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Difficulties Faced by Teachers in Teaching Mathematics Word Problems

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Abstract

This research explores the mathematics teachers in Malaysia's problem of teaching word problems on mathematics with pedagogical, content, mathematical, and student difficulties. Word problems are part of the Malaysian curriculum because they unite abstract mathematical theories and real-world exercises. Deficits in content knowledge compound these problems, as teachers often lack the breadth of knowledge needed to break down and present mathematics in word problems. Interviews and theme analysis was used where the result revealing challenges experience by primary school mathematics teachers such as professional development, lack of time and big class sizes. Teachers report problems with bringing together cross-disciplinary knowledge, creating culturally sensitive word problems, and differentiated teaching to cater to diverse student interests. To overcome these issues, strengthening teacher training programmes around content knowledge, class collaboration, and classroom technology use was recommended. Questions based learning, manipulative and visual strategies, culturally sensitive teaching, are recommended to maximize students' engagement and comprehension. Also emphasised are frequent formative assessment and reflection as critical to spotting student learning inconsistencies. Therefore, this study was conducted to help improve the practice of teaching mathematics in the form of sentences among mathematics teachers, thus helping to improve student achievement.

Keywords: Mathematics Education, Word Problems, Content Knowledge, Teacher Challenges, Primary School

Introduction

Word-based mathematics problems are mathematical questions written as narratives set in a universal context. The mathematics curriculum in Malaysia has integrated word-based mathematical problems into classroom activities. Math word problems are supposed to foster higher-order thinking and applications of math concepts to real-world situations (Johari et al., 2022). However, result from TIMSS and PISA have indicated the need for Malaysian students to increase their skills in problem solving.

For teachers, teaching word problems in mathematics can be challenging and difficult. These challenges fall into four broad categories. Firstly, pedagogical challenges. Pedagogical factors is very important to support students in understanding and solving these problems is paramount. Providing timely and constructive feedback on students' words problem-solving processes is not an easy task (Sabaruddin et al., 2020). Next, content knowledge challenges. Content knowledge factors relate to how well teachers understand the mathematical concepts that are being tested in the word problems, not only teaching how to solve the problem (Sabaruddin et al., 2020). Based on past research, in solving mathematics questions, teacher not only coming up with solutions to the problem but how students arrived to that solution and to be able to explain the reasoning (Khoshaim, 2020). Furthermore, mathematics knowledge challenges also become the factor that can cause the mathematics teaching process become difficult. A teacher should have expertise in problem-solving strategies and techniques such as problem modelling, approximation, rational reasoning, and many more. Lastly, knowledge of student challenges. The knowledge of student factors relates to learning or cognitive and affective characteristics, learning abilities and learning styles of students and common challenges they encounter in working with word problems (Subramaniam et al., 2022).

The purpose of this study is to understand the difficulties that mathematics teachers experience when they are teaching the word-based mathematics problem-solving, and to determine the ways which they can use to deal with these difficulties. This paper will focus on the Malaysian education context in which recent changes in the curriculum require the development of problem-solving skills to increase global competitiveness of students.

The results of this study hopefully can closes an important gap in the research around the pedagogical, content knowledge, and student-related problems encountered by teachers in the Malaysian education system. Next, this research might serve as a foundation for the formulation of educational theories about curriculum design, educational strategies, and teacher training programs. Besides, this study also adds to the global discourse on mathematics education comparing it globally. Lastly, this study can help teachers to develop assessment tools that properly assess problem-solving skills in students, as well as provide feedback that can be used to improve problem-solving (Gunasegar et al., 2021).

Methodology

The qualitative research design was used due to ability to provide in-depth information for exploring how teachers face problems when they teach their students how to solve mathematical word problems (Taherdoost, 2022). The sample population for this study consists of 6 mathematics instructors above 18 across all levels of primary education in Malaysia. The sample was choose using convenience sampling method. Table 1 show the data collection and analysis technique that has been used referring to research objectives.

