PERSIDANGAN MEJA BULAT 4 PPSMI
(PENGAJARAN SAINS DAN MATEMATIK DALAM BAHASA INGGERIS)

ANJURAN: KEMENTERIAN PELAJARAN MALAYSIA:
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The Scenario

The Teaching and Learning of Science and Mathematics in English or PPSMI is now being seriously debated by academicians, representatives of the non-governmental organizations (NGOs), policy makers and the public at large. Central to the discussion is the use of English as a medium of instruction in the teaching of science and math at both the primary schools and secondary schools in Malaysia. The issue is whether PPSMI, which was implemented in January 2003, has improved not only the English proficiency among pupils but most importantly the learning and the achievement level of science and math. At stake now is whether PPSMI should be allowed to continue in its present format, terminated or changed to a different more receptive and acceptable format.

The PPSMI debate began when the findings of an impact assessment report on the use of English for the Teaching and Learning of Math and Science at primary schools were made public by researchers at Universiti Perguruan Sultan Idris (UPSI). Primarily, the researchers published a volume of statistical information on the survey and tests that the researchers did on 68 primary schools from February 2007 to January 2008. One thousand five hundred and sixty four Year 5 pupils participated in Feb 2007, 636 Year 5 pupils in July 2007 and 1,703 Year 5 pupils in Jan 2008. The findings and the conclusion had prompted many quarters to voice their views on the PPSMI. I take this opportunity to comment on the conclusion of the study and to offer an alternative view from the perspective of a public university educator.

Even though the results from the study did not scientifically show that the use of English as a medium of instruction in Science and Math led to low achievement of science and math for the Year 5 pupils, the authors of the study led by Prof. Ishak Haron, an emeritus professor, claimed that PPSMI has failed to achieve its purpose and hence a reversal of the policy must be made. The call for a reversal in the PPSMI policy as was reported by local media is strongly supported by a few politicians, prominent academicians and NGOs. As a practicing science educator who has indulged in science and physics education research and who is actively involved in the training of using active learning strategies to science and physics educators locally and internationally for the past 16 years, I strongly disagree with both the conclusion of the findings and the call for a reversal of the PPSMI policy.

I argue that the arguments given in the study are invalid because the research design is flawed and that the authors of the study were making plenty of conjectures (unfounded claims) in arriving at their call for a reversal of the PPSMI policy.

Flaws of the Research Design

The research employed by the study is a descriptive research which means that the study did not offer any kind of hypothesis that can be tested or falsified. The second part of the study tried to establish a correlation between mean scores of science and math test with the frequencies (percentage) obtained from surveys on PPSMI practices. For the benefit of the reader, descriptive research employs the use of surveys and questionnaires to systematically observe and record data without manipulation of the observed phenomenon. On the other hand, correlational research is done to identify apparent relationships between two variables or factors. Although the authors did not mention the two types of research methods they are employing in their methodology section but readers are reminded of the two types of research method which is typical in social sciences. Using questionnaires, the researchers at UPSI were observing the percentages of teachers using English in teaching science and math, the percentages of students who are able to *"follow"* the teaching and the percentages of students who *"understand"* teachers who teach science and math in English.

Unfortunately, knowing the percentage of teachers using English only or using a mixture of English and Bahasa Malaysia (BM) in their teaching, will not, in any way, be correlated to either achievement of pupils in science and math or the increase in English proficiency among pupils after 4 years of PPSMI. However, it does give the reader a quantitative picture of the comfort level of teachers or the lack of and the concern of teachers on students' *"uneasiness"* during the classroom learning activities.

My concern with the authors' choice on the concept of *"easy to learn"*, *"hard to learn"* and *"understand"* is that none of the concepts are behaviorally measurable and the authors never operationally define the concepts in their methodology. Since *"easy"* and *"hard"* are relative and the reference point is not defined, the term "*easy*" for one pupil could sometimes be *hard* to another. Hence, the use of *"easy to learn"* or *"hard to learn"* cannot be considered a significantly meaningful variable and the percentages of the frequency for those two variables cannot be conceived to be meaningful in associating the use of English to teach science and math to the pupils' actual learning of the subject matter. Therefore, using this variable to argue for the reversal of PPSMI is invalid and not logical.

