DEVELOPMENT OF DIFFERENTIATED PEDAGOGICAL MODULE FOR BASIC OPERATION IN PRIMARY SCHOOL

MAYSHANTHINNY A/P BANDIRAU

SULTAN IDRIS EDUCATION UNIVERSITY

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ABSTRACT

This study aimed to develop a Differentiated Pedagogy Module for the topic of basic operations in Year Five Mathematics, with specific emphasis on multiplication and division. The objectives of the study were to evaluate the level of need, validity, and usability of the developed module. A quantitative approach was employed through the (Design and Development Research, DDR) methodology. Data collection was carried out using questionnaire instruments. In Phase 1, the needs analysis involved 12 teachers, while Phase 3 focused on evaluating the module's usability by 50 teachers. Two sets of questionnaires were used in this study, one set for expert evaluation, and another set comprising two parts to gather user feedback. Data were analysed using SPSS software. The findings revealed that the developed module achieved a high level of validity based on expert evaluation, with a validity score of 89.3%. In terms of usability, the findings showed that most items received high mean scores, ranging from 4.36 to 4.48, indicating a high level of usability. Respondent evaluations found the module to be relevant, useful, and highly applicable within the classroom context. All teachers also agreed that the module clearly covers the basic operations topics and provides a positive impact on teaching and learning effectiveness. Overall, the Differentiated Pedagogy Module was found to be suitable for use by teachers, especially in enhancing students' mastery of multiplication and division-related questions. The study's implications suggest that this module has the potential to serve as a teaching aid that strengthens students' understanding of basic mathematical concepts in a contextual, interactive, and meaningful manner.

PEMBANGUNAN MODUL PEDAGOGI BERBEZA UNTUK OPERASI ASAS DI SEKOLAH RENDAH

ABSTRAK

Kajian ini bertujuan membangunkan Modul Pedagogi Berbeza bagi topik operasi asas Matematik Tahun Lima, dengan penekanan khusus kepada pendaraban dan pembahagian. Objektif kajian adalah untuk menilai tahap keperluan, kesahan, dan kebolehgunaan modul yang dibangunkan. Pendekatan kajian menggunakan kaedah kuantitatif melalui reka bentuk dan pembangunan (Design and Development Research, DDR). Pengumpulan data dilaksanakan menggunakan instrumen soal selidik. Dalam Fasa 1, analisis keperluan melibatkan 12 orang guru, manakala Fasa 3 menumpukan kepada penilaian kebolehgunaan modul oleh 50 orang guru. Dua set soal selidik digunakan dalam kajian ini, iaitu satu set untuk penilaian pakar, dan satu set lagi yang terdiri daripada dua bahagian bagi memperoleh maklum balas pengguna. Data dianalisis menggunakan perisian SPSS.Hasil kajian menunjukkan bahawa modul yang dibangunkan mencapai tahap kesahan yang tinggi berdasarkan penilaian pakar, dengan skor kesahan sebanyak 89.3%. Dari aspek kebolehgunaan, dapatan menunjukkan kebanyakan item memperoleh skor min yang tinggi, iaitu antara 4.36 hingga 4.48, sekali gus menunjukkan tahap kebolehgunaan yang tinggi. Penilaian responden mendapati modul ini bersifat relevan, berguna, dan mempunyai aplikasi tinggi dalam konteks bilik darjah. Kesemua guru turut bersetuju bahawa modul ini merangkumi topik-topik operasi asas dengan jelas serta memberikan impak positif terhadap keberkesanan pengajaran dan pembelajaran.Secara keseluruhan, Modul Pedagogi Berbeza ini didapati sesuai digunakan oleh guru, khususnya dalam usaha meningkatkan penguasaan pelajar terhadap soalan melibatkan operasi pendaraban dan pembahagian. Implikasi kajian menunjukkan bahawa modul ini berpotensi menjadi bahan bantu mengajar yang dapat memperkukuh pemahaman pelajar terhadap konsep asas Matematik secara kontekstual, interaktif, dan bermakna.