Table 1
Data Collection and Analysis Technique

No	Research Objectives	Instruments	Data Analysis
1	To understand difficulties teachers face in teaching word-based problems and determine ways to deal with them.	Semi-structured interview protocol	Thematic analysis

This study employed semi structured interviews via Zoom, followed by an audio recording as the primary data collection method. Semi-structured interviews, as opposed to structured interviews that standardize the order of questions (as compared to semi-structured) are less restricted and more genial, yet fixed on addressing the primary themes mentioned in each interview and acknowledging that certain topics are still there without being explicitly asked (Almansoori et al., 2020). The analysis for this instrument is thematic analysis where it is a qualitative means of identifying, analysing and reporting patterns (themes) within data.

Results and Analysis

In this section, the results and analysis of the study will be discussed in three parts. The first part is level of self-confidence of year 4 math students. Next is level of mathematics self-assessment scores of year 4 math students. Lastly, relationship between self-confidence and mathematics self-assessment scores Year 4 math students.

Level Of Self-Confidence Of Year 4 Math Students

Table 2 show the finding based on research objectives 1. There are four major themes emerged from the data which is i) Student Understanding, ii) Teacher Preparedness, iii) Curriculum Constraints, iv) Student Mistakes and Student Motivation.

Table 2
Finding Based on Research Objective 1

Theme	Codes	Example (Verbatim Transcripts)
Student Understanding	Misunderstanding context, skipping steps, and errors in procedure	"Most of the time they have kids that aren't understanding anything because they read and they don't understand the problem and they can't do it when it comes to math word problems." - Interviewee 1
	Inability to comprehend the language of word problems	"Most students say that word problems are intimidating and hard. As they've often said...'The language doesn't really tell you how to do the math.'" - Interviewee 1
	Students' fear and dislike of word problems	"Often students don't like word problems, they find them 'the hardest part of math.' They are just as good at solving equations without reading." - Interviewee 5
Teacher Preparedness	Lack of specific training for word problems	"I would say I have some training but it was mostly just about general teaching

		and not really word problem teaching techniques." - Interviewee 1
	Workshops too broad to address specific needs	"I've been to a couple workshops but it was so broad and there were no word problems specifically. They were useful for general methods of instruction, but not for the problem of word problems." - Interviewee 1
	Need for targeted professional development	"I would like to be trained in creating culturally sensitive word problems, and on data analytics for student tracking." - Interviewee 2
Curriculum Constraints	Insufficient time in the curriculum to focus on word problems	"No, I don't have time. There is a lot on the course, and we often have to cut things short to get things done on time. So, there is no room to dig deeply into word problems." - Interviewee 1
	High-level syllabus limits depth of teaching	"Not really. The focus on a high-level syllabus leads to weaker learning on difficult topics such as word problems." - Interviewee 2
Student Mistakes	Misinterpretation of problem context	"The big mistake is not reading or missing the details properly and making the wrong assumption about the question the problem asks." - Interviewee 2
	Errors in identifying mathematical operations	"Kids often confuse operations like adding instead of subtracting and multistep problems are just too difficult for them." - Interviewee 4
	Failing to connect calculations with problem requirements	"The most common pitfalls are jumping to conclusions and not knowing the question. They often correct for the wrong variable or ignore part of the problem." - Interviewee 5
Student Motivation	Lack of confidence in solving word problems	"One thing that I see a lot, is that students don't trust themselves, and they get keyword or concept wrong in word problems, and solve them incorrectly." - Interviewee 2
	Negative perceptions of word problems	"I've had students complain that word problems are annoying because they have no idea how to make sense of it or what is being asked." - Interviewee 4

Based on the finding in Table 2, there are several difficulties that can be identified. Firstly, it is often not clear to the student how the word problem fits into the context, and this is why they make mistakes when solving it. The result in the Interviewee 1 it is not only the language that hinders these, students tend to be intimidated by word problems because of the language. Next difficulties is there is no special training to teach word problems.

