving problem, counting ability, place value, numbers, fraction, money, and size.

Even though the main difficulties faced by pupils with dyscalculia are four basic arithmetic skills, however, the existing interventions did not fill the gap to fulfill the requirement of these pupils. Most of the interventions for arithmetic only focused on addition and subtraction skills. According to Boz and Erden (2021), this is insufficient as the basic arithmetic skills are crucial for the pupils' success in Mathematics, where pupils with dyscalculia are often having difficulties related to multiplication and division skills. Hence, intervention that includes all four basic arithmetic skills is needed to be designed specifically for these pupils with dyscalculia symptoms.

Based on the aspects of methodology, seven out of twelve studies applied experimental design, whereas two of them applied single subject research. Meanwhile, one study applied qualitative approaches, namely interview and observation. Another one study applied formative and summative evaluation, while the other study applied prototying-based methodology. However, most of these studies did not mention about the design and development process of the interventions. In order to fill this gap, this study applied a systematic approach to develop an intervention module, which is ADDIE approach, where quasi-experimental design was applied in the final phase, in order to evaluate the module that had been developed.

Table 1.3

Interventions for Pupils with Dyscalculia

No.	Source	Intervention	Country	Content	Methodology
1	Dhingra, Aggarwal, Garg, Pujari, & Yadav, 2022	Mathelete	India	Early Numeracy Skills	Experiment
2	Somayeh Nazari, Farnaz Hakiminejad, & Saeid Hassanzadeh, 2022	Process-based Executive Function Intervention	Iran	Factual and Procedural Arithmetic Knowledge	Semi-experimental Design
3	Ziadat, 2022	Sketchnote Technique	Jordan	Word Solving Problem	Three Groups Experimental Design
4	Chin & Fu, 2021	Reconnecting Learning	Malaysia	Counting Ability	Interview, Observation
5	Islamyati, Sunardi, Yuwono, & Widyastono, 2021	[Kantong Bilangan] Media	Indonesia	Place Value	Single Subject Research
6	Widodo, Prihatiningsih, & Taufiq, 2021	Interactive Video	Indonesia	Natural numbers	Single Subject Research
7	Lu, Ma, Chen, & Zhou, 2020	Abacus Course	China	Arithmetic Computation	Experiment
8	Cheng et al., 2019	Computerized Apple-collecting Game	China	Arithmetic	Experiment
9	Miundy et al., 2019	Visual Based Augmented Reality Learning Application [V-ARA-Dculia]	Malaysia	Fraction	Formative and Summative Evaluation
10	Mazeyanti Mohd Ariffin, Fiqa Azureen Abd Halim, & Sugathan, 2018	Calculic Kids	Malaysia	Numeral learning	Quasi-experiment
11	Nor Elleeiana Mohd Syah, Nur Azah Hamzaid, Murphy, & Lim, 2015	Computer Play Pedagogy Intervention	Malaysia	Counting and Arithmetic Operations	Experiment
12	Amirah Khairul Anuar, 2011	DyscalCo Courseware	Malaysia	Money and size	Prototyping-based Methodology

There were studies mentioned that the prevalence rate of dyscalculia is higher among female (Cheng, Miao, Wu, Chen, Chen, & Zhou, 2022; Chinnaraj & Kavitha, 2021; Lewis & Fisher, 2016). Another study shows that dyscalculia is as common in male and female (Morsanyi et al., 2018). However, previous studies did not compare the effectiveness of the dyscalculia interventions among different gender. Thus, it was not stated whether these interventions are equally effective among male and female pupils.

Most of the studies on intervention focused on a certain age group. For example, the mobile application named Calculic Kids is suitable for pupils at the age from six to ten years old (Mazeyanti Mohd Ariffin, Fiqa Azureen Abd Halim, Noreen Izza Arshad, Mazlina Mehat, & Ahmad Sobri Hashim., 2019). Pupils need to master in four basic arithmetic skills between nine to 12 years old (Shalev & Gross-Tsur, 2001 in Nor Elleeiana Mohd Syah et al., 2015). However, study shows that 11.4 per cent of primary school pupils have not mastered in basic arithmetic skills (Sajida Mah Jabeen, Muhammad Javed Aftab, Robina Naqvi, Tajammal Hussain Awan, Muhammad Siddique, 2021). It is crucial for these age group of pupils to master in basic arithmetic skills as the inability to solve these skills may lead to math anxiety (Sorvo et al., 2017). Since pupils with special educational needs learn based on their different cognitive developmental level, it is necessary to develop a module which is suitable for the whole age range of pupils with dyscalculia symptoms in primary schools.

