

**DEVELOPMENT AND EVALUATION OF
THE “GRID AND GAME” MODULE FOR
IMPROVING MULTIPLICATION SKILLS
AMONG REMEDIAL PUPILS**

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IMPROVING MULTIPLICATION SKILLS
AMONG REMEDIAL PUPILS**

by

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LIST OF ABBREVIATIONS

COVID 19	Corona Virus Disease 2019
CVI	Content Validity Index
GNG	Grid and Game
KIA2M	Program Kelas Intervensi Asas Membaca dan Menulis
LINUS	Program Saringan Literasi dan Numerasi
MCO	Movement Control Order
MOE	Ministry Of Education
PINCH	Program 100% Celik Huruf
PISA	Programme for International Student Assessment
PROTIM	Program Penguasaan Tiga M
UNESCO	United Nations Educational, Scientific and Cultural Organization

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PEMBANGUNAN DAN PENILAIAN MODUL "GRID DAN GAME"
UNTUK MENINGKATKAN KEMAHIRAN DARAB DALAM KALANGAN
MURID PEMULIHAN

ABSTRAK

Kajian ini bertujuan untuk membangunkan dan menilai keberkesanan Modul “Grid and Game” bagi meningkatkan kemahiran darab dalam kalangan murid Pemulihan Tahun Tiga. Modul ini direka berasaskan Pembelajaran Multimodal, Teori Konstruktivisme, dan Pembelajaran Masteri bagi memenuhi keperluan murid pemulihan. Pendekatan kaedah gabungan digunakan, melibatkan pengumpulan data kualitatif dan kuantitatif. Kajian ini dilaksanakan dalam tiga fasa. Fasa pertama melibatkan analisis keperluan melalui temu bual bersama lima orang guru pemulihan bagi mengenal pasti cabaran pengajaran kemahiran darab. Fasa kedua memberi tumpuan kepada reka bentuk dan pembangunan Modul “Grid and Game” berdasarkan analisis keperluan serta sorotan literatur yang relevan. Dalam fasa ketiga, reka bentuk kuasi-eksperimen digunakan untuk melaksanakan dan menilai modul “Grid and Game”. Seramai 60 orang murid Pemulihan Tahun Tiga dari daerah Kuala Muda telah dipilih melalui persampelan bertujuan dan dibahagikan kepada kumpulan rawatan dan kumpulan kawalan. Kumpulan rawatan menggunakan Modul “Grid and Game”, manakala kumpulan kawalan menggunakan Buku Instruksional Pemulihan KPM. Ujian pra dan pasca dijalankan, dan data dianalisis menggunakan ANCOVA bagi mengawal perbezaan skor pra-ujian. Keputusan ANCOVA menunjukkan perbezaan skor pasca ujian yang signifikan antara kumpulan, $F(1, 57) = 47.23$, $p < .001$, sekali gus membuktikan keberkesanan modul dalam meningkatkan kemahiran darab. Dapatan kualitatif daripada analisis tematik menunjukkan murid lebih bermotivasi,

melibatkan diri secara aktif dan menunjukkan pemahaman konsep yang lebih baik dalam kemahiran darab. Guru turut menyatakan modul ini mudah dan praktikal untuk digunakan di dalam bilik darjah. Dapatan ini mencadangkan bahawa modul berstruktur berasaskan permainan dapat memperkukuh pengajaran pemulihan dan disarankan agar adakan program latihan guru dengan menggunakan modul seperti ini untuk mengukuhkan strategi pedagogi dalam pendidikan pemulihan. Selain itu, kerjasama antara pembangun kurikulum dan unit pendidikan khas turut digalakkan bagi mengintegrasikan modul seumpamanya ke dalam sumber pengajaran pemulihan peringkat kebangsaan. Kesimpulannya, Modul “Grid and Game” merupakan alat bantu yang berkesan, menyeronokkan dan mudah diakses untuk membantu penguasaan darab dalam kalangan murid Pemulihan Tahun Tiga, serta menyokong peningkatan akademik dan penglibatan mereka dalam bilik darjah.

**DEVELOPMENT AND EVALUATION OF THE “GRID AND GAME”
MODULE FOR IMPROVING MULTIPLICATION SKILLS AMONG
REMEDIAL PUPILS**

ABSTRACT

This study aimed to develop and evaluate the effectiveness of the Grid and Game Module in improving multiplication skills among Year Three remedial pupils. The module was designed based on Multimodal Learning, Constructivist Theory, and Mastery Learning to suit pupils with diverse learning needs. A mixed-method approach was employed, involving both qualitative and quantitative data. The study was conducted in three phases. Phase one involved a needs analysis through interviews with five remedial teachers to identify teaching challenges. Phase two focused on designing and developing the Grid and Game Module based on the analysis and relevant literature. In phase three, a quasi-experimental design was used to implement and evaluate the module. A total of 60 Year Three remedial pupils from Kuala Muda district were selected through purposive sampling and divided into treatment and control groups. The treatment group used the Grid and Game Module, while the control group used the KPM Remedial Instructional Book. Pre- and post-tests were conducted, and data were analyzed using ANCOVA to control for pre-test differences. The ANCOVA results showed a statistically significant difference in post-test scores between groups, $F(1, 57) = 47.23, p < .001$, indicating the module's effectiveness in improving multiplication skills. Qualitative findings from thematic analysis revealed that pupils were more motivated, actively engaged, and demonstrated better conceptual understanding in multiplication skills. Teachers noted the practicality and ease of the module's implementation in the classroom. These findings suggest that