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LIST OF DIAGRAMS

LIST OF ABBREVIATIONS

BEAMS	Basic Essential Additional Mathematics Skills
BPK	Bahagian Pembangunan Kurikulum
DDR	Design & Development Research
DSKP	Dokumen Standard Kurikulum & Pentaksiran
HOTS	Higher Order Thinking Skills
KSSR	Kurikulum Standard Sekolah Rendah
KPM	Kementerian Pendidikan Malaysia
NCTM	National Council Teachers of Mathematics
PBD	Pentaksiran Bilik Darjah
PDP	Pengajaran dan Pembelajaran
PISA	Program for International Student Assessment
PPD	Pejabat Pendidikan Daerah
PPPM	Pelan Pembangunan Pendidikan Malaysia
SPSS	Statistical Package Social Science
TIMSS	Trends in International Mathematics & Science Study

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CHAPTER 1

INTRODUCTION

1.1 Overview

This study's introduction aims to provide differentiated pedagogical modules and to evaluate the quality of the module. Following that, research objectives and research questions developed to progress this study towards the goal of the intended outcome. In addition, it is necessary to acknowledge background research from the start in order to make sure that the study's quality is maintained. This would highlight the importance of the research and put this study in a more favorable perspective. It would also highlight the study's limitations, which should be taken into consideration when upcoming researchers are referencing this work.

1.2 Background Research

The word pedagogy refers to an educator or teacher. Juha Hamalainen (2012) explains that pedagogy theory is an efficient conception of how education works and the factors of human growth in the perspective of both individuals as well as society. It concerns the aspects of social and cultural growth in education, learning, and developing methodologies. Pedagogical focus on the education, including lesson planning, teaching methods, and even the form of the classroom. König (2019) defined that pedagogy is a primary objective of teacher education and preservice teachers can benefit from the teacher educator's pedagogical style by expanding their knowledge of the challenging aspects of teaching.

Numerous recent studies have identified division and multiplication as among the most challenging arithmetic operations for primary school students. According to Pearn and Merrifield (2021), many students continue to rely on basic counting strategies and exhibit a lack of fluency with division facts, often expressing anxiety and low confidence when encountering division tasks. Their study highlights that division is commonly perceived as the most difficult of the four operations due to its abstract nature. Similarly, Vigneswery and Chin (2024) conducted a quasi-experimental study on Malaysian primary students and found that learners demonstrated significantly low fluency in multiplication computation when taught through traditional methods. The research showed that students struggled to recall multiplication facts and often reverted to repeated addition, indicating insufficient conceptual understanding of multiplication. These difficulties were notably more

pronounced compared to students' performance in addition and subtraction. Collectively, these studies underscore that division and multiplication involve higher cognitive demands, such as conceptual understanding of inverse relationships, grouping, and place value, which are not as prominently required in addition or subtraction. As such, selecting these operations as the focus of the present study is justified by the documented learning gaps and consistent underperformance observed in both local and international primary mathematics contexts.

Students often face problems in basic operations of multiplication and division due to challenges like difficulty understanding concept and lack of memorization in multiplication tables, which can eventually affect their multiplication and division calculations (Siegler & Braithwaite, 2017). It is named basic operation, so every individual need to know, understand and use every basic thing in their life. Therefore, mastering these basic operations is important as they form the foundation for further level mathematics calculation, including fractions, algebra, problem-solving and daily life-style like budgeting and measurements (Kilpatrick, Swafford, & Findell, 2011)

Differentiated instruction (DI) can improve division and multiplication with different teaching strategies according to the students' learning needs. Providing leveled practice worksheets can encourage students for conceptual understanding and fluency (Tomlinson, 2014). Previous study by (Tomlinson, 2014) has highlighted that differentiated teaching methods can significantly improve students' learning outcomes in mathematics by providing to multiple student needs. Besides, in the same study Tomlinson emphasized that differentiated instruction, enable teachers to modify content, process, assessments based on students' ability and interest to encourage their engagement level and performance.