The term *"understand"* suffers the same fate since understand is an abstract word. Could it be referring to comprehending and knowing what was said or could it refer to experiencing meaningful learning of the subject matter? In addition, one pupil's *"understand"* could as well be *"always understand"* for another pupil. Since *"understand"* was not operationally defined and the reference point was never described in the methodology section, the frequency percentages for this variable cannot be conceived to be meaningful in associating the use of English to teach science and math to the pupils' actual learning of the subject matter. Hence, using this variable to argue for the reversal of PPSMI is invalid and not logical. It would have been more meaningful to replace the term *"understand"* with a few measurable verbs such as distinguish, describe and write, classify, organize, argue, reason, suggest, state and draw.

The math and science tests used for determining the achievement of science and math in the study are not standard instruments. The tests were never piloted (no mention was made in the methodology) and the authors failed to describe how the instruments were constructed and tested for validity and reliability except to say that the items were created by the authors. Since the blueprint of the test construction was never described and the validity and reliability were never ascertained, the worthiness of the instruments in determining achievement in science and math is questionable. Hence using the mean scores from these tests to claim that PPSMI is a failure is illogical and invalid. Note that any scientific research must be repeatable by any interested parties in order to be accepted as a scientific research.

Conjectures

The research on PPSMI cited by the authors in the report were also of descriptive research and most did not discuss on the validity and reliability of their instruments and none really did any kind of experiment with well-defined variables on understanding or meaningful learning. Hence, the conclusion that they arrived at are not justified. Prof. Ishak Haron's team made a lot of conjectures (claim without supportive evidence) in their report. They claimed, on page 38 of their report, that one of the reasons why Malay pupils are weak in science and math is because the pupils are not proficient in English and that they were unable to *"understand"* the teaching of their teachers in English. The researchers arrived at this conclusion from results of the research's survey that teachers use a mixture of English and Bahasa Malaysia and a significantly large percentage of the students claimed that they do not *"understand"* science and math taught in English. Was there really any hard evidence from the survey to indicate that language proficiency, especially English, caused pupils of PPSMI to be weak in science and math? The observations made were;

- ❖ teachers used English or a mixture of English and BM in the teaching of science and math and
- ❖ students claimed that they *"do not understand"* or only *"sometimes understand"* the teaching of science and math in English.

Based on these observations (obtained from the survey), the authors' conclusion remains only as a **conjecture** and the argument given is invalid since the conclusion has no association with any of the 2 premises or observations made. In other words, their theory that English language proficiency (or lack of) caused pupils to be weak in science and math based only on the two premises is inductively invalid.

In addition to the invalid argument made about language proficiency and being weak in science and math, there are a number of other glaringly invalid arguments made on page 48 of the report:

- ❖ Pupils cannot understand and think about math and science concepts in English due to the lack of proficiency in English
- ❖ Malay pupils can easily understand and think about math and science's technical concepts in BM because they are proficient in BM.
- ❖ Teaching in BM is easier to understand.
- ❖ Pupils easily read and understand references for science and math in Bahasa Malaysia.
- ❖ 70% of Malay students will not master concepts and knowledge in math and science in the long run (upper secondary and tertiary level).

For all the claims above, the authors did not make any form of quantitative or qualitative measurement to support the claims. They are just mere speculations. In fact, the authors were bold enough to make a prediction that 70% of Malay students will not master concepts and knowledge in the long run, a prediction based on conjectures and invalid arguments.

Chapter 4 and 5 of the report discussed the scores of math and science tests and the mean score for each item were correlated to percentages of students who found it *"hard to follow"* and *"understand"* science and math in English. While the low mean scores for the tests informed the readers on the low achievement of the pupils, the cause of that was not ascertained. In other words, the claim that there is a positive correlation for *"hard to follow"* and *"understand"* teaching in English and the mean score of the tests is unfounded and must be rejected. Furthermore, the instrument itself has not been shown to be valid and reliable by the authors (none was discussed in the methodology). Science relies heavily on the validity and reliability of the instruments used to make measurements and hence make science bias-free. The hypothesis or claim that the low mean scores is due to *"hard to follow"* or *"understand"* science and math taught in English could probably have been tested by a number of interventions in the form of learning activities. In addition, the tests should include questions both in English and BM that address the same assessment outcomes. Since this was not done, hence the hypothesis that low mean score on the science and math tests is caused by students finding it *"hard to follow"* and *"understand"* the science and math in English must be rejected.

