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Challenges and Opportunities: A Comparison of PISA 2022 Mathematics Performance in Malaysia and other ASEAN Countries

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Abstract: Malaysia recorded the largest decline among other ASEAN countries in the 2022 PISA mathematics performance. Although the COVID-19 pandemic may have contributed to this poor mathematics performance, previous PISA trends have shown that Malaysian students were already struggling in mathematics before the pandemic. Given this pressing concern, this research aims to compare Malaysian PISA mathematics results with those of other ASEAN countries to identify the challenges Malaysia faces and discover strategies that can be adopted from others. The findings reveal that nearly 60% of Malaysian students failed to meet the baseline of mathematics proficiency levels, and only 1% reached the high-performing level. Such results reflect that a large proportion of students in Malaysia struggles with basic mathematics. This study proposes several strategies for improvement. These include adopting Singapore's subject-based banding system to give equal opportunities and a flexible learning environment for students from all levels; continuous improvement of professional development for teachers by adopting the Singapore SFEd roadmap and the World Bank teacher development roadmap; and incorporating PISA-released items into classroom practices to familiarize students with the assessment structure and problem-solving strategies. However, further investigation is required to confirm the effectiveness of the proposed implementations.

Keywords: PISA-released items, mathematics proficiency, COVID-19 pandemic, ASEAN, Malaysia, subject-based banding system, continuous professional development

INTRODUCTION

PISA is an international programme administered by the Organisation for Economic Co-operation and Development (OECD). The main objective of PISA is to understand how well 15-year-old students perform in mathematics, science, and reading. The uniqueness of PISA mathematics assessment lies in its non-curriculum-based assessment approach, which looks at students' ability to apply their mathematics knowledge to real-life situations rather than assessing their memorisation of formulas and algorithms.

The first PISA assessment occurred in 2000. Initially, only 43 countries participated in the PISA assessment, including two ASEAN countries: Indonesia and Thailand. Since then, the assessment has taken place every three years. However, the eighth cycle of PISA, which was supposed to be conducted in 2021, was postponed to 2022 due to the disruption caused by the COVID-19 pandemic. However, it has increased to 81 countries participating in PISA 2022, including eight ASEAN countries. These ASEAN countries are Brunei Darussalam, Cambodia, Indonesia, Malaysia, Singapore, Thailand, Vietnam, and the Philippines. Notably, this was the fifth cycle of participation for Malaysia since 2009.

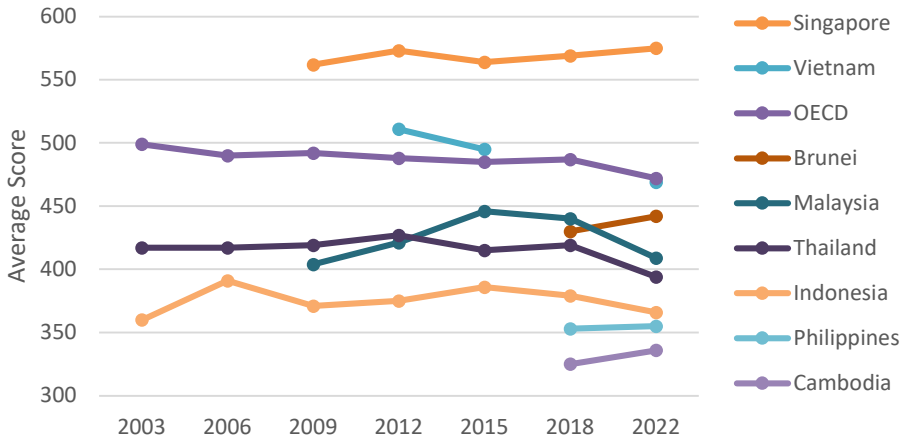

Figure 1: Trends in PISA mathematics achievement among ASEAN countries from 2000 to 2022 (Data: OECD, 2023)

Since the first participation in 2009, Malaysia's 15-year-old students have not achieved above the OECD average in mathematics. Among the participating ASEAN countries, only Singapore has always exceeded the OECD score, as depicted in Figure 1. More critically, Malaysia had the largest decline among other ASEAN countries in its most recent PISA mathematics performance. In addition to PISA, Malaysia also showed a poor performance in Trends in Mathematics and Science

Study (TIMSS). The recent TIMSS results also showed that the average mathematics score of Malaysian Grade 8 students falls below the international intermediate-level standards (Mullis et al., 2020). Furthermore, using the measurement where 20 points equals about one year of schooling, the findings showed that Malaysian student performance was 3 years behind Vietnamese students and 8 years behind Singapore students in mathematics, a*lthough Malaysia consistently ranks among the top ASEAN countries in investing the highest percentage of its Gross Domestic Product (GDP) in education* (Lynn & Becker, 2019; Avvisati & Givord, 2023; Schleicher, 2023). Other indicators, such as the average IQ administered by Lynn & Becker in (2019), also reported that Malaysians had lower intelligence than people from Singapore, Thailand, Vietnam, and Cambodia.