structured, game-based learning tools enhance remedial instruction. It is recommended that teacher training programs incorporate modules like this to strengthen pedagogical strategies in remedial education. Additionally, collaboration between curriculum developers and special education units is encouraged to integrate similar modules into national-level instructional resources. In conclusion, the Grid and Game Module is a highly effective, engaging, and accessible tool that promotes multiplication mastery among Year Three remedial pupils, supporting their academic growth and classroom involvement.

CHAPTER 1

INTRODUCTION

1.1 Introduction

This study focuses on the development and evaluation of the "Grid and Game" module which specifically designed for remedial teachers and remedial pupils in primary school. The module emphasizes multiplication skills, addressing the challenges faced by remedial pupils who have not yet mastered multiplication skills among other mathematical operation. Ministry of Education execute varieties of efforts to ensure pupils master on literacy and numeracy skills as early as year 1970 by forming remedial education program to help in overcome learning problem among primary school pupils in Malay language and Mathematics (Ministry of Education Malaysia, 2013).

Remedial education plays role as a vital program for pupils to master the core skills of reading, writing and masters arithmetic skills which highly related to the quality of education (Fong, 2018). Trained remedial teachers are deployed to schools to assist remedial pupils with mastering numeracy and literacy skills (Ministry of Education Malaysia, 2021). These remedial teachers conduct teaching and learning sessions in remedial classes, tailored to the individual abilities of each pupil. The Teaching and Learning Guidebook for Mathematics in the Special Remedial Program (Buku Panduan Pengajaran dan Pembelajaran Matematik Program Pemulihan Khas) was also updated in 2019 to align the remedial program syllabus with the Primary School Standard Curriculum (Ministry of Education Malaysia, 2021). The remedial program forms paths for individuals in fostering the qualities in education to stay in line with world education standards as Malaysia's Ministry of Education (MOE) set

aim on pupils to achieve literacy and numeracy skills from level one in primary schools (Special Education Sector & Ministry of Education Malaysia, 2012).

The Ministry of Education has implemented several initiatives to support pupils in acquiring literacy and numeracy skills. The PROtim (Program Tindak Awal) program was introduced first in 1995, targeting Year Four to Year Six pupils who still face difficulties in mastering basic literacy and numeracy skills. It was conducted by mainstream teachers to help reduce the workload of remedial teachers (Mohd Asnorhisham & Abdul Rahim, 2017). Following that, the KIA2M (Kelas Intervensi Awal 2M) program was introduced in 2006, specifically for Year One pupils to provide early intervention in reading, writing, and arithmetic. The Remedial Program, on the other hand, has been in place to support Year One to Year Three pupils who are identified as having learning difficulties. However, in 2009, the KIA2M program was replaced by the LINUS (Literacy and Numeracy Screening) program. LINUS aims to ensure that all pupils acquire basic literacy and numeracy skills by the end of Year Three, except of pupils with special needs (Siti Ramli & Mohd Tajudin, 2021). This structured approach reflects the government's commitment to strengthening foundational learning. Consequently, remedial education has become an integral part of primary education and is further enhanced under the implementation of the new curriculum.

Most of the remedial pupils are left behind because of a lack of interest in mathematics. The interest of remedial pupils in Mathematics is shaped by the methods used in teaching, learning, and assessing mathematical knowledge. The finding of research shows that remedial pupils are unable to understand and perform in Mathematics even though it is a significant subject for pupils. The fundamental problems faced by remedial pupils are low memory power and lack of interest in doing

repetitive mathematical questions (Polo-Blanco et al., 2022). Among primary school pupils especially those in level one have low achievement in Mathematics as common, with the rate of co-occurrence estimated between 30–70% (Moll et al., 2019). This highlights a greater risk of low achievement in Mathematics compared to reading among remedial pupils. Mathematics is a mandatory subject in both primary and secondary school curricula in Malaysia. Although it is integral to daily life, many pupils experience anxiety toward the subject, especially during tests and examinations.

This issue is particularly evident among remedial Mathematics pupils who have yet to master basic arithmetic skills. One key challenge lies in learning multiplication, which imposes a high cognitive load and requires the ability to understand it conceptually as repeated addition (Azzizah et al., 2022). Additionally, many students struggle with connecting multiplication to real-life situations such as equal groups and arrays due to innumeracy and a lack of contextual understanding. This problem has been addressed through the Realistic Mathematics Education (RME) approach, which emphasizes the importance of mathematization in helping pupils build meaningful mathematical concepts (Hong Duyen, N. T., & Loc, 2022).