My Arguments

My arguments above focused on the flawed research design by the authors and hence their conclusion and suggestion that PPSMI is a failure must be rejected. The authors, being in the cognitive science, may find it instructive to refer to the volumes of research published regarding difficulties in the learning of science and math. I suggest reading some articles written by researchers in science education, physics education, engineering education, chemical education, biology education and math education in helping them design a valid and reliable survey and inventory instruments. The standardized aptitude tests (psychometric) which measure arithmetic, science reasoning skills, verbal and comprehension would be a good start for the authors to consider using in any follow up studies. Tests that measure motivation could also be used to determine if teaching in English motivates students to learn science, mathematics and English. In addition, I suggest that the authors take extra measures to distinguish between a valid and an invalid argument using science as a tool to confirm or refute the truth of an argument.

Even though there are some flaws to the research design and the conclusion, the report serves as an eye opener to me and to the public about the current state of affairs of PPSMI, five years down the road. Fortunately, all is not lost. Since the purpose of PPSMI is to strengthen the foundation in order to obtain information, facts and knowledge in science and math by improving students' proficiency in English, then PPSMI may just need to be reviewed in ways that it is being implemented.

As suggested by NUTP in an article published by the New Straits Times in September 08, English needs to be strengthened during the first four years of a child's education (kindergarten till Year 3) before formally introducing science and math in English. Instead of teaching science and math in English at this level, the science and math activities can be embedded in the English subject. This means that the contact hours for English may need to be increased. Prof DiRaja Ungku Aziz and NUTP suggested introducing and strengthening the English grammar and word pronunciations. In addition, I suggest that pupils at this level be given the experience to develop their writing and oral skills. The playful and inquisitive nature of the pupils at this level demands that classroom learning activities be focused more on active participation and involvement by the pupils.

Success in increasing or improving English proficiency at this level is best done through active learning such as drama, acting out and role playing in the classroom (which I presume without any proof, has and is being done by many concerned teachers). There are plenty of research-based best practices that can be used in the classroom learning that will put the students at the center of learning. In fact, let us not forget that Piaget categorized pupil's intellectual skills at this stage, as preoperational (lacking logical operations) and early concrete operational level (beginning to think logically but based on concrete objects). I believe that Prof Ishak has more expertise to dwell on intellectual growth theories of Piaget, Brunner and Vygotsky and I believe that he can significantly contribute in the curriculum design (defining the learning outcomes and learning activities) appropriate for this level.

PPSMI must be allowed to continue. Billions of taxpayer's money had been spent not only to train teachers to be proficient in English but also in supplying teaching and learning hardware and multimedia courseware to assist teachers in the classroom activities. It is unfortunate that many teachers are still not proficient in English but then again, proficiency in any language requires continuous practice and requires a long time to master. Short courses here and there will not guarantee proficiency and mastery. It has to be the teacher's individual effort, the school's buddy system and support from the community complementing each other and a long time that will help teachers be more proficient in English. Proficiency breeds confidence and with confidence teachers will be more at ease to teach in English. Five years is too short to show that both teachers and students are at ease listening to and begin to communicate and comprehend the English language and the science and math taught in English.

Unfortunately, English proficiency is not a ticket to ensure understanding in science and math. Researches in cognitive psychology had revealed how our brain works in obtaining and retaining information and how this information eventually becomes knowledge. Since education is the change in cognitive, psychomotor and affective behaviour, research-based best teaching practices must be incorporated into the PPSMI classrooms. In other words, there must be alignment between learning outcomes, be it cognitive or psychomotor and the teaching and learning activities (instructional strategies) derived from research-based teaching and learning best practices using English as the medium of instruction. Since understanding of science and math depends so much on knowing the concepts and the ability to comprehend and apply the concepts, it is very important for teachers to employ effective teaching and learning methods.