1.3 Problem Statement

An article by FMT News (K. Parkaran – 26 June 2022) Malaysia's Low Ranking in Trends in International Mathematics & Science Study (TIMSS) & Program for International Student Assessment (PISA) is the reason for more difficult in School Curriculum. A school teacher claims that Primary School Curriculum in Mathematics is extremely difficult. The Ministry of Education has been continuously modifying the primary school curriculum over the past few years to make it more difficult as a way to improve the country's position in Pisa, despite these efforts, Malaysia continues to rank lower in international assessments compared to neighboring countries like Singapore and South Korea, highlighting the need for further reforms in curriculum design and teaching approaches (Ministry of Education Malaysia, 2013). Teachers have been asked to attend courses in recent years to be briefed on these changes. It was then that we were informed that the move was a result of the Pisa rankings.

According to K. Parkaran (2022), the teacher said the ministry gradually upgraded the Year 5 Mathematics and Science curriculum for use in Year 4, Year 6 content for Year 5, and Form 1 syllabus taught to Year 6 students. Textbooks were also changed, and many students struggled to adapt, especially during the pandemic. This has affected teaching and learning in schools over the past two years. Assessments show that at least four to five students achieve the lowest band in each subject, which is not good. Teachers gave feedback to the headmaster, who is supposed to convey it to higher authorities at the state level. Teachers really hope they do so because this is a

serious issue. Teachers on the ground are struggling. A teacher claimed that there were instances where certain headmasters advised teachers to avoid giving students the lowest band in their assessments so that the school would not have to submit reports to the State Education Department.

Besides, Fahmy A Rosli (2024) has come out about Primary students losing interest in Mathematics Subject. The high level of and Mathematics syllabuses in primary school makes learning difficult for students who are just entering the school environment, causing some to find the subjects boring. The poor mastery and understanding of these subjects in primary school can have long-lasting effects as they move on to secondary school, eventually putting them at risk of failing exams such as the (SPM) Sijil Pelajaran Malaysia (Mokhtar & Salleh, 2016). Dr. Othman Talib, an Education Lecturer at UCSI University, described the current content of primary school Mathematics subject contains too much content at the start of schooling and is further complicated by dense textbooks, which are not aligned with the cognitive level of the majority of students.

Teaching basic operations, particularly multiplication and division, in primary mathematics includes few challenges like students' struggles with conceptual understanding, procedural fluency, and anxiety. In Malaysia, such challenges are amplified by curriculum density and mismatched cognitive demands. Studies indicate that ineffective teaching methods and insufficient differentiation fail to address diverse learning needs. These issues often result in poor foundational skills, impacting overall mathematics performance (Cheng 2023; Saidi & Sulaiman, 2022). Professor Dr. Muhammad Nubli Abdul Wahab from the Center for Human Sciences,

Universiti Malaysia Pahang (UMP), also shares the opinion that one of the factors for students' weakness in mathematics is their inability to grasp the basic concepts of the subject.

According to Abdul Razak (2019), there is a lack of locally developed implements and systems for evaluating the effectiveness of pedagogical modules. Furthermore, cultural and popular challenges to the implementation of instruments from other nations restrict the application and effectiveness of current instruments in the Malaysian context.

In addition, the development process is complicated by the scarcity of specific guidelines to develop pedagogical modules that align with Malaysian educational standards. To address these difficulties effectively, it is critical to improve access to resources, promote local research projects, and develop recommendations customized to the Malaysian education system. A study by Tan and Lim (2018, 2018) stated that primary school students often face difficulties in memorizing or applying multiplication due to a lack of practice. Students usually can-do simple divisions like single digit divisor, example 300 000 divided by 6, but problems arise when the division involves a two digits divisor like dividing 932 700 by 30 (Mahpop & Sivasubramaniam, 2010). According to Mod Nor Amri and Effandi (2016), students often face problems in division due to confusion in understanding place values during division operations. In the study by Santos and Patton (2016), they found that students indeed encounter difficulties related to the concept of division even though they have been taught in various multiplier materials like counters, base-ten blocks, and others related to it.

The study aims to develop a differentiated pedagogical module to address the difficulties students face in basic operations like multiplication and division. The module seeks to enhance conceptual understanding and students' performance. Eventually, this will lead to higher-quality education by advancing students for future learning and aligning their abilities with the expectations of national assessments.