In summary, dyscalculia is yet a new term that needs to be discovered in our country. More research needs to be conducted in the area of dyscalculia. Appropriate teaching and learning strategies are needed to help pupils with dyscalculia symptoms

to organise their learning structure by addressing their mathematical skills. Hence, a module for dyscalculia was developed in order to assist these pupils who are facing difficulties in learning Mathematics. Basic arithmetic skills are among the core skills in Mathematics subject, so the rationale for the design and development of BAS Module is to improve the basic arithmetic skills among the pupils with dyscalculia symptoms.

1.4 Rationale of the Study

This study aims to design and develop BAS Module to improve the basic arithmetic skills among pupils with dyscalculia symptoms in primary schools. This study focuses on pupils in primary schools because the data shows that special needs pupils in primary schools constitute the largest percentages among all the special needs pupils in different school levels. The distribution of special needs pupils in our country is as follow; 1,629 pupils (1.54 per cent) in preschools; 58,625 pupils (55.42 per cent) in primary schools; and 45,531 pupils (41.17 per cent) in secondary schools (Ministry of Education Malaysia, 2022). Figure 1.2 shows the distribution of special needs pupils.

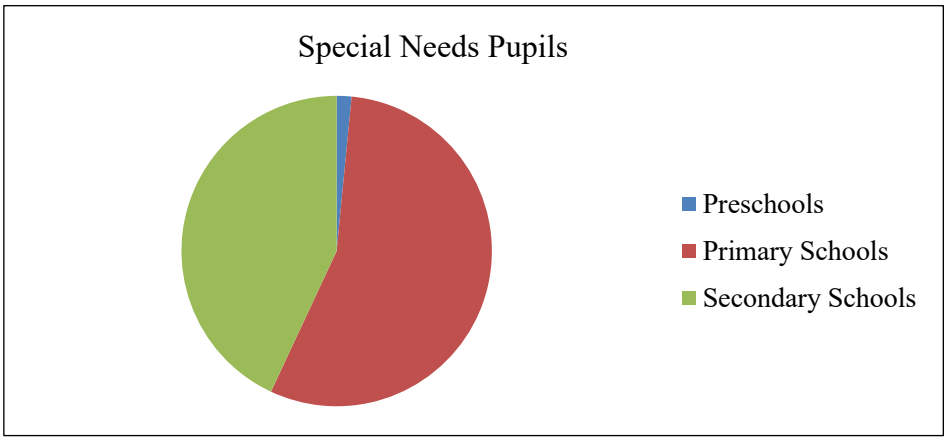


Figure 1.2. The Distribution of Special Needs Pupils. Adapted from Ministry of Education Malaysia, 2022.

In the context of this study, BAS Module is proposed in primary schools not only because of the higher percentage of special needs pupils in this group, but also supported by previous researchers who stated that, even though pupils with learning difficulties can be diagnosed as early as six years old. However, in Malaysia, most of the pupils are diagnosed at the age of seven years old (Fiqa Azureen Abd Halim, Mazeyanti Mohd Ariffin, & Sugathan, 2018). Hence, it is very suitable for this study to focus on pupils in primary schools instead of pupils in preschools, secondary schools, or other school levels.

Besides, previous study shows that national schools have higher prevalence of pupils with specific learning difficulties compared to private schools (Ashraf & Najam, 2020). Hence, the researcher selected pupils with dyscalculia symptoms in national schools instead of other school types, such as private schools, international schools, home schools, religious schools, and so on. Intervention using BAS Module were carried out to assist the teachers in the teaching and learning for pupils with dyscalculia symptoms so that their basic arithmetic skills were able to be improved.

Mathematics is a difficult task for pupils with dyscalculia symptoms, so teachers need to be innovative in developing the products or toolkits to improve the Mathematics core skills among these pupils (Yoong & Nor Azmidy Ismail, 2021). Many teachers perform re-teaching, drill, and practices to overcome pupils' learning difficulties in Mathematics, however, they seldom develop teaching strategies and media that fit the needs for pupils with dyscalculia (Wijaya, Retnawati, Setyaningrum, Aoyama, & Sugiman, 2019).

Pupils with dyscalculia manifest persistent problems in applying the basic methods of arithmetic (Chinnaraj & Kavitha, 2021). The interventions are greatly needed to assist the pupils with specific learning difficulties, especially pupils with dyscalculia symptoms. A module focused on the interventions for basic arithmetic skills was designed and developed because these are the core skills for every pupil to learn Mathematics. If pupils are lacking of these skills, they will face difficulties not only in Mathematics subject but also in their everyday activities.