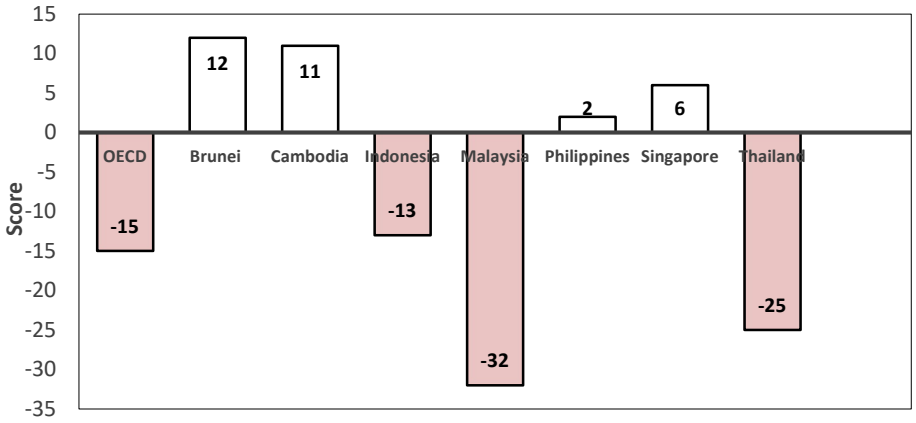

Figure 2: Trends in PISA mathematics scores among ASEAN countries from 2018 to 2022 (Data: OECD, 2023)

According to the Malaysia Education Blueprint 2013–2025, the nation aspires to rank in the top third quarter of countries in international comparative studies such as PISA and TIMSS by 2025 (Ministry Education of Malaysia, 2018). However, based on the most recent scores in the PISA and TIMSS assessments, Malaysia is still too far from realising this vision. The COVID-19 pandemic may have contributed to poor mathematics performance in Malaysia, but it is not the main factor. Based on previous findings, Malaysia already had long-standing educational issues before the COVID-19 pandemic, such as students with varying mathematics abilities in large classes, inconsistent teacher acceptance in professional development programs, and a lack of high-level cognitive mathematics problems in textbooks (Abu Hassan & Ajmain, 2022; Sianturi et al., 2021; Yaakob et al., 2020). As illustrated in Figure 2, despite the effect of the pandemic on students, it is important to note that some of the ASEAN countries improved in PISA 2022, such as Brunei, Cambodia, the Philippines, and Singapore, in their 2022 PISA math scores. Although Indonesia, Thailand, and Vietnam also experienced a decline in their mathematics scores, the decline was not

as steep as that of Malaysia. In addition, Figure 1 shows that Malaysian students were already performing poorly before the COVID-19 pandemic began. This clearly indicates that although the pandemic has intensified the situation, long-term issues in the education system has also contributed to the decline.

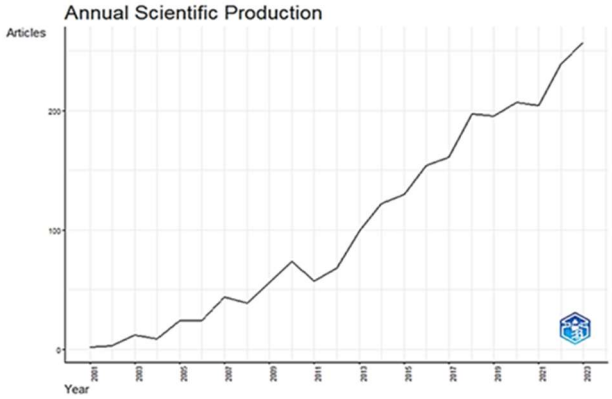

Figure 3: Annual Scientific Publication of PISA from 2001 to 2023 (Data: Scopus, 2024)

Given these pressing concerns, this research aims to compare Malaysian PISA mathematics results with those of other ASEAN countries. It also aims to identify the common issues Malaysia faces and discover the strategies we can apply from other successful ASEAN countries. Thus, this study intends to answer the following research questions: a) How did the Malaysian students perform in the PISA mathematics results compared with those of the ASEAN countries? b) What challenges do Malaysia face in achieving higher PISA mathematics proficiency? c) What are the strategies that Malaysia can apply from other successful ASEAN countries to improve PISA mathematics results? The key contribution of this study is to understand the challenges Malaysian students face in their persistent low performance in PISA. Based on comparisons with other ASEAN countries, the study seeks to understand the successful strategies they have used in their countries that Malaysia can adopt.

LITERATURE REVIEW

PISA Data for ASEAN Mathematics Improvement

Throughout the years, researchers have increasingly used PISA data to analyse the mathematics performance of countries participating in the study. Figure 3 illustrates this trend, in which a growing number of scientific articles on PISA were published annually and indexed in the Scopus database from 2001 to 2023. Various methodologies have been used to compare PISA results

across countries. One of them is the descriptive approach. Many research papers use descriptive statistics before conducting more advanced statistical analyses (Kandeel, 2021; Kim & Kim, 2023; Rowley et al., 2019). By exploring the data with descriptive measures, researchers can better identify student performance patterns and trends across countries before moving into more in-depth investigations. For instance, Rowley et al. (2019) used descriptive analysis to compare mean achievement scores in various countries to identify patterns and differences. In addition, Rowley et al. (2019) used descriptive analysis to compare high and low-socioeconomic students to identify achievement gaps.

Beyond comparative studies, many researchers have used PISA-released items to improve their countries' educational systems. For instance, in Singapore, PISA results are not only data resources to examine the effectiveness of its educational system, but the PISA-released items are also used to revise their education assessment model (Wu et al., 2020). Apart from Singapore, Indonesia has also been active in developing PISA-like items with the aim of improving mathematics results. They emphasise connecting mathematics tasks to real-life contexts, such as cultural heritage, sports, pandemics, and other everyday life situations (e.g., Aini et al., 2023; Putri & Zulkardi, 2020; Wulandari et al., 2024). Research has indicated a significant improvement in mathematics literacy for students who practiced PISA-like tasks compared to the group of students who did not (e.g., Almarashdi & Jarrah, 2022; Efriani & Putri, 2019). Thus, Malaysia mathematics education can also benefit from the PISA-released items by ensuring that they are relevant to culture and local contexts.