It is imperative that all teachers must aim to be not only content experts but also pedagogical-content experts who are proficient in English and able to use technology and multimedia as tools for effective learning. As the constructivists would argue, effective learning depends on present knowledge and new knowledge can only be generated or integrated via cognitive conflicts which must be done by teachers through different instructional activities. Piaget conceptualizes this process as adapting the present mental structures or schemata via assimilation, accommodation and equilibration. If PPSMI is to be successful in serving its objectives, then its implementation requires that teachers use the research-based teaching and learning best practices. Oppositions to PPSMI must realize that English proficiency is only the tip of the iceberg in promoting meaningful learning and improving the achievement of science and math at all levels of education.

University Students' English Proficiency

Presently, the written and verbal abilities in English of my baccalaureate students who are from the non PPSMI cohorts, is very depressing. Presented below are samples of a ten-minute composition, from my philosophy of science students when they were asked to write (they do compositions every end of class to confirm their class attendance) about their beliefs in their area of study. The spelling, grammatical errors and the articulation or reasoning abilities shown by each student have been preserved and underlined for you to observe. Note that the samples are representatives of the cohort.

Student A is majoring in Physics and is now in semester 5:

My belief is solar energy can be a vital part as <u>a sources</u> of energy in the future. This is because <u>there are always sun</u> until the end of the days. <u>With increasing of cost in our daily life, nowadays people are trying to cut off their expenses in order to ensure</u>

their future life are safe. Sources such as oil will be finish at once day. So, it no longer will help us supply the energy such as in automotif field. So, we need some sources that remains till the ends of the days that is the sun. The energy of the sun can be converted to electrical energy and so on. Therefore, I belief that solar energy played a vital sourced to the future.

Student B is also majoring in Physics and is now in semester 5:

I belief that the gravitational force was exist. For the argument, when the something such as apple was falling from the tree to the ground, there was gravitational force exist. Besides that, because of the gravitational force, people can walking, running, sitting and so on. Compare to the situation at the moon, there no gravitational force, so that people that visit the moon, was floating.

Student C is also majoring in Physics and is now in semester 5:

I beliefs that Neil Armstrong do not arive in the moon in 1964. It because this year (2008) after 44 years after that, there has no people can reach the moon, with advance technology and machine compare in year of 1964.

Student D is majoring in Food Technology and is now in semester 3:

I believe that anything or things that we don't assume can't be consumed through out the innovation of food technology. The waste of food from the preparation before cook may contain the same nutrient as the food we cook and consume. That means, we can budget our day life expences through thin innovation and reduce waste.
For an example, the innovation in pineapple skin can be converted to the nata de coco. The product also have the pharmacuetical/properties. Thus from this believe, may be one day I also can make the grass edible to be as human food. Hence, I can change the human perception about thing that we assumed as a waste but it is became our main food.

For the same course and during the debate sessions held in March 2008 (a total of 480 students were involved), most students were observed to be reading emotionlessly from a prepared text and were unable to articulate and provide valid arguments to confirm or refute a claim. A small percentage of the students were quite proficient but they were fumbling in their reasoning and were not coherent in their arguments. These are just samples of the lack of English proficiency and the inability to reason among science and applied sciences students even though most of them have been students at the university for more than 2 years. In fact, even the understanding of the scientific method and their basic scientific skills were also disappointing as indicated in their midterm and final term papers. For the record, these students learn every subject (except English) in BM while at primary and secondary schools.

Besides the English proficiency, I would also like to highlight the shallow conceptual understanding of the students who came from the school system where BM was the medium of instruction for science and math. Using the oft-cited Force Concept Inventory (FCI), the students' conceptual knowledge on physics of motion (kinematics and dynamics) is identified. This inventory consists of 30 forced-multiple-choice questions (only 1 scientific answer) which tests the most basic conceptual understanding on causes of motion and describing how physical objects move. The strong feature of FCI is that all the distracters were constructed based on options derived from interviews with students. It was piloted, validated and tested for its reliability by the authors and eventually published in 1995 as the most widely used instrument which is both valid and reliable in determining students' initial beliefs about motion. It was designed for those who never took any physics classes at the high school level and it aims to identify students' belief system about motion (Aristotelian beliefs versus Newton's or scientific beliefs).