Arithmetic is a major building block for children's development of more complex mathematical abilities (Bellon, Fias, & Smedt, 2019). Basic arithmetic skills are very important because they are the underlying factors for the performance in academic by many pupils (Williamson et al., 2019). Pupils with low basic arithmetic skills may become anxious in various kinds of situations involving Mathematics and calculations because of their earlier failures and negative experiences (Sorvo et al., 2017). These are the reasons pupils need to master in basic arithmetic skills as it may lead to math anxiety and affect their performance in other academic subjects. Also, pupils with dyscalculia symptoms who faced difficulties in Mathematics need to be given appropriate interventions so that they are able to master in addition, subtraction, multiplication, and division.

Most studies focused on understanding dyscalculia and its diagnosis, nevertheless little has been focused on educational intervention (Espina et al., 2022). For intervention programme, conceptual teaching needs to be focused to foster basic arithmetic understanding should be carried out to primary school pupils who are facing difficulties in calculation (Karakonstantaki, Simos, Michalis, & Micheloyannis, 2017).

More intervention programmes and modules are needed in order to assist pupils with dyscalculia symptoms in acquiring basic mathematical skills.

Previous dyscalculia interventions studies usually focused on early numeracy skills, number, general cognitive ability, counting, place value, and mathematical word problem solving ability (Dhingra et al., 2022; Ziadat, 2022; Chin & Fu, 2021; Islamyati et al., 2021; Widodo et al., 2021). There were also dyscalculia interventions studies on components of arithmetic and simple arithmetic involving addition and subtraction (Somayeh Nazari et al., 2022; Lu et al., 2020; Cheng et al., 2019; Mazeyanti Mohd Ariffin et al., 2018; Noor Elleeiana Mohd Syah et al., 2015). Hence, this study designed and developed a module which comprises the intervention techniques of four basic arithmetic skills, not only addition and subtraction, but also multiplication and division.

1.5 Purpose of the Study

The main purpose of this study is to design and develop a module to improve basic arithmetic skills for pupils with dyscalculia symptoms in primary schools. The focus of this study is the pupil with dyscalculia symptoms in primary schools. They are facing difficulties in learning Mathematics, especially in acquiring basic arithmetic skills. These skills are essential as they are the foundation for other higher order skills. Based on the literatures, a module for basic arithmetic skills is yet to be developed.

This study has been divided into five phases based on ADDIE approach, namely analysis phase, design phase, development phase, implementation phase, and evaluation phase. This process aimed to design and develop a module specifically for pupils with dyscalculia symptoms in a systematic way. Through this approach, a valid and reliable module has been produced. This study also aimed to evaluate the effectiveness of BAS Module in improving the basic arithmetic skills among the pupils with dyscalculia symptoms in primary schools.

1.5.1 Objectives

The five objectives to achieve the main purpose are identifies as follow:

1. To identify the needs of BAS Module for pupils with dyscalculia symptoms in primary schools.

2. To identify the activities in BAS Module for pupils with dyscalculia symptoms in primary schools.

3. To measure the validity of BAS Module among pupils with dyscalculia symptoms in basic arithmetic skills.

4. To measure the reliability of BAS Module among pupils with dyscalculia symptoms in basic arithmetic skills.

5. To measure the effectiveness of BAS Module in improving basic arithmetic skills among pupils with dyscalculia symptoms.

1.6 Research Question

According to the objectives, five research questions are listed below:

1. What are the needs of BAS Module for pupils with dyscalculia symptoms in primary schools?

2. What are the activities in BAS Module for pupils with dyscalculia symptoms in primary schools?

3. What is the validity of BAS Module among pupils with dyscalculia symptoms in basic arithmetic skills?

4. What is the reliability of BAS Module among pupils with dyscalculia symptoms in basic arithmetic skills?

5. Is BAS Module effective in improving basic arithmetic skills among pupils with dyscalculia symptoms?

1.7 Hypothesis

Hypotheses are used often in experiments or intervention trials in which researchers compare groups (Creswell & Creswell, 2018). Three null hypotheses in this study are:

H_{o1} : There is no significant difference between the mean scores of five different zones and the needs of BAS Module.

H_{o2} : There is no significant difference between the means of the pre-test and the post-test for the treatment group.

H_{o3} : There is no significant difference between the means of the post-test for the treatment and control groups.

H_{o4} : There is no significant difference between the means of the improvement for the male and female pupils.

H_{o5} : There is no significant difference between the means of the improvement for pupils with different age.

1.8 Significance of the Study

Every study should bring significance, impacts, and contributions to the society. This study is very important as it will provide significant benefits to Ministry of Education Malaysia, educators and teachers, pupils with dyscalculia symptoms, parents of pupils with dyscalculia symptoms, researchers, and individuals. This study is to design and develop a BAS Module which will bring significant impacts and contributions to the society.