It is worth mentioning that Singapore has integrated Cognitive Diagnostic Models (CDMs) with PISA items to monitor its educational assessment structure and students' cognitive abilities (Wu et al., 2020). CDMs not only give detailed diagnostic information about the students' specific strengths and weaknesses in their cognitive abilities but also enable the teachers to know exactly where the students are weak or where they require improvement (Williamson, 2023). As a result, their national mathematics assessments are always consistent with international standards. Malaysia's educational assessment can benefit from the CDM approach, but its implementation must consider teachers' and educational assessment system readiness.

In contrast, Malaysia's overall mathematics cognitive assessment is more general and lacks in-depth analysis. In 2011, Malaysia introduced school-based assessment (PBS) to reform its education policy (Ministry of Education Malaysia, 2025). PBS comprises two components: academic and non-academic. The academic component includes central (PP) and classroom-based (PBD) assessments. Central assessment is a comparable summative assessment used to evaluate students' learning outcomes at different academic levels. For instance, the Malaysian Certificate of Education (SPM) is administered to Grade 11 students in Malaysia as a national examination to

determine their future academic paths (Ministry of Education Malaysia, 2025). Classroom-based assessment, on the other hand, consists of both formative and summative assessments (Ministry of Education Malaysia, 2025). An online integrated assessment management system is available to key in and generate a PBD report. However, compared with Singapore CDM, the analysis and assessment report lacks the in-depth details needed to diagnose the specific mathematics cognitive skills that students struggle with. Thus, there is a need to refine the cognitive assessment system and develop a more advanced and practical mathematics cognitive diagnostic assessment framework (Chin et al., 2019).

Mathematics Learning Support in ASEAN

In addition, the Ministry of Education (MOE) in Singapore has introduced ongoing projects to support children with different mathematical learning disabilities. An example of such successful projects is the Learning Support for Mathematics (LSM) program. At the beginning of primary school, children in Singapore must take a screening test to identify whether they have mastered the basic mathematics skills. For children who did not pass the screening test, it is necessary to join the LSM program (Ministry of Education Singapore, 2024). The LSM program is conducted for the selected children in four to eleven sessions weekly during regular school hours (Ministry of Education Singapore, 2024). It is conducted in small groups to ensure each child receives personalised attention while building their basic numeracy skills (Yeo & Cheng, 2021). Once these children meet specific criteria, they are discharged from the LSM program. Hence, early intervention not only reduces the number of innumerable children in the beginning stage of mathematics learning, but also supports children from low-income families who have limited support from their parents when doing homework (Ang et al., 2019).

Such interventions are also available in Malaysia. In 2010, Malaysia started the Literacy and Numeracy Screening (LINUS) program in primary schools to ensure all students acquire basic literacy and numeracy skills in their first few years of primary school (Ministry of Education Malaysia, 2018). The LINUS program was then replaced with the Primary Literacy and Numeracy (PLaN) program in 2019 (Ministry Education of Malaysia, 2023). Although both projects focus on the literacy and numeracy of primary school students, PLaN is more decentralised and school-based, which enables schools with autonomy to manage their own literacy and numeracy issues (Ministry Education of Malaysia, 2023). In addition, the Malaysia MOE introduced another intervention in 2024 to detect literacy and numeracy in primary 1 students early in 2024. It takes three months for the screening process and another three months for the intervention program (Rajaendram, 2024). As stated by the Education Director-General, Azman Adnan, this group of

students will continue in this program if, within three months, they do not master literacy and numeracy (Rajaendram, 2024). They will only return to the original class once they have achieved the expected level of proficiency within the time frame.

Unlike the Singapore LSM program, which is integrated into the mainstream mathematics curriculum, Malaysia numeracy support is intensive. However, the students are separated from the mainstream curriculum for at least three months, which may further widen their mathematics gap and affect their social reintegration with normal class students.

Professional Development for Teachers in ASEAN

Another factor contributing to Singapore's outstanding PISA results is its special attention to the life-long learning of teachers. Under the initiative of Continual Professional Development (CPD), Singapore MOE has long offered 100 hours of fully sponsored CPD credits to all teachers annually. Teachers can use these 100 CPD hours during or after working hours, depending on their conveniences. They can update their existing knowledge and skills through attending courses, doing research projects, joining a networking group, and any other training offered in school or outside the school (Stewart, 2018).

Beginning in 2020, Singapore MOE launched the SkillsFuture for Educators (SFEd) roadmap to guide teachers in optimising and planning their 100 hours of CPD. Mrs. Chua-Lim Yen Ching, the Singapore Deputy Director-General of Education (Professional Development) in 2020, pointed out that SFEd guides teachers to identify their competency gaps and then plan for the professional development that they really need. After surveying teachers and experts about the kind of training they require to cope with the rapidly changing needs of learners, Singapore MOE focused on the six priority areas of practice that every teacher should focus on in their professional development over a five-year period. These areas include assessment literacy, differentiated instruction, special educational needs, inquiry-based learning, the use of technology for learning and character and citizenship education (Schoolbag the Education News Site, 2020). As a result of the continuous implementation of sustainable professional development for teachers, Singapore has managed to maintain its position as the top country in international student assessments, such as PISA and TIMSS.