In summary, remedial education serves as an early detection and intervention strategy to support students with lower academic performance (Yoong, S.M. & Noor Aini Ahmad, 2018). While it is most effective when implemented in the early stages of education, it can also be applied across all educational levels from kindergarten to higher education to help learners catch up and perform on par with their peers. Certain groups of children deserve particular attention, as they face a high risk of developing significant challenges in literacy and numeracy. In Malaysia, remedial education is not classified as Special Education. However, the pupils under remedial education are considered in special needs. Hence, this study will focus on remedial education for

remedial pupils in remedial Mathematics to improve their Multiplication skill.

1.2 Research Background

Remedial education is a huge field of study which includes varieties of practices, learning environment and provision of stimulating activities to offer the pupils with experience that could extend knowledge and enhance basic skills. Out of one billion pupils in world 98% of student population have affected by school closure during COVID-19 pandemic (UNESCO, 2020). This results in dramatical change in education system in worldwide. The world pushed into urgent transition to online teaching and learning process which posed challenges to both pupils and teachers (Chiu, 2021). Thus, the educational landscape of the country changed because of the Movement Control Order (MCO) when teaching and learning sessions in face to face had to be stopped. Consequently, Ministry of Education introduced Literacy and Numeracy Enhancement Program as an effort to help pupils in level one who haven't mastered literacy and numeracy skills because of Covid-19 impact and Movement Control Order (MCO).

Literacy and numeracy skills are important in helping pupils to improve and achieve next level in learning. Both literacy and numeracy skills constitute a need to be mastered so that learning in primary school becomes easier. In fact, the awareness of importance in mastery of literacy and numeracy skills will allows us to create a literate country and able to compete in the era of globalization. Education is a life-long process. Thus, it is mandatory to continue education and ensure life-long learning to acquire knowledge. Accordingly, basic literacy and numeracy is vital in everyone's life to share common ideas. In contrast, many children still face difficulties in literacy and numeracy. According to indicator of percentage of pupils at each proficiency level

in Mathematics in Year 2018 by Programme for International Student Assessment (PISA) shows 69.8% of 15 year-old pupils are below level three out of six levels (*PISA 2018 Results (Volume I)*, 2019). This shows the importance of enhancement in Mathematics from the root of education which begins from early childhood education and primary school education. Thus, the researcher focused to enhancement of Multiplication skill for remedial pupils.

Ministry of Education execute Catch-Up Plan as an initiative to help pupils to mastery the skills when schools reopen after post-COVID in November 2021. One of the plans for low achievers is program “*PERKASAKU*” which provides with module for literacy and numeracy (Ministry of Education Malaysia, 2021). The objectives of the numeracy modules are to enable pupils understand the simple mathematical idea and enforce numeracy skill for further learning (Kementerian Pendidikan Malaysia, 2021). Currently, Mathematics education employs remedial education worksheets published in 2012 which provided by Special Education sector after LINUS program comes to end in 2019. The worksheet used is more in term of traditional way and it gives lack of interest to keep remedial pupils engaged in teaching and learning (Lei & Hu, 2020). Yet, effective and interacting teaching and learning tool and strategy is highly needed to achieve the learning outcome.

The remedial pupils pay lack of interest in Multiplication when compared to other numeracy skills (May & Ahmad, 2018b). Addition, subtraction, multiplication, and division are basic and initial skill in numeracy. Therefore, mastering multiplication is important before progressing to more advanced mathematical operations (May & Ahmad, 2018a). To address the importance of mastering multiplication and enhance pupils’ engagement, the researcher will design and develop Grid and Game module

with integrating interactive element as one of the strategies to strengthen multiplication skills among remedial pupils.

Multiplication, one of the four fundamental mathematical operations, is an essential skill taught during the early years of primary education, forming the basis for more advanced mathematical learning. Mastery of the single-digit multiplication table, in particular, is a key objective at this level, as it lays the foundation for more advanced operations like division and multi-digit multiplication (May & Ahmad, 2018a). Teaching multiplication poses specific challenges for educators as they work to foster pupils' conceptual understanding of these operations (Salminen et al., 2021). Pupils' problem in learning Mathematics especially in the operation of the basic multiplication facts started since they were in Year Two where they need to learn the multiplication tables from one to five and the tables from six to nine when they were in Year Three (Saleh et al., 2020).