1.8.1 Significance to Ministry of Education Malaysia

Malaysia's achievement of Mathematics in Trends in International Mathematics and Science Study (TIMSS) reached the highest average score of 519 in year 1999. However, this achievement had dropped in year 2003, with an average score of 508 and continued to drop in year 2007 to 474 scores. Malaysia's average Mathematics score was further dropped to 440 score in year 2011. TIMSS 2015 shows an increase in the score to 465, however this score again dropped to 461 in year 2019 (Ministry of Education Malaysia, 2020).

This shows that the ranking of Malaysia for Mathematics achievement had been dropped since 1999. To improve the international level of our country's Mathematics achievement, fundamental Mathematics skills should be built for pupils to elevate their skills to the higher level. Among these skills, basic arithmetic skills are crucial as they

are needed by everyone in their everyday life. This is important for special educational needs pupils, especially those who face difficulties in mastering mathematical skills.

National Philosophy of Education stated that education in Malaysia is an ongoing effort towards further developing the potential of individuals in a holistic and integrated manner, in order to produce individuals who are intellectually, spiritually, emotionally and physically, balanced and harmoniously. Accordingly, the researcher believed that all pupils, including special education and special needs pupils should be given the most suitable education according to their levels. Better interventions and strategies are therefore needed in order to develop their potential to the maximum.

In Malaysia, the concept of dyscalculia remains in an infancy stage (Mohammad Amimul Ihsan Aquil & Mazeyanti Mohd Ariffin, 2020a). Studies show that there is a lack of awareness regardomg dyscalculia (Mazeyanti Mohd Ariffin et al., 2019). Special Education Data in year 2021 even shows no data in the area of dyscalculia (Ministry of Education Malaysia, 2021). There is little research being done on dyscalculia in general, in comparison to dyslexia. More fun and interesting teaching and learning strategies are needed to assist the pupils with dyscalculia symptoms.

The design and development of BAS Module brings significant impact to Ministry of Education Malaysia as it is able to build the fundamental knowledge and skills of pupils who are facing learning difficulties in Mathematics. BAS Module is able to improve the Mathematics achievement of the pupils as it focused on basic arithmetic skills, which are the foundation for other higher mathematical skills. Thus, it will not

only bring consequences on the ranking of Mathematics achievement in our country but also on the international level.

1.8.2 Significance to Educators and Teachers

Teachers and educators play an important role in recognizing the symptoms and tendencies of pupils with dyscalculia and supporting them with different learning styles. Teachers without the knowledge of dyscalculia might label pupils with dyscalculia symptoms as lazy or stupid (Fu & Chin, 2017). Teachers need to understand the individual differences of the pupils in order to help them to achieve the highest success as possible. In fact, teachers should always have alternative ways that are helpful for pupils with learning difficulties (Noor Aini Ahmad, 2018c). Besides, special education teachers may collaborate with regular education teachers, as this will lead to positive outcomes (Ines, Pacheco, Abelha, & Seabra, 2022).

Teachers can help pupils with dyscalculia symptoms to overcome their difficulties and enjoy the time they spend on mathematical activities instead of suffering (Kunwar & Sharma, 2020). Pupils who are enjoying learning can improve better than those who are struggling in it. Most of the time, teachers play a role as educators as well. However, there are times that educators are not teachers but they are the people who involved in the practice of education. They are both equally important and play the same role as a mediator between policy makers and the pupils.

After the policy makers made a decision, educators or teachers should always make sure that the pupils received the proper education as they are required to. Instead of labelling a pupil as stupid or lazy, teachers and educators should have the ability to detect those with learning difficulties in order to assist them. They also have no rights to diagnose a pupil as dyscalculia, however they can provide teaching and learning interventions and strategies to improve the weaknesses of the pupils in academic.

Regarding this, if the BAS Module is being approved by the Ministry of Education Malaysia, it will be able to widely apply in the nation, so that educators and teachers can implement this BAS Module to build the fundamental knowledge of Mathematics among their pupils with dyscalculia symptoms. This is very important as these fundamental skills are the base for other knowledge which is more complex no matter in the school's syllabus or the daily living.

1.8.3 Significance to Pupils with Dyscalculia Symptoms

Dyscalculia is a specific learning difficulty that affect the correct acquisition of arithmetic skills and significantly influences both the daily life of pupils with dyscalculia symptoms and their academic success (Espina et al., 2022). Eventually, this study is significant for pupils with dyscalculia symptoms. A pupil with dyscalculia has low number sense, facing difficulties in subitizing, estimating, and solving basic arithmetic operations. These pupils often perform poorly in Mathematics assessment and face difficulties in their daily activities. In consequence, if these pupils with dyscalculia symptoms are not being assisted, they will continue to be left out or labelled.