Similarly, other ASEAN countries have also created different professional development plans for teachers. Despite this, it is not sufficient and adequate if the programs do not account for factors like teacher workload, time constraints, teacher's existing knowledge and equity, which provides individualised support and culture of growth in teachers (Fletcher-Wood, 2020; Kilag et al., 2023;

Senawongsa et al., 2023). For instance, teachers in the Philippines reported that most professional development training was contextually irrelevant and had low applicability to practice (Bonghanoy et al., 2019). Malaysian research has also shown a mixed level of teachers' satisfaction with the professional development program compulsory for them to attend. It suggested that different teachers have different preferences and needs for professional development. For instance, Gen X (born 1964–1981) teachers were less interested in professional development that involved research activity, while Gen Y teachers (born 1982–1994) preferred to acquire information immediately and did not like top-down communications (Yaakob et al., 2020). Also, many in-service teachers in East Asia and the Pacific region have insufficient knowledge of their subjects leading to improper teaching (Afkar et al., 2023; Kurniasih & Hidayanto, 2022).

Recognising all these challenges, Afkar et al. (2023) have introduced a teacher professional development roadmap specifically for the middle- to low-income countries in East Asia and the Pacific region that face literacy and numeracy issues. The study revealed that many in-service training programs in these countries do not incorporate the four essential elements of effective teacher training programs. These elements include a focus on content knowledge, opportunities to practice what is learned with colleagues, continued support through follow-up visits focused on training content, and career incentives through promotion or increased salary (Afkar et al., 2023). By improving the quality of professional development, students' international assessment outcomes can also be improved. Again, the effectiveness of professional development for teachers depends on well-structured and thoroughly researched programs that meet teachers' specific needs. Otherwise, many teachers attend professional training programs just to fulfil the required credit hours but not to truly improve their teaching skills.

METHODS

This study used the PISA online database from 2000 to 2022. This study focuses on comparing mathematical scores across ASEAN countries using descriptive methods. The descriptive methods used in this study were mean score comparison, stacked column chart, and grouped histogram analysis. Mean scores across proficiency levels were used to compare the distribution of mathematics proficiency among ASEAN countries. The mean scores illustrate the trends over multiple PISA cycles across ASEAN countries. Stacked column charts were used to compare the percentage distribution of proficiency levels among ASEAN countries. By comparing the percentages in stacked column charts, we can easily see the proportion of students at each level for each ASEAN country. Grouped histogram analysis was used to understand the distribution shape

and skewness of the data across ASEAN countries. By observing the distribution shape and skewness of the overall ASEAN countries, we can detect at which proficiency level they cluster.

According to the National Center for Education Statistics (2022), the PISA assessment comprises one major domain, two minor domains, and one optional domain. The major domain for the 2022 PISA cycle was mathematics literacy. The two minor domains were science literacy and reading literacy, while the optional domain was financial literacy. The mathematics literacy instrument consisted of 160 new items and 74 existing items, which took more than 6 hours for a student to answer all of them. Hence, PISA used a hybrid multistage adaptive test design (MSAT) to divide items into smaller test booklets. This helped to shorten the duration of answering the PISA items. Each student took only 60 minutes to answer 28-30 items for the mathematics literacy assessment.

The target population of this study includes the 15-year-old students from eight ASEAN countries who took part in the PISA assessment. The cohort comprised 7069 students from 199 schools in Malaysia, 6606 students from 149 schools in Singapore, 8495 students from 279 schools in Thailand, 13439 students from 410 schools in Indonesia, 7193 students from 188 schools in the Philippines, 5279 students from 183 schools in Cambodia, 5576 students from 54 schools in Brunei Darussalam, and 6068 students from 178 schools in Vietnam. The rationale for choosing these ASEAN countries, but not Myanmar and Laos, were their participation in multiple PISA cycles.

RESULTS AND DISCUSSION

Distribution of Mathematics Proficiency across ASEAN Countries

Students' performance in the PISA mathematics assessment is categorised by proficiency levels. Previously, the scale had seven proficiency levels, ranging from below Level 1 to Level 6. However, from 2022 onward, the scale has expanded to nine levels. Students are subdivided into three levels at Level 1, with 1a being the lowest, followed by 1b and 1c. Students in Level 2 are only considered to have achieved the basic level of proficiency. Levels 3 and 4 are classified as intermediate levels, while Levels 5 and 6 are grouped as advanced levels. Hence, the new adjustment in 2022 gives a more detailed view of students below the level of basic mathematics proficiency.

Figure 4 shows the distribution of students across different mathematics proficiency levels in ASEAN countries that participated in PISA 2022. Singapore has a significant proportion of students with higher proficiency levels. This indicates that most Singaporean students have strong mathematical skills. On the other hand, other ASEAN countries, such as Malaysia, Indonesia, Cambodia, Thailand, and the Philippines, share a common issue of having a higher proportion of

students with lower proficiency levels than at any other level. This phenomenon implies that most students in these countries still struggle with basic mathematics.

