

## Malaysian Education Plan 2013-2025: Transformation on Science Classroom towards Student's Achievement in TIMSS and PISA

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**Abstract:** Malaysian Education Plan 2013-2025 has outlined strategic planning with aim to raise Malaysian education standard to be at par to international standard. To measure the quality of the transformation of Malaysian Education System and comparable internationally, performance of Malaysian students in TIMSS and PISA were used. Many have raised questions on Malaysian student's performance in both international assessments especially in the latest assessments where Malaysian student's performance was far from convincing. Therefore this study was aimed to investigate is there any transformation occur in science learning towards student's achievement in TIMSS and PISA. This research used qualitative approach where the data were collected through three methods which were interviews, observations and also document analysis. From the findings, the teachers agreed that TIMSS and PISA did affect teaching and learning in science classroom especially on the use of set induction. They also revealed improvements in science classroom especially on the integration of higher order thinking skills and the approach of science teacher in classroom. The study also highlighted the importance of using students centered learning in science classroom.

**Key words:** Assessment, teaching and learning, science classroom, PISA, TIMSS

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### INTRODUCTION

Malaysia towards becoming a developed nation in year 2020 has put education as one of the major forces to spur the country towards that objective. The new National Education Blueprint has outlined strategic priorities to achieve this and has transformed the national education towards holistic system that focuses on changing the traditional teacher-centered learning to a more immersive and interactive learning. As the Preliminary Blueprint Report has identified that success of an education system depended on what students know, understand and able to do and it is not enough for our students to just master the content of the knowledge but they must be able to creatively apply the knowledge into unfamiliar problems.

Program for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS) have the tools to measure such skills and are comparable internationally. This new Malaysian Education Plan 2013-2025 also aspire Malaysia to be in the top third of countries in term of performance in internal assessments as measured by outcomes in TIMSS and PISA in the space of 15 year.

There are many factors that could contribute towards the student's performance such as their effort, school facilities and many more. However, there is one factor that plays a bigger role towards the student's performance than the other factors which is teachers (Ismail *et al.*, 2015). Effective teachers would bring a transformative power towards the student's performance as effective teachers has a direct influence in enhancing student's performance (Tucker and Strong, 2005).

To be an effective, a teacher needs to master the subject matter and good pedagogy skill to enable the teacher to deliver the content effectively. Besides, it will help students to have better understanding and to avoid from having misconception. Having both skills mentioned probably will not sufficient to be claimed as an effective teacher. In fact, an effective teacher needs to have the Pedagogical Content Knowledge (PCK). PCK involves combination of both subject matter and pedagogy. Knowing what teaching skills that fit the subject matter to be taught and also the ability to determine how the subject matter could be arranged for a better teaching strategy.

Since, TIMSS and PISA are essentially new to our education system, our teachers have been trained to

effectively teach our students to succeed in our national assessments. However, there is no specific training provided to teachers regarding TIMSS and PISA and all its assessment tools. To make it worse, TIMSS and PISA assessed our students from different point of view. This causes challenge on science teacher's ability in subject matter, pedagogy and pedagogical content knowledge to prepare the students for TIMSS and PISA. In another word are the teachers ready to teach students effectively so that students could perform in TIMSS and PISA? The objective of this study is to investigate the changes that occur in science classroom towards student's performance in TIMSS and PISA. The stated objectives that accompanied the study are:

- To determine the effects of TIMSS and PISA towards teaching and learning in science classroom
- To investigate how TIMSS and PISA can improve teaching and learning in science classroom
- To determine what is the best method of teaching for students to perform in TIMSS and PISA

**Literature review:** In October 2011, the Ministry of Education launched a comprehensive review of the education system in Malaysia in order to develop a new National Education Blueprint. This decision was made with the aim to raise Malaysian education standard to be at par to international standards, the government's aspiration of better preparing Malaysia's children for the needs of the 21st century and increase public and parental expectations of education policy. The result is a preliminary blueprint that evaluates the performance of Malaysia's education system against historical starting points and international benchmarks. The blueprint also offers a vision of the education system and students that Malaysia both needs and deserves and suggests eleven strategic and operational shifts that would be required to achieve that vision. The Ministry hopes that this effort will inform the national discussion on how to fundamentally transform the Malaysia education system to be in the top third of countries in term of performance in international assessments.

**International assessments:** Malaysia has decided to take part in international assessments two decades ago as a way to ensure our competitiveness in the world stage.