Pupils with dyscalculia symptoms should be identified as early as possible, and be given proper interventions suitable to their learning level. Pupils with dyscalculia symptoms face difficulties in mastering the basic skills in learning Mathematics. They should be given assistance in different approaches to help them understand the number concepts and mastering the basic arithmetic procedural operations. In this matter, BAS Module was developed in order to help them to build the basic arithmetic skills in Mathematics, such as addition, subtraction, multiplication, and division.

The learning of basic arithmetic operations became interesting and easy when using BAS Module. Not only a variety of techniques are provided, but also number sense interactive games are able to boost pupils with dyscalculia symptoms' interest at the same time build the number sense among them. Thus, learning resources such as BAS Module can build the fundamental knowledge, improve their Mathematics achievement, and hence cultivate self-confidence among the pupils with dyscalculia symptoms in their daily lives. Therefore, it is very important to develop a module specifically for pupils with dyscalculia symptoms, so that they can enjoy Mathematics like other peers do.

1.8.4 Significance to Parents of Pupils with Dyscalculia Symptoms

Parents should always be aware if the symptoms or characteristics of dyscalculia are shown upon their children (Yoong & Noor Aini Ahmad, 2020c). Parents should constantly monitor the development of their dyscalculic children to find a way out of this problem. If their child has the symptoms of dyscalculia, preventive measures

should be taken immediately (Muhammad Sofwan Mahmud, Mohd Syazwan Zainal, Roslinda Rosli, & Siti Mistima Maat, 2020). In this matter, parents should work hand in hand with teachers to provide various stimuli to build the knowledge of basic mathematical skills among their children.

Having the sufficient knowledge to assist children diagnosed with dyscalculia, a disability in learning arithmetic, can be challenging for parents (Knudsen, 2016). Undeniable, parents play a very crucial role in the development of their child. This BAS Module is also suitable to be applied as a home-based teaching and learning learning tool. Parents are encouraged to involve as a part of the supportive team to assist the learning of their children at home. Besides, parents can provide a comfortable learning environment or space for their children when learning using this BAS Module.

The cooperation between parents and teachers is the key to cultivate learning and motivation among pupils with dyscalculia symptoms. BAS Module not only brings significance to teachers and pupils, but also benefits parents of pupils with dyscalculia symptoms. This is because it can act as guidance for parents to teach dyscalculic child, at the same time understand the needs of their child to learn using different interesting techniques and strategies. With this BAS Module, parents can now understand why their dyscalculic child struggling so much in Mathematics. Thus, they can give support to their dyscalculic child to learn Mathematics based on their needs and unique ways.

1.8.5 Significance to Researchers

In Malaysia, pupils with special educational needs include pupils with hearing impairment, visual impairment, physical disabilities, speech difficulties, multiple disabilities, and learning disabilities such as dyslexia, ADHD, ASD, and Down Syndrome (Ministry of Education Malaysia, 2013). Notably, dyscalculia is still a new term to be discovered and further explored in our country (Yoong et al., 2022). Studies on diagnosis, instruments, and interventions of dyscalculia are needed to provide a clearer view and knowledge for the researchers.

There is around four to six per cent among the population are dyscalculia. Dyscalculia is also known as number dyslexia, which is as common as dyslexia. Dyslexic pupils display severe deficits in reading, whereas pupils with dyscalculia symptoms present with arithmetic deficits (Peters & Ansari, 2019). The research studies in this field are relatively small compared to dyslexia. Since dyscalculia is a very important field and yet it is very new, there is still a huge space of exploration for the future researchers.

The design and development of BAS Module is important as guidance and reference for other researches relevant to this field. Researchers should understand that pupils with dyscalculia symptoms face difficulties, hence intervention should be created based on their cognitive development level. In compliance with this, BAS Module was designed and developed based on strong theory, model, and framework. Hence, this module could lead to more knowledge and skills that needed to be mastered by pupils with dyscalculia symptoms. It also provides different ways with a series of

learning activities on how pupils with dyscalculia symptoms can learn Mathematics effectively.

Besides, this study also contributes towards a more systematic documentation which involved the analysis, design, development, implementation, and evaluation of the BAS Module, and a systematic way to analyse the data until the discussion of results. Theoretical, practical, and methodological implications will be discussed in Chapter Five of this study. Thus, researchers can refer to the knowledge on the content of dyscalculia or methodology of the study and adapt to their own studies. The articles published through this study are also able to contribute to the body of knowledge so that references can be made by academic researchers around the world.