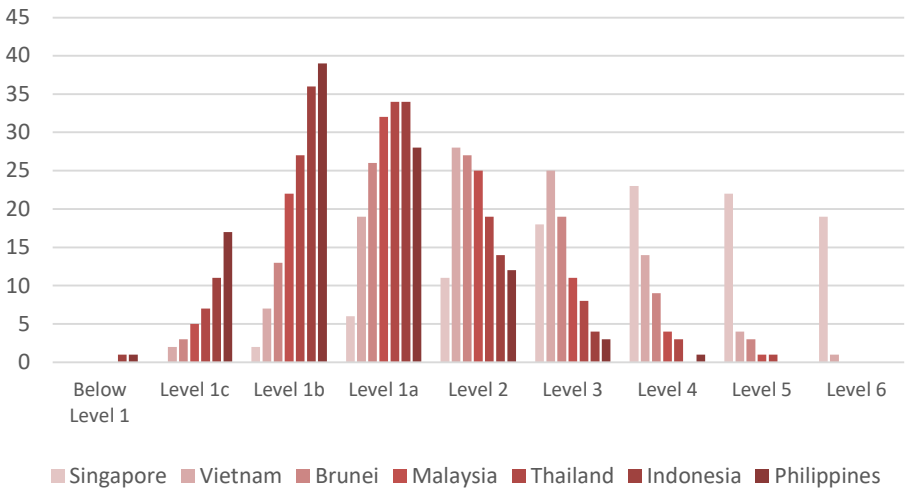

Figure 4: Mathematics proficiency levels of students across ASEAN countries in PISA 2022 (Data: OECD, 2023)

Based on the proficiency standard of OECD (2023), 15-year-old students who scored below Level 2 in the PISA mathematics assessment were regarded as low achievers. The United Nations' Sustainable Development Goals, which were launched in 2015, set a target whereby all teenagers worldwide should be able to achieve at least Level 2 in mathematics by the end of lower secondary education (United Nations, 2024). If they fail to do so, it becomes very challenging for them, whether in their further studies or competing in the workplace, both of which require some basic mathematics skills.

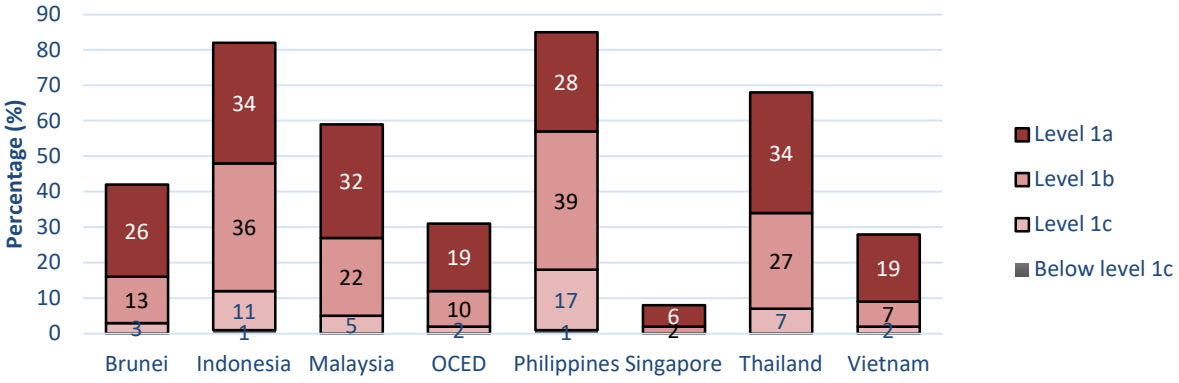

Figure 5: Percentage of students below basic proficiency levels across ASEAN countries in PISA 2022 (Data: OECD, 2023)

In PISA, students who score below Level 2 typically struggle to design simple problem-solving strategies (OECD, 2023). Such problem-solving strategies involve tasks like running direct simulations with one variable, extracting key information from one or more sources that use slightly more complex modes of representation, such as two-way tables and charts or two-dimensional representations of three-dimensional objects; understanding basic functional relationships and simple ratios; and making direct interpretations of results (OECD, 2023).

To illustrate how alarming this issue is, Figure 5 provides a closer view of the percentage of students who performed below the basic proficiency levels in ASEAN countries. Most ASEAN countries, such as Malaysia, Thailand, Indonesia, and the Philippines, struggle with higher percentages of students not meeting these standards. In particular, Malaysia is in a very alarming position where 59% of students cannot even achieve minimum proficiency levels, a situation that has worsened by 17% since 2018 (OECD, 2019). Compared with Indonesia, Thailand, and the Philippines, Malaysia has the largest increase in PISA from 2018 to 2022. On the contrary, only 8% of Singapore's students and 28% of Vietnam's students perform below this proficiency level. An important point is that although Vietnam has a lower GDP (gross domestic product) per capita than Malaysia, it has 31% fewer students falling below basic proficiency.

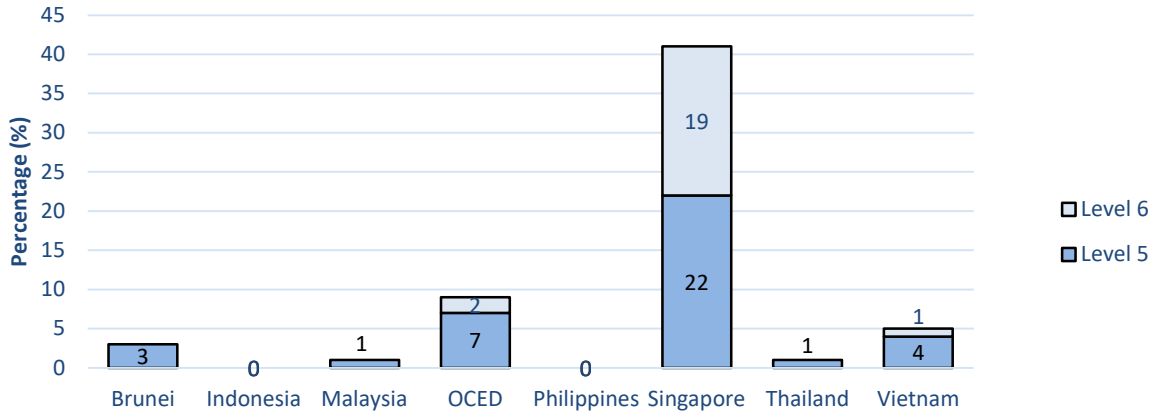

Figure 6: Percentage of students with high PISA mathematics proficiency levels across ASEAN countries in 2022 (Data: OECD, 2023)