Remedial Mathematics contains nine main skills which are (1) Pre number, (2) Number Concept, (3) Even Number, (4) Addition operation, (5) Subtraction operation, (6) Multiplication operation, (7) Division operation, (8) Money and (9) Time (Bahagian Pendidikan Khas Kementerian Pendidikan Malaysia, 2019b). Children are presented with the viewpoint that multiplication is more challenging than addition. For example, multiplication facts are more likely to be taught in a memorized, rote way than addition facts and addition concepts are introduced several years before multiplication concepts in the course of early schooling (Shin & Bryant, 2015). For multiplication and division, the direction of effect varies with the size of the operands. Multiplying numbers above one always yields a product greater than either multiplicand, but multiplying numbers between zero and one never does (Park et al., 2021).

Arithmetic facts, particularly multiplication tables, are structured in an interconnected network within long-term memory, enabling individuals to quickly retrieve answers to basic arithmetic problems, such as 3×4 (Karnes et al., 2012). Single-digit multiplication mental calculations are considered essential, as children in most countries are taught to memorize multiplication tables (Lambert et al., 2021). These multiplication facts are stored verbally, and retrieval depends primarily on verbal modality; thus, children with stronger verbal working memory can respond more swiftly to mental multiplication tasks (Lee et al., 2021). In this context, research indicates that remedial pupils struggle with mental and abstract multiplication calculations due to limited cognitive processing abilities and working memory (Ahmad & May, 2018).

Therefore, pupils who facing problem in literacy and numeracy need special help in the process of learning so that they can master in those skills. Without such special help, they will fail to build self-confidence and will loss the excitement of explore school life for six years in primary school. If remedial pupils continuously neglected will lose interest and focus on learning and may results in dropping out. So, remedial education is an important element that need and should be mastered and given priority as early as in primary school.

1.3 Problem Statement

There are few problems can be related to the difficulties in mastering multiplication skills among remedial pupils. The first problem is the low achievements in multiplication skills. The children who entered preschool in 2020 and progressed to Year One in primary school in 2021 have encountered significant challenges in acquiring basic numeracy skills, particularly multiplication. The closure of schools

during the COVID-19 pandemic severely affected early education, especially for this group of pupils. Data from the Ministry of Education (Kementerian Pendidikan Malaysia, 2021) reveals that only 21% of remedial pupils participated in online learning between August 2020 and August 2021 and the 2019 *PPSR* (Primary School Assessment Report) revealed that 16.87% of students failed to achieve a passing grade in Mathematics (Ministry of Education Malaysia, 2021). As a result, multiplication was identified as one of the lowest-achieved skills in remedial mathematics.

Many pupils lack basic knowledge, which hamper their ability to grasp more complex mathematical concepts. Research indicates that pupils who do not achieve proficiency in basic multiplication facts often fall behind their peers, leading to long-term academic challenges (Rao & Mallow, 2009). Additionally, without a solid understanding of multiplication, these pupils find it difficult to engage with subsequent mathematical operations, such as division and multi-digit multiplication (May & Ahmad, 2018a). This lack of mastery can create a cycle of frustration and disengagement from mathematics.

The second problem is the implementation of educational modules like PERKASAKU and LINUS has not been fully effective for all pupils. These programs often require a level of proficiency that many remedial pupils do not possess. The effectiveness of these modules is contingent upon the pupils' prior knowledge and their ability to engage with the material presented. Studies show that when pupils struggle with foundational skills, they may not benefit from advanced teaching methods designed for more proficient learners (Salminen et al., 2021). Consequently, there is a pressing need for tailored interventions that cater specifically to the needs of remedial pupils. These modules, though well-intended, often face execution problems due to a lack of teacher training and insufficient classroom resources (Saleh et al., 2022). Many

teachers are not equipped to adapt these modules to meet the diverse needs of remedial pupils. Consequently, the pupils' progress in mastering multiplication skills remains stunted, as they are unable to benefit fully from these targeted interventions. Addressing these implementation challenges is crucial for ensuring the effectiveness of the modules in building foundational numeracy skills especially in multiplication skills.

The third problem is in the teaching methods employed for multiplication skills. Traditional memorization techniques, though widely used, are ineffective for many remedial pupils, especially those with low retention capacities (Salminen et al., 2021). The traditional teaching style employed in many classrooms often relies heavily on rote memorization, which can exacerbate anxiety around mathematics (Ahmad & May, 2018). This method does not accommodate diverse learning styles; many pupils benefit more from visual representations and hands-on activities rather than abstract symbols. Research suggests that effective teaching strategies should incorporate visual aids and manipulatives to enhance understanding (Lei & Hu, 2020b). By focusing on conceptual understanding before memorization, educators can foster a more supportive learning environment that encourages mastery of multiplication. Research shows that merely memorizing multiplication facts without a clear conceptual understanding can lead to high levels of anxiety and disengagement (Ahmad & May, 2021). Remedial pupils require teaching strategies that not only focus on memorization but also emphasize comprehension through visual aids, manipulatives, and practical exercises. However, current teaching approaches largely remain focused on abstract and rote learning methods, which alienate pupils who need more hands-on, visual experiences in learning multiplication.