**TIMSS:** Since 1999, Malaysia has participated in an international education assessment called TIMSS. TIMSS which stands for Trends in International Mathematics and Science Study (TIMSS) is used to measure the student's achievements in mathematics and science for year 4 and

form 2. The assessment has been running since the 1995. In 2011, <60 countries all around the world have taken part involving <500000 students. The assessment measured the student's performance in two aspects; content such as algebra and geometry and cognitive skills such as knowing, applying and reasoning. For the first involvement in TIMSS, Malaysia scored 519 points in Mathematics and was ranked at 16th from 28 countries that took part. So, it was above the international average but the score was still way beyond our closest neighbour, Singapore who scored a whopping 604 points for Mathematics and was ranked at 1st position. For science assessment, Malaysia scored 492 points which was also above the international average and was ranked at 22nd position.

For the second assessment in 2003, Malaysia's performance in term of ranking did increase even though the score declined. For Mathematics, Malaysia scored 508 points which was still above the international average while climbed into 10th position out of 45 countries. For science assessment, our students scored 510 points; 18 points of increase compared to the last assessment and climbed the ranking up to 20th position. The controversial moment occurred in 2007 when Malaysia performance in TIMSS was so bad and fell down below the international level. The score for Mathematics fell to 474 points and ranked at 20th from 48 countries while science fell to 471 and was ranked at 21st from 48 countries. However, the biggest concern from the result was not the ranking or points but analysis on the student's performance. Almost 20% of our students failed to achieve the minimum benchmarks in both Mathematics and science.

From the analysis, Malaysian students have failed to use the knowledge they have acquired in problem solving questions. They have shown that they understood the basic concept of Mathematics and science but lacked in term of applying the concept into real life situation.

The report also acknowledged that only 2-3% of our students managed to succeed at the highest level which involves complex-problem solving. This numbers was far too low in comparison to our nearest neighbour, Singapore where >30% of their students involved in TIMSS scored at the highest benchmark level.

So, the problem lies in the second part of the assessment, cognitive part. TIMSS assesses the student's ability in cognitive skills from three different areas which are knowledge recall, the application of knowledge in solving problem and the ability to reason in working through problems. Our students failed to perform in all three areas. In the preliminary report published by the Ministry of Education, three factors have been thought to be the main factors behind the declining

performance of our students in the year 2007. First factor was on the incomplete coverage of the concepts tested in TIMSS. However, this factor according to the report does not cause any major effect towards the student's performance as only 10% of the syllabus tested was not covered. The second factor being discussed was the language used. Since TIMSS used both English and Malay language in their assessment, this factor also has been put aside. The third factor was the sampling distribution which also cannot be taken into account as the sample was spontaneously distributed.

**PISA:** Another international assessment participated by Malaysia is called PISA which stands for Program for International Student Assessment. This assessment measured form 3 students in three components which are reading, mathematics and science literacy. Other than the three components, this assessment also measures general or cross-curricular competencies such as problem solving as this assessment emphasizes on functional skills that the students have learned from school.

The first assessment was conducted in the year of 2000 and the assessment is run every 3 years. The most recent assessment was in 2015. Malaysia first involvement in PISA was in 2009 and the result was not admirable either. Malaysia was ranked in the bottom third for all three components out of 74 countries participated. From the preliminary, Malaysia's performance in PISA in 2009 was far lower than other regional countries; at least 100 points lower than Singapore, Japan and Hong Kong.

In this assessment, they measured that a 38 point means a year of schooling. If country A scored 38 points higher than country B, it means that country A have an extra year of school. In case of our country that scored at least 100 points less than the other regional country, it means that our 15 year old students performed like they have less of 3 year of schooling than the 15 years old from the regional country. Less year of schooling could be seen as having less knowledge. Further breakdown into Malaysia's performance in PISA, it was discovered that almost 60% of students failed to achieve the minimum benchmarks in Mathematics where in PISA. The benchmark represents the minimum proficiency to effectively and productively participate in daily life situation. While for reading and science components, 44% and 43% also failed to achieve the minimum level of proficiency. To make it worse, not <1% (0.1% to be exact) managed to achieve the highest level performance.

**Higher order thinking skills:** TIMSS and PISA, the questions in both assessments are more on Higher order

Thinking Skills (HOTS) type of questions. HOTS defined as a level higher than just memorizing information (Thomas and Torne, 2009). HOTS require someone to understand the information and able to connect the information with other facts and concepts. The person with HOTS ability must be able to categorize, manipulate and apply the information that they have in order to solve unfamiliar problems.

In TIMSS and PISA, the assessments have the tools to measure the students thinking skills. In contrast, our education system's assessments only focus on content-based assessments with limited higher order thinking skills. This was evident in the Preliminary Blueprint report published by the Ministry of Education. In 2007, the same students took both examinations; PMR as Malaysia national education assessments and TIMSS as the international assessments. From the result of both examinations, it could be seen that there was a big gap in term of the student's performance even though both assessments were taken by the same students. From the 30% which succeed with flying colours in PMR, only 2% managed to achieve the advanced level in TIMSS. The reason for this steep difference according to the report was due to the differences in testing tools. TIMSS focuses more on higher order thinking skills questions such as application and problem solving while PMR focuses only on content knowledge.