In addition, Figure 6 shows the percentage of students in ASEAN countries that achieved high mathematics proficiency levels (Levels 5 and 6) in the PISA assessment. Singapore had 41% of its

students at these levels. This indicates that Singapore has far more top performers (Level 5 or 6) than the international average of 9%. On the contrary, the rest of the ASEAN countries, especially Malaysia, Indonesia, Thailand, and the Philippines, scored far below the OECD average, with very few students being able to achieve a high level of proficiency. Only 1% of Malaysian students achieved Level 5, and none achieved Level 6. This implies that there could be serious issues within Malaysia's educational system that prevent the development of highly skilled students. In the long run, if these issues remain unresolved, a shortage of highly skilled workers in Malaysia will ensue. This will then force Malaysia to rely on expatriates from other countries.

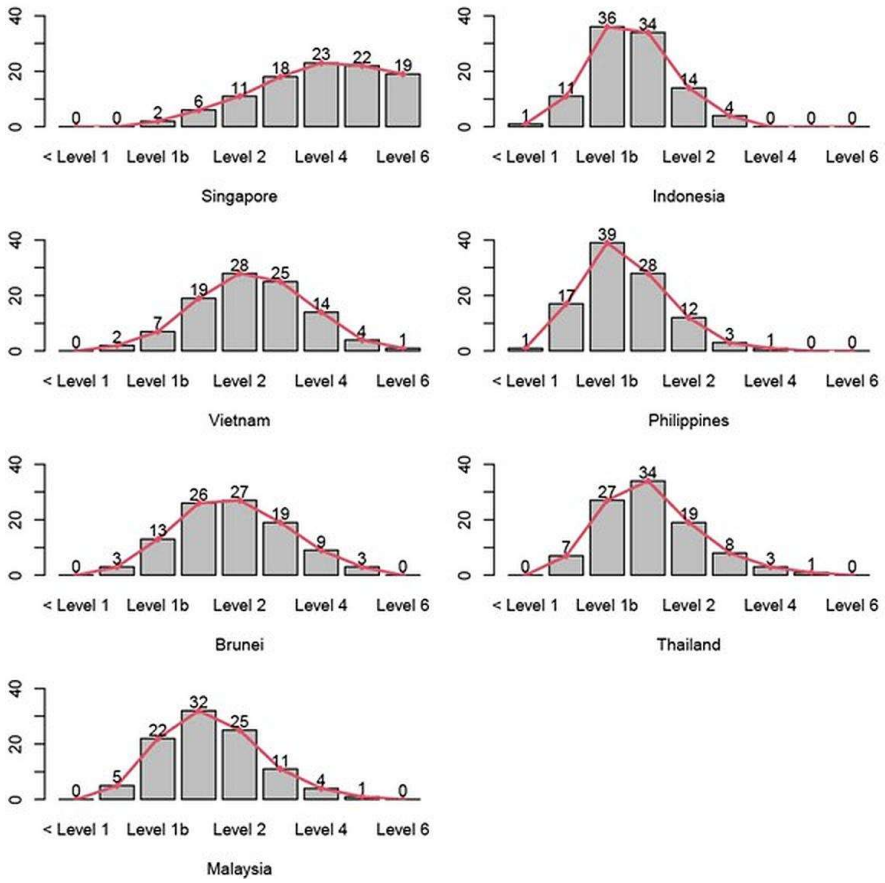

Figure 7: Distribution of PISA 2022 Mathematics Proficiency Levels in ASEAN countries. (Data: OECD, 2023)

Figure 7 shows the percentage of students at each proficiency level, ranging from 'below level 1' to 'level 6', for each of the ASEAN countries that participated in PISA 2022. In Figure 7, it can be

observed that the distribution of students in Singapore is positively skewed. This means that most students are highly proficient in mathematics. In comparison, Vietnam and Brunei have a distribution pattern that is close to a normal curve. This indicates that most students in these two ASEAN countries have basic mathematics proficiency.

On the contrary, Figure 7 shows that other participating ASEAN countries, such as Malaysia, Indonesia, Thailand, and the Philippines, have left-skewed distributions, with most of their students below the basic proficiency level. This suggests that most students in these countries struggle in mastering basic mathematics skills. Hence, these ASEAN countries should place greater emphasis on enhancing fundemental improvements in mathematics education. As more students move up from the lowest levels, their distributions will gradually shift to the right, approaching a more normal distribution. This trend sets a more realistic goal for these ASEAN countries to accomplish in the near future.

Focusing on Malaysia in particular, Figure 7 reveals that 59% of students were below the proficiency level; 25% had basic proficiency in mathematics; 15% had intermediate proficiency; and 1% had high proficiency in the PISA 2022 mathematics assessment. Hence, other than ensuring low-performing students master basic mathematics, supporting other groups of students with different abilities and learning needs is important. This is to ensure that each students receives equal opportunities to improve their mathematical skills.