1.4 Objective of Study

The research objective of this study are as follows:

1. To conduct a need analysis for the developed pedagogical module.
2. To develop and evaluate the usability of differentiated pedagogical modules for Primary School Mathematics teachers, specifically focusing on Multiplication & Division (Standard 5).
3. To evaluate the usability of the differentiated pedagogical module.

1.5 Research Question

To achieve the goals and objectives of this study, the research questions are as follows:

1. What is the level of need analysis for the developed pedagogical module?
2. Does the Differentiated Pedagogical Module have good Validity?
3. Does the Differentiated Pedagogical Module have good Usability?

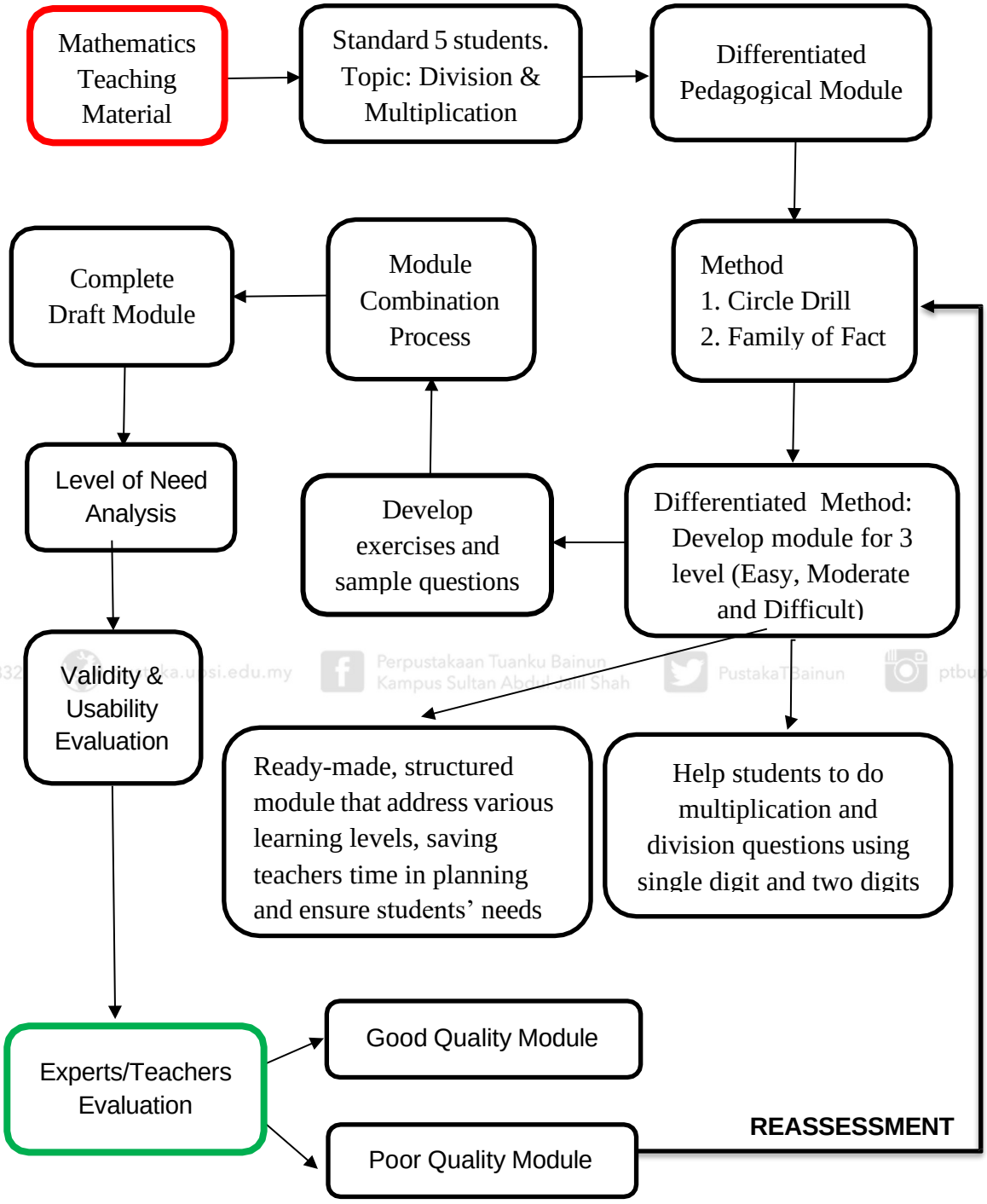
1.6 Conceptual Framework

This study is a quantitative study and in the form of Design and Development Research (DDR). The purpose of this study is to develop a differentiated pedagogical module for Year 5 Mathematics under the topic of division and addition. The Sidek and Jamaluddin (2005) model development module is used as the main core in the construction of this differentiated pedagogical module so that the construction of the module can meet the objectives of its construction.

However, to develop a module that meets the set criteria, it is necessary to obtain validity and usability. The opinions and evaluation of field experts must be taken into account and then it is necessary to obtain usability from the teachers' point of view before it is known as a complete, quality, and ready-to-use module. Nevertheless, the developed module should coincide with the demands of the Ministry of Education to develop more competitive students and cultivate the process of reasoning and self- learning. Diagram 1.1 below explains further about the conceptual framework of this study.

Diagram 1.1

Conceptual Framework



1.7 Operational Definition

1.7.1 Pedagogical

The term pedagogical is most frequently generalized as a teaching approach and a method of learning. Nicolas C. Burbules and Nathan Raybeck have stated that pedagogic theories besides analyzing the scope of education, they also include recommendations about how education needs to move forward, purpose of it and to whom it needs to serve. In the academic field, pedagogy evaluates the connections that occur throughout learning and the way of imparting knowledge and skills in an educational environment.

1.7.2 Differentiated Pedagogy