The forth problem is the teaching aids used in classroom to mastering multiplication skills. Creative and interactive teaching aids is essential to guide remedial students in generalizing knowledge to the abstract phase, enabling them to solve problems without relying on concrete teaching aids. Unfortunately, most of the classroom environments often emphasize abstract learning without enough support for pupils who require alternative approaches. Abstract methods, such as relying solely on numbers and symbols, fail to engage remedial pupils who need visual and interactive ways to grasp multiplication concepts. The reliance on abstract and concrete teaching methods may contribute to a lack of engagement and retention to generalize knowledge from concrete to abstract concepts among these pupils (May & Ahmad, 2018a). While remedial students may successfully complete operations with the aid of concrete objects, this does not guarantee their ability to generalize the concepts into abstract procedural skills (Hutkemri & Sharifah, 2017). Weak number sense and working memory further hinder remedial students from mastering basic counting skills as quickly as their peers (Yoong & Noor Aini, 2021).

Research suggests that introducing games, physical manipulatives, and interactive digital tools can significantly enhance pupils' engagement and understanding of multiplication (Yoong & Ahmad, 2021). This calls for a shift from abstract to multimodal learning approaches to better cater to the needs of these pupils. Therefore, it is essential for educators to recognize these differences and adapt their teaching strategies, accordingly, integrating more hands-on activities that allow pupils to visualize and manipulate mathematical concepts in multiplication skills.

Low memory retention among remedial pupils is a fifth problem affecting remedial pupils' ability to master multiplication skills. Salim et al., (2022), have highlighted those remedial pupils, particularly those with learning difficulties, often

struggle with working memory, which is crucial for retaining and recalling multiplication facts. Many pupils struggle to retain multiplication facts due to cognitive limitations or insufficient practice opportunities (Saleh et al., 2020). Research indicates that repeated exposure and cumulative practice are critical for skill retention; however, remedial pupils often do not receive adequate reinforcement in this area (Drevon & Reynolds, 2018). Addressing memory challenges through targeted interventions can help improve outcomes for these learners. Without the ability to hold multiple pieces of information in their minds, these pupils find it challenging to progress in multiplication. Teachers need to incorporate memory-enhancing strategies, such as spaced repetition and mnemonic devices, to help these pupils retain multiplication facts over time.

Environmental factors are a sixth problem which affect remedial pupils' ability to learn multiplication. Many of these pupils come from low socioeconomic backgrounds, where access to learning resources at home is limited (Rahman & Lee, 2023). The home environment, often lacking in educational materials and support, contributes to a widening gap in multiplication skills. School closures during the pandemic exacerbated these challenges, as many remedial pupils could not access online learning platforms. The learning environment within schools also needs improvement, with many remedial classrooms lacking sufficient teaching aids and tailored instructional materials to support multiplication learning. Factors such as classroom dynamics, access to resources, and emotional support can significantly impact student engagement and performance in learning (Kementerian Pendidikan Malaysia, 2021). A supportive and resource-rich environment is essential for fostering a positive attitude towards mathematics. Teachers must strive to create an inclusive atmosphere where all pupils feel valued and motivated to learn.

Lastly, there exists a research gap in the study of effective teaching methods for multiplication, particularly concerning remedial pupils and teachers. Findings from studies involving mainstream teachers are also difficult to generalize to the context of remedial teachers (Suhaila Idris & Siti Mistima Maat, 2020). This is because differences in the characteristics and needs of the students being taught influence the use of teaching aids by teachers. Therefore, this study requires identifying the current needs of remedial teachers for the development of “Grid and Game” module. The study should begin with a needs analysis that examines the use of basic numeracy teaching aids in the latest guidebooks, involving a sample of remedial teachers and remedial pupils.

While much research has focused on general numeracy skills, few studies have specifically addressed the unique challenges faced by remedial pupils in mastering multiplication (Salminen et al., 2023). There is a need for further research to explore evidence-based practices that cater to the diverse needs of remedial pupils, including adaptive teaching methods, differentiated instruction, and the integration of digital tools. Addressing this gap will provide educators with the necessary insights to design more effective interventions for improving multiplication skills.

In summary, mastering multiplication remains a significant challenge for remedial pupils due to issues ranging from ineffective teaching methods to environmental barriers. Addressing the multifaceted issues surrounding the teaching and learning of multiplication skills among remedial pupils requires a comprehensive approach. By recognizing the challenges related to mastery, module implementation, teaching styles, learning preferences, memory limitations, environmental factors, and research gaps, educators can better support these learners in overcoming their difficulties in multiplication. The gap in numeracy, particularly in mastering

multiplication, demands a focused intervention, such as the development of modules like the Grid and Game module, which target micro-skills in multiplication and are tailored to the learning needs of remedial pupils.