## **MATERIALS AND METHODS**

For this specific study, a qualitative approach is used whereby data were gathered through interviews and supported by document analysis of Education Report and Education Blueprint produced by Ministry of Education. It is considered appropriate as the information and rich data could be acquired to specifically answer the objective stated. A set of guidelines on what to ask the respondents was prepared prior to the interviews. The study used purposive sampling. The target population was secondary science teachers who are directly or indirectly involved with TIMSS and PISA assessments in the state of Selangor. Twenty three science teachers agreed to participate. All interviews were tape recorded and for the analysis purposes, it later being transcribed according to specific themes that correspond to the objectives of the study.

## **RESULTS AND DISCUSSION**

The discussion focuses on the following) the effects of TIMSS and PISA towards teaching and learning in

science classroom) the improvement in teaching and learning in science classroom) the suitable methods of teaching for students to perform in TIMSS and PISA.

With regards to effects towards teaching and learning in science classroom, it was found that majority of teachers realized the introduction of TIMSS and PISA does bring impacts on teaching and learning. Most of them responded the teachers need to come out with good lesson plan and should put more emphasized on set induction at beginning of the lesson. They highlighted, the good set induction prepared by teachers will motivate students to focus on the lesson that will be taught and also stimulates student's thinking:

“Set induction will make them use their critical thinking to relate the concept highlighted”  
Teacher 3

“Having a good set induction will motivate students to develop interest in that specific lesson” Teacher 12 “when the teachers having a good set induction, it's quite easier for teachers to attract student's attention and when we managed to grab student's attention, it's quite easier for us to teach the students and sustain their attention” Teacher 6

It is important to have set induction for the students in order to attract their attention before the lesson starts so that they can concentrate during the lesson (Shahran, 2013). One study found out those students who are familiar with set induction score higher marks in his research compared to students who are not given set induction (Schuck, 1969).

Besides, there are also respondents highlighted that previously, some teachers tend to skip the set induction and straight to teach students. This indirectly gives impacts not only to the students but also to the teachers:

“Some teachers tend to skip the set induction and even some of them not understand the purpose of having set induction” Teacher 8

“When they not doing the set induction, the students thinking will not be stimulated towards the lesson that going to be taught and students tend to do their own works rather than focusing on lesson, thus, the outcomes will not be achieved” Teacher 21

Apart from that, the respondents also highlighted the integration of technology in the lesson by teachers increase gradually:

“TIMSS and PISA more focusing on critical thinking elements, teachers will use internet sources to find the relevant software that can help in teaching and learning” Teacher 2

“The use of technology nowadays can be said as compulsory for science teachers. We need to find the latest news on science, besides lots of free platform on Web 2.0 can be utilized by teachers in their lesson” Teacher 7

Since, TIMSS and PISA emphasize more on application and real life situation questions, the use of technology would be really useful. Internet contains a lot of useful information such as facts and videos where teachers could use it as their teaching aid. Teachers could not rely solely on textbook nowadays as the syllabus and information in textbook are only revised once in a several years. Interesting activities, fun facts and beautiful videos from the internet would easily capture their attention and make a successful set induction. The integration of technology can be considered as vital to the new generation which could bring a lot of positive impacts<sup>9</sup>. This can lead students to develop their critical thinking since it involves lots of hands on activities to be conducted. One of the benefits of hands-on activities in teaching science for students is that it would increase independent thinking, perception and creativity which are one of the objectives of the MEP 2013 (Haury and Rillero, 1994).

With respect to the improvement in science teaching and learning, all respondents unanimously agreed that introduction to TIMSS and PISA give impact on science classroom. Most of them highlighted the use of higher order thinking skills (HOTS) will directly help to develop student's thinking skills and apply the knowledge learned into real life situation. Thus, teachers approach in science classroom has totally changed:

“The use of HOTS questions in teaching and learning will make them to think out of the box and integrate knowledge that they have learned into real life situation” Teacher 11

“Our approach should be different since TIMSS and PISA more focusing on HOTS elements, thus we need to be more creative in conducting the classroom” Teacher 16

“We cannot depend solely on textbooks; we need to think what kind of activities that they can apply the theories learned into real life situation” Teacher 19

Teachers need to vary their teaching method and more focusing on current issues so that it would trigger the student's thinking ability. There is a study mentioned the change of teacher's approach as a good thing for teachers themselves and also for the students (McKinney, 2013). The excitement of students obtained when the researcher changed his approach to text-independent teacher whereby his students have been more engaging towards his teaching.