Interviewee 1 states that he has only attended a couple workshops and it was just really general and no word problems specifically.

Other than that, the speed of the curriculum was emphasised as one of the biggest limitations, as there was little time to spend systematically dealing with word problems. Interviewee 2 indicated that the extensive syllabus and the inclusion of complex topics such as word problems result in weakened learning outcomes. In addition, student mistakes is one of the factors that will affect self-confidence of Year 4 math students. The findings from the interview conducted with Interviewee 2 show the major error is not reading or not knowing the information properly and just taking the wrong answer about the problem.

Lastly, discrepancy and bad reviews of word problems added another obstacle. Interviewee 4 shared that he heard kids tell me that word problems are really a bother because they don't know how to understand it or what is asked for. These results point to the complexity of difficulties for teachers and students when trying to solve mathematics word problems.

Level Of Mathematics Self-Assessment Scores Of Year 4 Math Students

Table 3 show the finding based on research objectives 2. There are five main themes that has been identified which are i) Differentiated Instruction, ii) Use of Technology, iii) Real-World Applications, iv) Peer Collaboration and v) Motivation Strategies.

Table 3
Finding Based on Research Objective 2

Theme	Codes	Example (Verbatim Transcripts)
Differentiated Instruction	Tailoring lessons to students' abilities	"I differentiate my lesson plan, I give easier problems to lower ability students and harder ones to higher ability students." - Interviewee 1
	Providing scaffolding for struggling students	"I give them graphical organizers (problem-solving charts, etc.) that allow them to sort and deconstruct a word problem." - Interviewee 3
Use of Technology	Integration of digital tools for engagement	"I teach using internet problem-solving and math games. These are practice aids for the students." - Interviewee 2
	Use of apps and simulations for interactive learning	"I use interactive whiteboards and learning apps. For instance, I have apps that model scenarios as if they're presented to students on a screen." - Interviewee 1
Real-World Applications	Connecting problems to everyday scenarios	"I encourage students to relate word problems to something that they can use them for... like shopping or playing a sport." - Interviewee 1
	Encouraging real-life problem-solving	"I relate word problems to something students can use, such as shopping or sports. Not only does it make problems more concrete, it also makes problems approachable." - Interviewee 4
Peer Collaboration	Group work and peer support to enhance understanding	"I use group work where they work together in pairs or groups and collaborate to solve the problem." - Interviewee 1

	Role-playing and collaborative problem- solving	"I design the lessons based on the multi-sensory method including practice, demonstration, and visual cues, for different types of learners." - Interviewee 4
Motivation Strategies	Gamification and rewarding effort	"I like to make learning games with quizzes and competitions for students. I also apply praise and reward to acknowledgment of effort and growth." - Interviewee 2

Based on the finding above, the results suggest a variety of teaching approaches that were designed to address students' multiple needs, create an educational setting and increase student problem-solving ability in the form of mathematics word problems. For the first theme, differentiated instruction became the primary method for addressing different student capacities and styles. There are two differentiated instruction can be obtained which are lesson plan and scaffolding. The findings from the interview conducted with Interviewee 1 show differentiates lesson plan enables educators to appeal to students' varying learning levels by providing them with problem that are appropriately difficult so they feel they have been successful, both at first and later. While, Interviewee 3 said that he hands them graphical organizers (problem solving diagrams, etc.) where students can sort and break down a word problem.

Next, implementation of technology into teaching was another approach that the interviewees referred to. Interviewee 2 said that he does it through internet problems and math games and that these are for students to practice with. In contrast, Interviewee 1 focused on apps and interactive whiteboards to demonstrate word problems to students. These virtual aids not only add fun to the word problems but they also give students context and give them an inkling about what mathematics can mean in real-world situations.