Differentiated pedagogy refers to a teaching that is intentionally designed to accommodate the diverse learning needs, readiness levels, and interests. This study, it is operationalized through a set of instructional strategies, learning materials, tasks, and assessments that are tailored based on students' individual differences. The differentiated pedagogy in the module involves modifications in content (what is taught), process (how it is taught), product (how learning is demonstrated), and learning environment. The effectiveness of the differentiated pedagogy is measured through students' academic performance, engagement, and feedback, as assessed via pre- and post-tests, classroom observation, and reflective instruments.

1.7.3 Pedagogical Modules

In an article of (Institute for Research and Community Service, 2021) describes that modules are a group, or an individual learner compiles the modules, which are then neatly and properly organized. In addition, it will be printed, and the students and instructional staff use the printed findings as a guide. The class as a whole can then continue to study because of this learning module. even when the class's instructor is unable to cover for them for whatever reason. in order for educational activities to continue. Pedagogical modules, also known as instructional modules or teaching modules, are structured units of educational material designed to facilitate learning in a specific subject or area. These modules are created to support educators in delivering targeted content, engaging activities, and assessments aligned with specific learning objectives.

1.7.4 Basic Operations

In the context of mathematics, basic operations refer to fundamental mathematical processes used to perform calculations or manipulate numerical values. There are 4 basic rules which are (addition, subtraction, multiply and division).

1.8 Study Limitations

The study focuses on the topic's multiplication and division only. So, this is limiting its applicability to other mathematical areas like addition, subtraction and problem-solving in basic operation. Then, targeted on Standard 5 syllabus only where the questions should follow the format of 'Hundred Thousand' digits. Therefore, the module cannot be used by the students from standard 1 – 4.

Furthermore, the sample consisted of 50 teachers only, which may not represent the broader population of teachers across different experience, school types, or regions. Moreover, the module evaluation was conducted by teachers only, and students were not involved in testing the module directly. This is limited the effectiveness of the module on how student engages or adapt their learning needs, and understanding the topics. Students feedback could lead to a positive impact on the module's usability and impact on learning outcomes.

During the module evaluation, the findings are limited to the perspectives and experiences of the selected participants. Broader usability feedback from diverse teachers or curriculum developers, was not explored, which could further improve the module's refinement and implementation.