Improving Mathematics Proficiency in Malaysia: Strategies and Best Practices

Malaysia has been spending many efforts to improve its mathematics performance in international assessments. Despite not achieving the desired outcomes to rank in the top third quarter of countries in international assessment, Malaysia continues to improve its educational system. To strengthen these initiatives, Malaysia could benefit from implementing some of the best practices used in Singapore's curriculum. For instance, the study proposes a subject-based banding system for secondary schools in Singapore. In this system, all the students are grouped into subject classes, namely G1, G2, and G3, based on their Primary School Leaving Examination (PSLE) results. As shown in Figure 5, there is a diverse range of students' abilities within a classroom. With thorough research, Malaysia may consider implementing this approach. In this approach, students are free to select subject levels based on their weaknesses as well as their abilities. Aside from that, they have the freedom to adjust their subject levels based on their development during their lower secondary school years. This new system offers a more flexible learning environment for students of all levels, allowing them to improve their mathematics at their own pace.

In addition, another key strategy to enhance Malaysia's mathematics performance at the international level is the continuous improvement of teacher professional development programs. The existing issues with the ineffectiveness of CPD in Malaysia include the lack of teachers' voice content, impractical knowledge, inadequate trainers, and insufficient time for practice (Osman et al., 2023). Malaysia can elevate its teacher professional development program by adopting effective policies from the Singapore SFEd roadmap and the World Bank teacher development roadmap. For instance, Malaysia can implement similar teacher professional development plans as those recommended in the Singapore SFEd roadmap. This roadmap strives to personalise professional development programs so that they are relevant to the needs of every teacher.

By looking at the results in Figure 7, we can see that the Malaysia mathematics proficiency level distribution was skewed to the right. The results indicate that Malaysia has more students who require foundational mathematics skills than those with higher proficiency skills.

The price and fuel consumption of four cars that Tania is considering purchasing are shown in the table below.
Fuel consumption is the number of litres of fuel needed to drive 100 kilometres. It is an estimate based on a combination of city and highway driving.

	Car A	Car B	Car C	Car D
Car Price (zeds) **Car price includes all taxes and registration fees**	8000	8700	9900	10500
Fuel Consumption (L/100km)	18.9	15.7	12.4	14.1

Some of the cells in the Cost Estimator have been filled in based on Tania's estimates.

Use the Cost Estimator to help you answer the question below.
To see how to use the Cost Estimator, click on "How to Use the Cost Estimator" above.
Based on Tania's estimates, which car would cost her the least to purchase and drive on the first year?

A. Car A
B. Car B
C. Car C
D. Car D

Figure 8: Sample of a PISA Level 2 online question. (Source: OECD, 2023)

Hence, Malaysia policymakers can consider adopting the World Bank 2023 teacher development roadmap, which aims to reduce literacy and numeracy rates in the middle- to low-income countries in East Asia and the Pacific region. This roadmap provides Malaysia with guidelines for evidence-based teacher training programs proven to improve foundational mathematics skills in low-performing students. Through consistent improvement in teacher training programs, it is believed to improve students' mathematics performance at the international level eventually. The success of teacher training programs also depends on the teachers' commitment, not following the teacher training programs as a formality to fulfil the minimum credit hours of CPD.

As we can see from the Malaysian education blueprint for 2013–2025, Malaysia strives to elevate its mathematics and science achievement to rank within the top third quarter of countries in international comparative studies. To intensify the effectiveness of these initiatives, Malaysia should put more effort into developing and incorporating PISA-released items in classroom practices and the national assessment model. Understanding the structure of the questions set for each proficiency level of PISA will also help to better determine where students face difficulties and how to help them improve their inadequacies. Figure 8 is an example of a PISA Level 2 online question.

This question reflects a real-life situation that a student might face when making a major decision in adulthood. This is a direct question and does not require any mathematical formula because a cost estimator is provided with the question. Students only need to insert the car price and fuel consumption for each of the four cars into the provided cost estimator to determine which car has the lowest price in the first year. If they are unsure how to use the cost estimator, they can find instructions by clicking on the "How to use the Cost Estimator" link with the online question.

Although this question is simple, some students may struggle because they are unfamiliar with using the cost estimator provided. Based on Figure 5, 59% of Malaysian students cannot answer this question. This typically occurs in students who have learned mathematics, mainly through paper-based practices. Some students may find the problem challenging because they are unfamiliar with lengthy problem-solving questions. This will likely happen when their mathematics learning is mainly focused on repetitive drill questions. Hence, instead of relying on paper-based practices, teachers can include more hands-on exercises related to real-life situations in mathematics classes. For example, they can simulate the car buying process as a mathematics activity. This will allow students to role-play while discovering how to calculate fuel consumption

and car prices. In addition, teachers can provide similar online cost estimators, and teach students how to input data and interpret it to boost their confidence in using these tools effectively.

Mara's family is moving. They can choose from two sizes of moving trucks to rent. The interior storage-compartment dimensions of the trucks are shown in the table below. All walls and the floor of the storage compartment of the trucks are rectangles.

Truck Size	Length of Floor	Width of Floor	Height
A	4 metres	2 metres	2 metres
B	6.6 metres	2.3 metres	2.3 metres

There are three different sizes of boxes available. The dimensions of these boxes are shown in the table below.

Box Size	Length	Width	Height
Small	0.4 metre	0.3 metre	0.3 metre
Medium	0.5 metre	0.5 metre	0.5 metre

Mara's family decides to rent truck A. What is the greatest number of medium boxes that could fit into truck A?