1.8.6 Significance to Individuals

This study is significant to the individuals such as those who involved directly or indirectly in this study. These individuals might be relatives and friends of pupils with dyscalculia symptoms, the educational specialist and therapists who are dealing with these pupils, psychologists, educational diagnosticians, and so on. Teachers have to collaborate with psychologist, occupational therapists, nurses, and other professionals. This is to ensure the pupils with learning difficulties acquire proper education in non-obstacle environment (Noor Aini Ahmad & Yoong, 2018). Previous study also mentioned that specialists should participate in special education to provide supports for the teachers (Gaidukevich, 2022).

It is important to help educators, psychologists, and neuroscientists acquire basic skills and knowledge of Mathematics so that they can utilise them to cope with this difficulty and subsequently to make sense of simple Mathematics in their everyday life (Fu & Chin, 2017). The awareness of dyscalculia among these individuals should be improved, and this is in line with the government's effort in implementing Zero Reject Policy, so that no child is left behind in our education system.

Other than that, every individual in the community has the responsibility to build a friendly environment for pupils with dyscalculia symptoms. The awareness among the individuals around the pupils with dyscalculia symptoms will make them feel accepted and belonging. By having the knowledge of dyscalculia, these individuals will be more appreciative of the existence of pupils with dyscalculia symptoms. They may provide assistance, motivation, and support to help the pupils with dyscalculia symtpoms learn better.

To sum up, this research is very important since the pupils with dyscalculia occupied around to six per cent of the population. Pupils with dyscalculia symptoms must be given suitable interventions in order to assist them in achieving their maximum level of learning. Thus, in this study, BAS Module was designed and developed to improve the fundamental mathematical skills, such as addition, subtraction, multiplication, and division among the pupils with dyscalculia symptoms in primary schools.

1.9 Limitation of the Study

In this research, limitations were implemented to ensure the validity of this study. This study involved primary schools Mathematics teachers. Screening instruments can be applied to pupils as early as the beginning of primary school (Hou et al., 2018). In another words, most pupils with learning difficulties are not identified as having potential disabilities until they start formal education. These pupils with dyscalculia symptoms might be undetectable in preschools as the arithmetic learnt is very simple. However, they may face difficulties since primary schools as the syllabus is becoming more complicated gradually. Hence, the target sample during analysis phase was Mathematics teachers in primary schools. A needs analysis survey was carried out in order to find out the needs to design and develop BAS Module based on the perceptions of Mathematics teachers.

The content of BAS Module covered four basic arithmetic skills, namely addition, subtraction, multiplication, and division. These skills were selected based on the findings of needs analysis. Based on the primary schools Mathematics teachers' perception, pupils with dyscalculia symptoms faced difficulties in borrowing, regrouping, recalling number facts, aligning vertical numbers in columns, performing simple calculation, and so on. Meanwhile, Diagnostic and Statistical Manual of Mental Disorder Fifth Edition (DSM-5) stated that pupils with dyscalculia are characterized by problems learning arithmetic facts, processing numerical information, accurate math reasoning and performing accurate or fluent calculations (American Psychiatric Association, 2013). Since basic arithmetic skills are the most important skills in primary

schools, thus this study focused on these skills where the higher order skills, such as math reasoning may be the focus of future studies.

There are several types of pupils based on their difficulties in the field of Mathematics, such as developmental dyscalculia, disabilities in mathematical concepts, difficulties in specific arithmetic operations, disabilities in learning arithmetic, and acalculia (Miundy et al., 2019). In this study, acalculia was excluded. Acalculia should be clearly distinguished from dyscalculia because aculculia is the inability to calculate by the entire system of the pupil, whereas dyscalculia is the inability of part of the system for the pupil to calculate.

This study focused on the intervention module for pupils with dyscalculia symptoms instead of diagnosing the pupils with dyscalculia. Study showed that teachers play an important role in detecting and identifying the pupils with dyscalculia symptoms (Kunwar & Sharma, 2020), so the limitation of this study was Mathematics teachers recommended the sample based on the symptoms of dyscalculia and no screening for dyscalculia was conducted to confirm if they fit into the dyscalculia category. Furthermore, this study was conducted using pupils with dyscalculia symptoms in the primary school age. Accordingly, the results may not be valid or generalizable to pupils with different school age groups.

A diagnosing instrument was not applied in the selection of sample since it is not commonly used in the situation of our normal classrooms. A briefing on dyscalculia was given to the Mathematics teachers to make sure that they understand the definition, symptoms, and characteristics of pupils with dyscalculia symptoms. These teachers

were appointed to recommend and suggest the name of pupils with dyscalculia symptoms to be involved in the experimental study.