1.4 Research Objective

The study will conduct to achieve the objectives of main purpose as identified as follows :

Phase One:

1. To analyse the needs for developing “Grid and Game” module for remedial pupils in mastering multiplication skills.

Phase Two:

2. To design a structured “Grid and Game” module for remedial pupils, focusing on mastering multiplication skills.
3. To develop the “Grid and Game” module by incorporating essential educational components for mastering multiplication skills.

Phase Three:

4. To implement the “Grid and Game” module in a classroom (experimental group) and compare the achievement of multiplication skills among remedial pupils using KPM Remedial Instruction Book (control group).
5. To evaluate the effectiveness of the “Grid and Game” module exploring teachers' experiences in terms of:
 - a) benefits gained, and
 - b) challenges faced

of the module in improving multiplication skills among remedial pupils.

1.5 Research Question

According to objectives, research questions are listed below:

Phase One:

1. How do remedial pupils experience difficulties in mastering multiplication skills, and how does this determine the necessity for developing the “Grid and Game” module to address these challenges?

Phase Two:

2. What are the structured designs of the “Grid and Game” module for remedial pupils, on focusing mastering Multiplication skills?
3. What are the essential educational components to be incorporated into the “Grid and Game” module to help remedial pupils master multiplication skills?

Phase Three:

4. What are the effectiveness in mastering multiplication skills when implementing “Grid and Game” module in classroom (experimental group) in comparison to the KPM Remedial Instruction Book (control group)?
5. How are the teachers' experiences in term of:
 - a) benefits gained, and
 - b) challenges facedof the “Grid and Game” module in mastering multiplication skills among remedial pupils?

1.6 Hypothesis

Based on research question four, following hypotheses have been developed and tested through statistical analysis.

Ho : There is no statistically significant difference in the post-test multiplication scores between the treatment group (Grid and Game module) and the control group (KPM Remedial Instruction Book), after controlling for the pre-test scores.

1.7 Significant of Study

Multiplication skills play extremely important role in teaching and learning of Mathematics in primary school. Children have to mastered the basic multiplication skill before achieved next level in arithmetic fluency (May & Ahmad, 2018b). The knowledge and understanding on practices in remedial education is vital to implement in teaching and learning. The significant of study can be generalize with different perspective.

The Grid and Game module will adopt the multiplication skill in fun way to learn the mentioned skills. The activity and visualisation employed in module could raise children interest and will ensure the engagement of pupils throughout the learning and teaching session. Therefore, the design and development of this module believed could give an alternative teaching strategy to help remedial pupils with low achieving to understand and masters the concepts of Multiplication skill in an easier and interactive way.

According to calling letter KPM.BSTP.S.600-6/5/1(126) dated 5 November 2021 by Educational Resources and Technology Division of Ministry of Education Malaysia, have initiated program and workshop for adding interactive materials in existing textbook for KSSM Form One and KSSR Year Four in November 2021, this

module can give some suggestions for policy makers to adding alternative method on emphasize program “PERKASAKU” which launched for remedial education. In short, findings of the contribution of Grid and Game module can be utilised by Curriculum Development Division of remedial education to select suitable game-based activity to integrate as interactive material to improve the delivery of lesson and to achieve the learning outcome of the lesson.

1.8 Operational Definition

There are various definitions of terms from expert for metrics of operational definitions. However, the most suitable and appropriate content of study have discussed in this section.

1.8.1 Remedial Pupils

Remedial pupils are facing difficulties and failed in certain skills and subjects (Ahmad & May, 2018). In this study, remedial pupils play part as sample who are low achieve in Multiplication skill. These pupils have difficulties to understand the content in mainstream class and will be followed remedial education as an intervention. Anyhow, the remedial pupils are not qualified and categorised as special education student. Thus, the remedial teacher will be responsible for teaching them in mainstream school. In this study, the researcher focused on remedial pupils in Mathematics only. Subsequently, the Mathematics remedial pupils involved in this study are the Year Three pupils in National School (SK).

1.8.2 Grid and Game Module

The Grid and Game module incorporates the multimodal, a widely endorsed instructional approach for teaching pupils with learning difficulties (Norberg, 2023). Researcher targeted to design, develop, and evaluate Grid and Game module which is a Remedial Mathematics module integrated with teaching manual, hands on gridline and interactive game using metaverse space. The term “Grid” is used because the multiplication technique is based on drawing grids and the term “game” refers to interactive game on multiplication. Thereupon, the researcher will plan and construct a module based on objective and learning outcome to be achieved by remedial pupils at the end of lesson in Multiplication skill which consists of gridline handout and interactive game using web-based activity. Grid and Game module stands for the combination of teachers E-module, pupil’s module, multiplication gridline, web based interactive game and metaverse space for instructional sessions.

1.8.3 Pupil’s Achievement in Multiplication Skill

Multiplication involves the repeated addition of a number a specific number of times, solving problems involving equal groups, and arranging objects, pictures, or numbers in columns and rows, known as an array. As an abstract concept, multiplication can be challenging for pupils, particularly for remedial learners. Recognizing this, the researcher advocates using visual teaching methods and animations to simplify the concept for pupils. Thus, the "Grid and Game" Module was created to support remedial pupils in mastering multiplication skills.