1.9 Importance of Research

The importance of developing differentiated pedagogical modules for primary school mathematics, specifically focusing on basic operations (addition, subtraction, multiplication, and division), aims to address the diverse learning needs of students while ensuring comprehensive understanding and engagement. These modules are tailored to accommodate various learning styles, cognitive abilities, and readiness levels among students.

According to Anderson and Anderson (2018), modules enable customized learning experiences that are suited to each student's unique needs, interests, and skill level. Modules allow educators to tailor assessments, pacing, and instructional content to create personalized learning pathways that meet the needs of a wide range of learners. Ensuring that instructional materials, activities, and assessments are in line with learning objectives and curriculum standards, modules help to promote curriculum alignment (Bates and Sangra, 2011). To guarantee coherence and consistency in instruction, educators can create modules that address subjects, abilities, or competencies listed in the curriculum.

Modules give teachers pre-made resources and learning materials, which expedites the teaching process and increases efficiency (Dwivedi and Dhar, 2019). Teachers can use pre-packaged modules to provide basic constant instruction across classrooms rather than creating lesson plans or teaching materials from scratch. Teachers can modify and customize lesson plans to meet the needs of their students with the flexibility and adaptability that modules provide (Kozma, 2014).

Developing differentiated pedagogical module can also develop the teaching benefits by adapting to various learning needs where teachers can do well-planning that can result in more functional core of teaching. This development can ensure that students can have equal understanding in mathematics education that can lead them to be more engaging in the classroom, regardless of their learning styles or abilities. This could achieve individual student's learning objective. All these developments can give a major impact on the students' engagement, conceptual understanding, critical thinking as well as their confidence in Mathematics. To mention specifically, students eventually improve their overall learning outcomes.

Students come from divergent backgrounds with different level of attitudes, learning styles, and capability. Therefore, differentiated pedagogical modules meets the diversion of the students by providing a module that can be accessible to all kind of students based on their experience. From their respective skills and ability, they can improve their level learning go beyond basic understanding through this differentiated pedagogical module.

In Mathematics, basic skill like addition, subtraction, multiplication and division is very essential skill as this will be helpful for their future mathematical performance. When students can master in these skills, they can eventually upgrade their skill in conceptual knowledge and problem solving. The developed differentiated pedagogical module is mainly focusing on students fundamental understanding in the basic operation. When students are able to succeed in their master in their basic operation, they can grow their self-esteem and confidence which can lead to their academic achievement. Hence, these can lead students to study at

their own momentum while receiving feedback from their teacher based on their work, resulting in the growth of confidence in Mathematics.

Differentiated pedagogical module support students' engagement and motivation by adapting learning based on their needs and interests. Students likely to get more involved in the classroom activity when they started to have the confidence in themselves and then they believe their needs have been identified. Differentiated pedagogical modules improve the development of critical thinking skills such as analysis, synthesis and evaluation through inquiry learning, problem solving. Students learn to think creatively and apply mathematical principles in real-world situations, preparing them for future learning and problem-solving skills.

1.10 Conclusion

In summary, this chapter gives a background and context to primary school mathematics education in Malaysia which helps to understand the significance of students building up their foundation knowledge base and skills. The varied educational setting needed to be framed as this study concentrated on Malaysian primary schools Year 5 students. Differentiated pedagogical module should be considered as it impacts educational practices, lesson planning and students' activeness in classrooms. The study addressed the existing problem in primary school mathematics pedagogy, emphasizing the need for a more tailored and inclusive approach to provide diverse learning needs. The research objectives were to design differentiated pedagogical modules focusing on Multiplication & Division for

Standard 5 students and to design and evaluate the usability of Pedagogical Modules for Primary School Mathematics Teachers.

The operational definitions clarified key terms, providing a foundation for understanding the terminology used throughout the study. The research questions were formulated to guide the investigation into various aspects of students' learning experiences in mathematics. Then, the chapter acknowledged the study's limitations, particularly in the scarcity of local literature on pedagogical modules in Malaysia and lastly this chapter provides the importance of this research to indicate the future positive impacts.