Since this study involved 29 schools, the interventions were carried out in different settings. The Mathematics teachers involved could carry out the lessons appropriately according to their pupils' need, since they might have only one or a few pupils with dyscalculia symptoms in the class. Hence, the limitation is that the researcher might not be able to control the progress of all teachers in the schools to carry out the intervention and activities at the same time. To ensure the validity of the study, a checklist was prepared so that teachers were able to tick on the activities they have carried out. Progress of intervention was also monitored through informal discussions between teachers and researcher by using the technology such as WhatsApp and emails.

One serious issue in carrying out research during the Covid-19 pandemic is the low attendance rate and health issue of the teachers and pupils. During the data collection, there were teachers and pupils who were positive Covid-19 or close-contacted. Hence, few schools rejected the researcher's request to carry out the experiment in their schools. What worsened the situation was the dropout rate of the pupils in the quasi-experiment. There were some pupils who were selected by their teachers but not able to be included in this study because they were absent for the intervention or post-test. Hence, the high dropout rate is one of the limitations in this study.

1.10 Operational Definition

There were different definitions of the terms by the experts. Nonetheless, the key terms that best fit the content of this study were listed out. These terminologies need to be clarified in the context of this study. The operational definitions of the five key terms in this section were learning difficulties, dyscalculia, intervention, basic arithmetic skills, and number sense.

1.10.1 Learning Difficulties

In practice, pupils with a learning difficulty receive services of special education only if they have an identified educational need. At the same time, even those who have not been diagnosed with a disability may be eligible for special support if that need is recognized as an educational need. Teacher's role is important in anticipating and early identification of different learning needs. They should recognize these different learning needs and reach out for assistance from the specialist when their pupils need help to keep up with the pace of the lessons (Bashir Abu-Hamour & Hanan Al-Hmouz, 2016).

Education services in United Kingdom use the term [learning difficulty] to refer to the pupils with specific learning difficulties, but do not have a general impairment of intelligence. Meanwhile, other countries such as the United States, Canada, and Australia use the term [learning disability] for the same group (Scherer, Beswick, DeBlois, Healy, & Opitz, 2016). Hence, research studies in the United Kingdom refer

dyscalculia as Mathematics learning difficulty, whereas researches in the United States refer dyscalculia as Mathematics learning disability. This difference in terminology might lead to a confusion or different use of diagnostic criteria or instruments.

In this study, learning difficulties mean difficulties faced by pupils in specific aspects of learning. The learning in the context of this study includes the academic skills, such as reading, writing, and counting. These pupils with learning difficulties have normal IQ and might not be diagnosed with disability. Three common specific learning difficulties are dyslexia, dyscalculia, and dysgraphia. This study emphasized on dyscalculia rather than the other types of learning difficulties.

1.10.2 Dyscalculia

Dyscalculia is known as a learning difficulty that has been characterised as a difficulty in basic arithmetic skills such as addition, subtraction, multiplication, and division where it can occur among people across the whole IQ range (Mazeyanti Mohd Ariffin, Nurshazlyn Mohd Aszemi, & Nurdiyanah Ismir, 2020). Dyscalculia refers to the difficulties students face in understanding number concepts and basic arithmetic skills (Miundy et al., 2019). Study shows that there was no evidence for a core deficit in dyscalculia (Mammarella, Toffalini, Caviola, Colling, & Szucs, 2021), however another study shows that the core deficit in pupils with dyscalculia symptoms could be linked to visual-perceptual discrimination and rapid scanning of visual information (Agostini, Zoccolotti, & Casagrande, 2022). Thus, the identification of pupils with dyscalculia symptoms remains as the central challenge in this field (Lewis, Thompson,

& Tov, 2022). Generally, pupils with dyscalculia symptoms refer to pupils who were less successful in Mathematics assessment compared to other typical pupils. They could be identified with tests without clear criteria or identified by teachers (Deruaz et al., 2020).

In this study, dyscalculia is a specific learning difficulty in Mathematics. Pupils with dyscalculia symptoms are less successful in Mathematics assessment if compared with other peers. However, they may perform averagely or above average in other subjects, and have average intelligence as their peers. These pupils have low number sense and face difficulties in learning Mathematics, particularly in basic arithmetic skills, including addition, subtraction, multiplication, and division. In another word, they are symptomatic dyscalculia. They may not be diagnosed as having disability or may have comorbidity with other identified disabilities, such as dyslexia, slow learner, ADHD, ASD, and so on.

1.10.3 Intervention

Intervention is needed to help meet the needs of the pupils with dyscalculia symptoms and improve their Mathematics achievement (Doabler et al., 2019). Early interventions enhance number knowledge for the pupils. Two categories of early interventions are; (1) the core instructional programs; and (2) the supplemental interventions. The core instructional programs correspond to the curriculum, while the supplemental interventions are delivered in a small group setting in addition to the core curriculum (Tonizzi, Traverso, Usai, & Viterbori, 2020). A well-planned early intervention should

include key elements for initiating algebraic reasoning through the development of number sense (Adamuz-Povedano, Fernandez-Ahumda, Garcia-Perez, & Montejo-Gamez, 2021).