In this study, multiplication skills refer to the ability to solve equations using gridline intersections with the aid of the Grid and Game Module. Upon completing the module, pupils should be able to determine correct multiplication answers by drawing

intersecting lines, counting intersection points, writing multiplication sentences, reading these sentences, and memorizing multiplication facts. In summary, this module breaks down multiplication skills into five essential steps: drawing, counting, writing, reading, and memorizing, which are incorporated within the Grid and Game Module. The success of pupils is measured by their post-test scores after completing the module.

This approach adapts the Japanese multiplication technique, a visually engaging method that simplifies multiplication to counting. According to Robson, (2010), Japanese pupils learn multiplication differently from Western pupils, focusing on counting lines and dots rather than memorizing tables. To make this method more engaging, the researcher developed the Grid and Game Module, incorporating gridlines and interactive games. By counting intersection points, this method offers a straightforward way for remedial pupils to grasp the abstract concept of multiplication.

In the module, teachers conduct teaching and learning activities guided by lesson plans in the Teacher's Manual. Each pupil receives a personal gridline to practice multiplication facts during every lesson. They are also allotted time to engage with the interactive game, enabling them to learn multiplication skills through animation and collaborative activities. Altogether, these activities lead pupils through sequential steps: drawing intersecting lines, counting intersection points, writing and reading multiplication sentences, and memorizing multiplication facts.

1.8.4 Teachers Experiences (Benefits and Challenges)

In the context of this study, teachers experience will be investigated in term of the suitability of content, type of activities, number of activities, impact of the module in multiplication skills and time provided to administrate the module. The teachers experience towards a pedagogical module includes the benefits gained from “Grid and Game” module, challenges faced during implementation of the module in ensuring sustainable education.

1.9 Limitation of Study

Limitations refer to factors beyond the researcher’s control that may impact a study (Lindner & Schwab, 2020). In this research, limitations have been acknowledged to ensure the study’s validity. This study exclusively involves National-Type Primary Schools (SK) in the Kuala Muda district, meaning the results cannot be generalized to the broader population of Malaysian pupils, particularly those in other districts, states, or different types of schools.

The selection of SK schools in Kuala Muda over other districts was made due to the pupils who fulfil the study’s specific inclusion criteria which able access to grid technique. The researcher targeted Year Three remedial pupils who failed previous Mathematics assessments and have yet to master single-digit multiplication. Based on data from the district education officer, Kuala Muda district was identified as an area needing intervention to improve multiplication skills among these pupils.

The sample is limited to Year Three remedial pupils, and the small purposive sample size restricts generalizability to all Malaysian pupils. In Malaysia, multiplication instruction begins at the pre-school or Year One level, following the KSSR syllabus. By Year Two, pupils should understand multiplication facts of two,

five, ten, four, one, and zero, and by Year Three, they expand to three, six, seven, eight, and nine. Thus, by Year Four, mastery of multiplication facts from one to nine is expected, and pupils who have not achieved this will likely fall behind. This study focuses on Year Three remedial pupils to support them in mastering these foundational multiplication facts.

The module content is confined to multiplication facts from two to six, as single-digit multiplication serves as the basis for more complex multiplication. It is because the screening of PINCH (Program 100% Celik Huruf) data at the end of year two shows remedial pupils have less mastery in multiplication facts from two to six (Mohd Ishak & Abdul Rahman, 2021; Suhaila Idris & Siti Mistima Maat, 2020). As a initiative to enhance the mastery of multiplication skills at the beginning of year three researcher limited to cover the multiplication facts two to six only.

In this study, the intervention requires pupils to draw intersecting lines, count intersection points, and write multiplication sentences. The researcher chose multiplication sentences as more accessible for pupils to memorize and recall multiplication facts, making them more appropriate for primary school learners.

Lastly, the study focuses exclusively on SK schools, excluding National-Type Chinese Primary Schools (SJKC), National-Type Tamil Primary Schools (SJKT), and other school types. The researcher's teaching experience within SK schools has highlighted specific challenges in this setting, motivating the development of a tailored solution. Familiarity with SK's culture and background also guided the module design to fit the target group's needs. Consequently, the study's findings are not representative of Malaysian pupils in other school types.

1.10 Summary

Teachers encounter numerous challenges in their daily roles, particularly in Mathematics, where pupils often struggle if they lack mastery of the four fundamental arithmetic skills. To address these difficulties, teachers must explore or create new strategies to enhance pupils' mathematical abilities. This study focuses on Year Three Mathematics remedial pupils, who are frequently overlooked. In school settings, these pupils are sometimes unfairly labelled as "lazy" or "stupid" due to their inability to perform at the expected level for their age and class.