Furthermore, linking word problems to real-world applications was another successful technique revealed in the interviews. Interviewee 4 said about utilizing the real world when dealing with problem- solving can help students see how math is actually applied and will be more motivative to learn word problems in a more practical manner. Interviewee 1 also state the same point like Interviewee 4 where he asks students to relate word problems to something that they can apply like going to the store or going to a sport.

Other than that, one of the methods to ensure words problems could be successfully solved is by using peer collaborations. As mentioned by Interviewee 1 he does group work and they are in pairs or groups so that they can converse and learn different ways to solve mathematics words problems. Interviewee 1 also creates the lessons around the multi-sensory approach, like practice, demonstration and imagery, with different learners.

Lastly, teachers use motivation strategies to motivate students to keep at it when solving word problems. Interviewee 2 said that he creates learning games with questions and competitions for the students. This strategy helps students do challenging things and can also help students become more motivated. Differentiated teaching, technology, real-world applications, peer work and motivation were all identified as methods of increasing student engagement and knowledge.

Relationship between Self-Confidence And Mathematics Self-Assessment Scores Year 4 Math Students

Table 4 show the finding based on research objectives 3. There are five main themes that has been identified which are i) Curriculum Structure and Pacing , ii) Impact of KBSR to KSSR Transition , iii) Impact of KBSR to KSSR Transition , iv) Professional Development and v) Curriculum Flexibility.

Table 4
Finding Based on Research Objective 3

Theme	Codes	Example (Verbatim Transcripts)
Curriculum Structure and Pacing	Fast-paced curriculum limits in-depth teaching	"No, I don't have time. There is a lot on the course, and we often have to cut things short to get things done on time. So, there is no room to dig deeply into word problems." - Interviewee 1
	Need for curriculum flexibility to focus on critical skills	"The syllabus is too rushed to tackle the word problems in depth, and that leaves little time to cultivate thinking skills." - Interviewee 4
Impact of KBSR to KSSR Transition	Shift to KSSR leads to increased difficulty of word problems	"Since I am now going from KBSR to KSSR, I teach word problems more holistically, because higher-order thinking makes me use more case examples and problem-solving activities." - Interviewee 1
	Transition demands more preparation and time	"I am happy to have made the shift to KSSR as it makes me work more problem solving and less rote learning. Yet the more detail takes more lesson prep time." - Interviewee 2
Curriculum Mismatch	Misalignment between curriculum content and student abilities	"The problems are usually too abstract or out of the syllabus." - Interviewee 1
	Lack of depth due to pressure of covering a broad syllabus	"Not really. The focus on a high-level syllabus leads to weaker learning on difficult topics such as word problems." - Interviewee 2
Professional Development	Insufficient professional development for teaching word problems	"I would like to be trained in creating culturally sensitive word problems, and on data analytics for student tracking." - Interviewee 2
	Need for more specialized training in problem-solving and curriculum adaptation	"I could use workshops on how to bring in technology and how to differentiate instruction for different learners." - Interviewee 1
Curriculum Flexibility	Need for time to practice and master complex problems	"There needs to be more time in the course to practice word problems and

		differentiated resources for different ability levels." - Interviewee 2

One of the main complaints voiced by the interviewees was that the curriculum is so rapid that it doesn't allow time for deep dives into topics such as word problems. Based on the interview session conducted with Interviewee 4, he said that the syllabus is too quick to cover the word problems and that is not enough time to develop thought habits. Not only that, the demand for curriculum flexibility was also expressed by mathematics teachers. The syllabus also needs to be arranged in such a way that there is sufficient time for concepts and critical thinking to be absorbed.

Next, impact of KBSR to KSSR transition shows that math teachers face challenges. Interviewee 1 states that he is now moving from KBSR to KSSR, and he is teaching word problems more holistically, because higher order thinking demands that he uses more case studies and problem-solving scenarios. On the other hand, Interviewee 2 stated that he is very happy that he switched to KSSR because now he works more problem solving and less textbook learning. In the interview session, the results of the analysis show that additional time and energy needed to prepare lessons on the KSSR model is overwhelming, especially if the teachers are not well- trained or given the right resources.