A. 320
B. 128
C. 26
D. 16

Figure 9: Sample of a PISA Level 2 online question. (Source: OECD, 2023)

The example shown in Figure 9 is also a Level 2 question. This question simulates a real-life scenario of moving house. It requires students to calculate the maximum number of medium-sized boxes Truck A can carry. Since all the boxes are the same size, students do not need to consider various box arrangements within the truck. For this question, students only need to use simple mathematical skills such as multiplication, division, and volume calculation. At the same time, they must also know how to convert between units of length. By applying these basic skills to the operation $(4\times2\times2)\div(0.5\times0.5\times0.5)$, it provides an answer of 128.

However, some students may find this question challenging if they have trouble visualising how to fit those medium-sized boxes inside the truck. This group of students still lacks a skill known as spatial visualisation, which is the ability to imagine objects in three dimensions. To help with this, teachers can use more manipulatives, such as blocks or models, when teaching volume topics. If the school is well-equipped with technology, teachers can also help students learn spatial visualisation with 3D models virtually. Improving students' spatial visualisation is essential not only for success

in mathematics literacy but also for preparing children for successful adulthood (Gilligan-Lee et al., 2022; Sorby & Panther, 2020). However, many teachers find it challenging to effectively use spatial visualisation tools in the classroom that truly benefit students. Potential barriers such as teacher preparedness and ICT infrastructure readiness must be addressed carefully.

The prices and fuel consumption of four cars that Tania is considering purchasing are shown in the table below.
Fuel consumption is the number of liters of fuel needed to drive 100 kilometers. It is an estimate based on a combination of city and highway driving.

	Car A	Car B	Car C	Car D
Car Price (zeds) **Car price includes all taxes and registration fees**	8000	8700	9900	10500
Fuel Consumption (L/100km)	18.9	15.7	12.4	14.1

A car's resale price is the estimated price for which it can be resold at a later time. For a car that stays in excellent condition, its resale price will decrease by 5% each year.
Tania decides to buy car D and resell it after three years in excellent condition, what will be the approximate resale price of the car in zeds?

A. 1575
B. 8925
C. 9000
D. 9975

Figure 10: Sample of a PISA Level 6 question. (Source: OECD, 2023)

After exploring the basic proficiency level questions, we next examined a high proficiency level question. Example 3 is a multiple-choice question about car purchases that comes subsequently after Example 1. Based on Figure 6, only 1% of Malaysian students could answer this question. In this high-level question, students are not given mathematical formulas to solve the problem. They are required to analyse the problem and decide on a formula based on their existing knowledge. These critical thinking and problem-solving skills are necessary for students to make major decisions throughout their lives.

To solve this question, students should first decide on a process to estimate the car's value after three years. While some students may use an exponential decay formula like $10500\times(0.95)^3$, others unfamiliar with the formula can still solve this problem with an iterative process. The iterative method is carried out by subtracting 5% from the original car price (RM 10,500) to obtain RM 9,975 and repeating this calculation using the car's latest value each subsequent year. The key idea

of the iterative method is to understand that they must always use the car's latest value for each new calculation. After three years with a depreciation of 5% annually, the car price would be approximately RM 9002.44 zeds. Hence, the closest correct answer to this question is 9000.

CONCLUSION

The main issue discussed in this study is the continuous decline in Malaysia's PISA mathematics results. Although some ASEAN countries are experiencing a decline in their PISA results, it is not as severe as the decrease in Malaysia. The percentage of Malaysian students who are below the basic proficiency level has increased from 41% to 59%. At the same time, the percentage of students who achieved high proficiency also decreased to 1%. In addition, PISA indicators also show that Malaysia is three years behind Vietnam and eight years behind Singapore in mathematics educational attainment.

From the comparative analysis of Malaysia's PISA results with those of other ASEAN countries, this study has identified a common regional issue affecting Malaysia as well as Thailand, Indonesia, and the Philippines. The results show a skewed distribution of PISA proficiency to the right in all countries. This indicates that a large proportion of students did not achieve basic proficiency levels, whereas only a small number achieved high proficiency levels.

This study proposes several strategies and best practices to improve the outcomes. First, countries with a high proportion of students below basic proficiency should put more effort into improving student's foundational skills in mathematics. At the same time, students with higher abilities should be given equal opportunities to improve their mathematical skills. This study suggests adopting Singapore's subject-based banding system for a more flexible learning environment for all students of all levels. By implementing this system, high-achieving students can learn more advanced content while low-achieving students can enhance their mathematics basic skills before moving to higher-level concepts. The results also revealed that students who scored below the basic proficiency level struggled to design simple problem-solving strategies. This highlights the need to develop and incorporate PISA-released items into classroom practices and the national assessment model. Ongoing professional teacher training is necessary to prepare teachers for the above strategies. This study suggests continuously improving teacher professional development by adopting effective policies from the Singapore SFEd roadmap and the World Bank teacher development roadmap.

Although the study used well-validated PISA data, it could provide richer information with triangulation. Future researchers could consider adding extra data sources from national

examinations, teacher assessments, or interviews with students and teachers. They could also extend this study by conducting an in-depth analysis of the problems faced by students when solving PISA questions at different proficiency levels. In addition, the proposed strategies in this study need to be validated for their implementation and effectiveness in Malaysia's educational context.

Thus, the declining trend in Malaysia's PISA mathematics scores is a pressing concern that requires immediate action. It is only through strong collaboration among all parties that the quality of mathematics proficiency in Malaysia can be improved. If we commit ourselves to the goal of turning Malaysia into the top third of countries in international comparative studies, it is an achievable goal.

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