Intervention is an action or a process to minimize the learning difficulties facing by pupils, particularly for pupils with dyscalculia symptoms. The intervention in this study included the pedagogical intervention in small group instructions and also digital intervention by using the PowerPoint games and number sense interactive games. In short, the intervention in this study refers to BAS Module. The purpose of this intervention is to improve the basic arithmetic skills among pupils with dyscalculia symptoms in primary schools.

1.10.4 Basic Arithmetic Skills

The knowledge of arithmetic has long been recognized as a key element in vocational and educational success (Somayeh Nazari et al., 2022). The development of the four basic arithmetic skills is the main goal of the primary school Mathematics curriculum (Boz & Erden, 2021). Fluent and accurate number word sequences are part of counting skills associated with solving basic arithmetic addition and subtraction problems since pupils use counting-based strategies at the beginning when they are learning basic arithmetic (Lopez-Pedersen, Mononen, Korhonen, Aunio, & Melby-Lervag, 2021). From educational point of view, innate specific number abilities are important to teach basic arithmetic skills to pupils, especially for those who are at risk for Mathematics learning problems (Soltani & Mirhosseini, 2019). Pupils with dyscalculia had poorer

arithmetic skills if compared with typical pupils in both formal and informal settings (Vigna et al., 2022).

In this study, basic arithmetic skills refer to four basic operations in Mathematics, which are addition, subtraction, multiplication, and division. These four basic arithmetic skills should be focused on as they served as the foundation for higher level of arithmetic and other mathematical skills. Hence, basic arithmetic skills should be taught in a systematic way especially to pupils with learning difficulties such as dyscalculia.

1.10.5 Number Sense

One of the recognisable characteristics of dyscalculia is struggles with quantity and number sense (Cornue, 2018). Number sense is an inborn ability to estimate small quantities in a set (Santos et al., 2012). It is the basis for every individual to learn numeracy skills such as numbers and arithmetic (Yoong & Noor Aini Ahmad, 2021). Previous study indicates that there is a relationship between number sense and Mathematics (Tosto et al., 2017). The lack of number sense in pupils with dyscalculia symptoms can be manifested at an early age. Pupils with no number sense may have problems in accessing representation of magnitude from the number symbols, which may lead to difficulties in learning Mathematics (Wong, Ho, & Tango, 2017). In sense of that, teachers play a powerful role in helping pupils to develop number sense, especially primary schools' teachers (Yang & Jan, 2019).

In this study, number sense is an understanding of numbers, Mathematics operations, and their relationships. The deficit of number sense is one of the core deficits for pupils with dyscalculia symptoms so it must be implemented in the intervention. Four activities to build number sense in this study are; comparing quantities, matching items, dot enumeration, and number comparison. These number sense activities included non-symbolic and symbolic representations. They acted as the foundation for the pupils with dyscalculia symptoms to build knowledge on the basic arithmetic skills.

1.11 Summary

Malaysian education has emphasized on pupils with special educational needs, as stated in Malaysian Education Blueprint. Although dyslexia, dyscalculia, and dysgraphia fall under the same category of learning difficulties, however the characteristics for each of them are very different. There are many pupils with dyscalculia symptoms who have not been detected and given proper intervention. In Mathematics subject, pupils with dyscalculia symptoms are found lack of number sense, and face difficulties in solving basic arithmetic problems.

Pupils with dyscalculia symptoms are often being labelled as incompetent, lazy, and not intelligent. These negative attitudes and judgement affect their psychology. At some point, they may begin to believe that they cannot master in the mathematical skills as good as their friends and peers. As this takes place day by day, pupils with dyscalculia symptoms may even develop a deliberate avoidance of numbers. Although

dyscalculia is almost as common as dyslexia, pupils with dyscalculia symptoms often go undetected and unidentified even after they leave schools. Even more, there is also a possibility of misjudging the pupils with dyscalculia symptoms. This can result in inefficient and improper interventions given to them.

The difficulty in Mathematics can cause low self-esteem, anxiety, and missed opportunities if these pupils are not given proper intervention as early as possible. When they have grown up, these adults might also face problems with time management, spatial recognition, motor functions, financial and budgeting. Hence, they should be detected and given proper interventions as early as possible. Thus, in this study, the researcher designed and developed a BAS Module as an intervention to improve the basic arithmetic skills for pupils with dyscalculia symptoms. The next chapter will discuss about the literature review on some concepts in this research.