Besides that, the data that has been obtain from the interview session show that curriculum didn't match what students were looking for or could do. Interviewee 1 said word problems sometimes go outside of the student's level of understanding or the syllabus. This has caused job of teaching difficult and students struggle to relate to the problems and make sense of them. Such a mismatch further underlines the need for curriculum adjustments that more closely reflect students' developmental stages and their ability to solve difficult word problems.

Furthermore, specialist professional learning need to be implemented. This will helps teachers to improve skills needed to teach word problems well in the classroom. Interviewee 2 stated that there is a need for special training to generate culturally appropriate word problems: He wants to be trained in order to create culturally appropriate word problems, and on data analysis for student tracking. While Interviewee 1 stated that he can use workshops about introducing technology and differentiate teaching for the various learners.

Lastly, demand for a greater degree of curriculum slack so that, say, word problems could be investigated further. Based on the interview session, Interviewee 2 stated that there should be more time in the class for word problem practice and differentiated materials to cater to different ability levels. In essence, it is shown that the curriculum makes teaching mathematics word problems a challenge but it also offers an opportunity. The lesson can be modified and the student and teacher support given more specific as well as flexible to make word problem instruction more effective.

Discussions

This study was conducted to identify the difficulties faced by primary school mathematics teachers in teaching mathematical problems in the form of sentences. The main emphasis was given to three main aspects, namely pedagogy, content and matters related to students. The results of the analysis carried out showed that there were difficulties in all three aspects.

From the perspective of pedagogical challenges, a lot of teachers complained that they didn't receive enough training to teach word problems. Not having been properly trained, teachers used direct instruction, which does not promote higher-order thinking skills (Prieto-Saborit et al., 2021). Teachers needed to teach width more than depth, at the expense of quality. Next, word problems are very difficult to solve without having knowledge of the mathematics and how it's used in practice. School teachers often said that they struggled to make concepts explicit and relate them to actual examples (Buschman, 2020b). The findings also show that year 4 students face problems understanding and mastering mathematical questions in the form of sentences. Word problems tended to be viewed as intimidating because they were hard (Mahmud et al., 2022). Therefore, this study recommends a few strategies and methods that can helps teacher to solve this problems. Some of the suggested solutions include differentiated instruction, integration of technology, real-world application and collaborative learning.

This study also focus on the curriculum constraints and opportunities. There are three main things that has been stated. First is pacing and structure. The result form the interview session show that curriculum was so frantic that there was very little time to do learning or review. Next, transition from KBSR and KSSR. This transition brought in HOTS and holistic learning to be more in synch with the world of learning. Nevertheless, these limits didn't deprive the curriculum of creativity. Hots-driven emphasis incentivised educators to use new teaching techniques including technological applications and application in the real world (Hui & Mahmud, 2023b).

Through this research, we have noticed that judicious teaching interventions, curriculum design and professional development are needed to improve the effectiveness of teaching mathematics word problem. Teaching methods are at the root of the problem with math word problems. There are some strategies that could make a big difference in classroom instruction and student learning, the study points out. Next, curriculum is the source of all learning. There is much to learn from the data in order to make curriculum design more helpful for both educators and students. Other than that, training is essential to equipping teachers to conquer mathematics word problems. This research also highlights the need for specialised training programmes for both pedagogical and content-based issues.

Conclusion

This study has stated three main recommendation for future research. The first recommendation is research long-term studies to assess the effect of curriculum reform. This research is interesting to know the short-term problems and opportunities in teaching word problems, but longitudinal studies are needed to determine how long-term curriculum reforms such as KSSR will last. Next, explore student-oriented strategies for increased interaction and performance. This is important because it can help teachers to better cater to different learners. Lastly, assess the ROI of technology adoption in other education institutions. If the potential of technology to change mathematics education remains, then future research will look at how it can work across different pedagogical environments. Although this research was carried out well, improvements can still be made in the future.

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