Introduction of TIMSS and PISA would help to polish the student's thinking ability as the questions asked in TIMSS and PISA concentrate on problem solving questions. Before the introduction of TIMSS and PISA, teachers and students focus was merely on memorizing all the theories and facts as our examination system focused more on subject matter. As highlighted, Malaysia examination system has led students to memorizing facts rather than understanding it. Finally, most of the respondents also highlighted some approaches that can be used for the better performance in TIMSS and PISA:

"Inquiry based require students to explore and think on that specific problem, thus will develop student's thinking skills" Teacher 16

"Inquiry based learning and problem based learning are the best approaches to be used in science classroom nowadays because it requires students to use HOTS element in specific lesson" Teacher 19

"The use of this approach (inquiry based learning) will make students more appreciate in the lesson since it involves students 100% to participate in discussion" Teacher 20

"Problem based learning or constructivism approach can be used since it is more on students centered and it inculcates students to be more participate in the lesson" Teacher 7

"Students centered will require application in daily life situation and the students can integrate theories they learned into practices. Example of students centered approach likes inquiry based learning, problem based learning" Teacher 9

"Teacher should consider new approach in science teaching where it should be based on students centered and also the teaching material use need to integrate daily life situation" Teacher 8

Inquiry method encourages students to develop their own conclusion from the data that they have analyzed (Minner *et al.*, 2009). Besides, it emphasizes on higher order thinking skills which is the main element in TIMSS and PISA assessments. This would help to develop student's thinking skill rather than they blindly processed the information given by the teacher. Student centered approach, i.e., inquiry based learning or problem based learning allow students to integrate real life situations into the lesson. This helps to increase student's understanding and stimulate them to think outside of the box. When more and more of real life example are given to students, it would indirectly increase the student's understanding on knowledge application thus will lead students to perform well in TIMSS and PISA. One article that being published, discussed on the categories of cognitive domain where it is one of the elements emphasized in teaching higher order thinking skills (Collin, 2014). By having this, the students probably have much higher percentage to perform in TIMSS and PISA. The teaching materials must involve daily life situations as an example and the current textbook rarely contains it. Most of the items in the textbook were merely facts and theory.

## CONCLUSION

From the study, the respondents realized that TIMSS and PISA does bring positive effects on teaching and learning. Science teachers need to be better prepared in term of planning of the specific lesson besides need also to be more creative for set induction at beginning of the lesson. This will stimulates student's thinking and motivate them to be more interested on that specific lesson in science. Apart from that, the use of technology also can be one of the teaching materials that science teachers can integrate in the lesson. Most of the respondents also highlighted the improvement in teaching and learning in science classroom after the introduction of TIMSS and PISA in term of the use of Higher Order Thinking Skills (HOTS) that directly help students to develop their thinking skills and apply the knowledge learned into real life situation. Thus, teachers approach in science classroom has totally changed. Student centered approach, i.e., inquiry based learning and problem based learning are the best approach that can be used by science teachers for better performance in TIMSS and PISA since it involves students to participate more in the lesson thus lead them to have meaningful learning not just memorizing the facts and theories given by textbooks.

**REFERENCES**

- Collins, R., 2014. Skills for the 21st century: Teaching higher-order thinking. *Curriculum Leadersh. J.*, Vol. 12,
- Haury, D.L. and P. Rillero, 1994. *Perspectives of Hands: On Science Teaching*. ERIC Publications, Washington, USA.,
- Ismail, M.H., N.S. Syarifuddin, M.F.M. Salleh and N. Abdullah, 2015. School based assessment: Science teachers issues and effect on its implementation. *Adv. Sci. Lett.*, 21: 2483-2487.
- McKinney, R., 2013. Moving beyond the textbook: Closing the book on the textbook-dependent classroom. The Whole Child Center, Oradell, New Jersey. <http://www.wholechilddeducation.org/blog/moving-beyond-the-textbook>.
- Minner, D.D., A.J. Levy and J. Century, 2009. Inquiry-based science instruction: What is it and does it matter? Results from a research synthesis years 1984 to 2002. *J. Res. Sci. Teach.*, 47: 474-496.
- Schuck, R.F., 1969. The effects of set induction upon pupil achievement, retention and assessment of effective teaching in a unit on expiration in the BSCS curricula. *Educ. Leadersh.*, 2: 785-793.
- Shahran, M.F.M., 2013. Leaving behind exam-oriented system. Star Media Group Berhad, Petaling Jaya, Malaysia. <http://www.thestar.com.my/opinion/columnists/ikim-views/2013/10/29/leaving-behind-exam-oriented-system/>
- Thomas, A. and H. Thorne, 2009. How to increase higher level thinking. The Center for Development and Learning, Metairie, Louisiana. <http://www.cdl.org/articles/how-to-increase-high-order-thinking/>
- Tucker, P.D. and J.H. Stronge, 2005. *Linking Teacher Evaluation and Student Learning*. ASCD Publisher, Alexandria, Virginia, ISBN:1-4166-0248-8, Pages: 175.