Mathematics is a crucial subject, as it equips pupils with essential problem-solving skills for daily life. Success in Mathematics is thus a fundamental educational goal, requiring pupils to master basic arithmetic skills during primary school. In response to the needs of remedial pupils, the researcher developed the “Grid and Game Module” to support Year Three pupils in learning multiplication in an organized and engaging way. This intervention will involve dividing pupils into a treatment group and a control group: teaching with KPM instruction book applied to the control group, while the “Grid and Game Module” intervention will be implemented for the treatment group. By the end of the intervention, pupils in the treatment group are expected to achieve proficiency in single-digit multiplication.

This chapter outlines the specific challenges faced by remedial pupils, underscoring the importance of Mathematics in daily life and justifying the need for a remedial Mathematics module. Based on these challenges, this chapter further defines the research objectives, questions, problem statement, significance of the study, study limitations, and anticipated contributions. The proposed module aims to support remedial pupils in mastering multiplication skills through an innovative approach that fosters engagement and understanding.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This study aims to design, develop, and evaluate “Grid and Game” module. This chapter will discuss about the concepts of the study which are overview of global approach of Multiplication skills, achievement of remedial pupils in Multiplication skills, existing module for multiplication skills, the teachers experience on implementing the module, theories related to the studies. This chapter also proceed with theoretical framework and conceptual framework. The literature review process enable researcher to discuss the concept of study according to expert’s view.

2.2 Global Approach to Teaching Multiplication Skills

Multiplication is a foundational arithmetic skill taught across the world, as it serves as a cornerstone for more advanced mathematical concepts. Proficiency in multiplication allows pupils to engage in higher-order mathematics, such as division, algebra, and geometry. However, teaching multiplication and achieving fluency in this skill varies widely between countries due to differences in educational policies, curricula, and instructional methods (Sönmez & Alptekin, 2020). Globally, a significant challenge lies in ensuring that all pupils, regardless of their background or learning abilities, develop strong multiplication skills.

In many countries, multiplication is introduced as early as year 1 and 2, with memorization of multiplication tables being a common practice. For example, in China and Japan, rote memorization is heavily emphasized, and pupils are expected to have multiplication tables memorized by the end of year 3 (Zhang et al., 2019). Research

from China shows that repetition and drill-based learning are effective in helping pupils retain multiplication facts, although this method often focuses more on memorization than on conceptual understanding (M. N. Hassan et al., 2020). In contrast, countries like Finland and Singapore adopt a more balanced approach, incorporating both memorization and conceptual teaching methods such as the use of arrays and number lines (Zhang et al., 2019).

In Western countries like the United States and the United Kingdom, teaching multiplication has evolved significantly over the years. Historically, rote memorization was the dominant method, but recent pedagogical shifts have encouraged the use of visual aids, manipulatives, and problem-solving strategies to foster a deeper understanding of multiplication. For example, in the U.S., Common Core State Standards emphasize the use of strategies such as decomposing numbers and applying properties of operations (e.g., distributive property) to teach multiplication. In the UK, the national curriculum also emphasizes fluency in multiplication tables, expecting pupils to recall multiplication facts up to 12 by the end of Year 4.

Research indicates that pupils in developing countries often face greater challenges in mastering multiplication skills due to factors such as large class sizes, lack of resources, and inconsistent teacher training (Polo-Blanco et al., 2022). In Sub-Saharan Africa, for example, studies have shown that pupils often lag behind in basic arithmetic, including multiplication, compared to their peers in high-income countries. Efforts to improve multiplication skills in these regions have included interventions such as teacher training programs, curriculum reforms, and the introduction of low-cost educational technologies (Kaufmann, 2019). However, the success of these interventions depends heavily on the local educational infrastructure and teacher preparedness.

Cultural attitudes toward mathematics also play a role in how multiplication is taught and perceived around the world. In countries like South Korea, where mathematics is highly valued and competitive, pupils receive additional tutoring outside of school to master multiplication and other arithmetic skills (Chin et al., 2019). On the other hand, in countries where mathematics is viewed less favourably, such as some parts of Latin America, pupils often struggle with multiplication due to a lack of engagement and interest in the subject (Karnes et al., 2012). Research has shown that cultural attitudes can significantly impact both student motivation and achievement in mathematics.

In conclusion, while multiplication is a universal skill taught in nearly every country, the methods and success rates of teaching multiplication vary widely. High-performing countries often employ a mix of rote learning and conceptual teaching, ensuring that pupils not only memorize multiplication facts but also understand the underlying principles. In contrast, many developing countries face challenges in providing quality math education due to resource limitations, which affects pupils' ability to master multiplication. Cultural attitudes toward mathematics also influence how multiplication is taught and perceived, further contributing to the global disparities in math education.

2.2.1 Multiplication Skills in Malaysia

The Malaysian education system emphasizes the development of basic mathematical skills from an early age, with multiplication being a critical skill introduced in the primary school curriculum. By Year 3, pupils are expected to have a firm grasp of multiplication, which serves as a foundation for more complex