Students who score more than 18 out of 30 (60%) are considered as beginning to crossover (become competent) from the Aristotelian (named after Aristotle, the great Greek philosopher) belief to Newton's or scientific belief and those getting more than 24 out of 30 (80%) are considered as having strong scientific knowledge (mastery) on the science of motion. The inventory was translated to BM by me with some contextual changes made to cater for the Malaysian culture. The BM FCI was piloted by 8 physics experts at Universiti Teknologi MARA (UiTM) in 1997 to check for language ambiguities before being piloted by students at UiTM. (The file is password-protected and can be downloaded from websites in the USA such as *http://modeling.asu.edu/R&E/research.html* or my website *http://www2.uitm.edu.my/drjj/*. You may obtain the password by sending email to *jjnita@salam.uitm.edu.my* or *drjjlanita@hotmail.com*.).

Since the inventory is very basic and involves only conceptual knowing of physics terms and laws of motion, physics lecturers usually expect their students to do well in the test. Unfortunately, in all traditional classes (lecture-laboratory-tutorial type instructional strategies) around the world including prestigious universities such as Harvard (see for example, Hake 1998), the performance was very disappointing. The BM version of FCI was administered to students at various public universities (UiTM, UKM, UPM, USM and UPSI) in Malaysia between the year 1998 and 2007. Since the inventory is in BM, the test intends to measure students' scientific knowing of physics concepts and laws about objects' motion rather than testing their language proficiency. Students who took the test range from semester one Diploma programs to the higher semesters in physics, engineering, science and technology, applied science programs and science education programs.

The FCI mean scores across the world range from as low as 9 out of 30 (27%) and not more than 22 out of 30 (73%) for the Harvard students. If Prof. Ishak's study claims that Malay students learn best when science is taught in BM were to be accepted, then, at the minimum, one would find our Malay students be performing well above the crossover or competent score of 20 out of 30 (60%). Unfortunately, the overall mean score for the Malay (*"bumiputera"- I shall use the term "bumi"*) students is only 21.3% (± 9%) compared to 27.4% (± 13%) for the *"non-bumi"*. In fact the mean score of 21% is a typical score when students are just guessing the answer. I had, through another study using the Certainty Response Index (CRI) and by monitoring the time taken to complete the FCI tests, confirmed that the students were actually thinking through the problems rather than random guessing. Note that out of 2,100 students in the sample, the *"bumi"* or the Malay and indigenous students make up 85% of the total number of students. If Prof Ishak's conclusion were true, then the *"bumi"* students ought to be doing far better than the *"non-bumi"* students since the *"bumi"* are very proficient in BM.

Unfortunately, by comparing just the mean score, the results do not seem to support this claim. Further study could be done to confirm if this claim is really true by looking at class performances and by looking at mean scores of standardized tests in other areas of science. Note that the *"non-bumi"* students are from UPM, UKM, USM and UPSI. Note also that the

UiTM students are engineering and applied science students, those from USM and UPM are science students and those from UKM and UPSI are pre-service teachers.

Surprisingly, only 19 students out of 2100 students (1%) in the study managed to show competency as determined by the FCI. Three *"bumi"* students from the UiTM's American Degree Program (ADP) scored 76%, 1 student from UKM ("*non-bumi*") scored 73%, 3 students from USM ("*non-bumi*") scored 70%, 3 "*non-bumi*" students from USM scored 67% and 4 students each from UiTM's ADP program ("*bumi*") and from USM scored 60%. Table 1 shows the pretest mean scores obtained from studies done oversea and at universities in Malaysia.

Table 1: FCI pretest (before a formal mechanics course) mean scores around the world

Scores from overseas	[+]Scores from Malaysian Public Universities	
United States of America: 27% - 73%	Overall for *ALL bumi*: 21.3% (N=1792). Overall for *non-bumi*: 27.4% (N=308). UKM (N=177) overall: 22.3% *Bumi*: 20%; *Non-bumi*: 30%	UPSI (N=414) overall: 20.1% (T-test at the 95% confidence shows no significant difference in scores between *bumi* & *non-bumi*)
United Kingdom: 28% - 33% Finland: 45.7 %	USM: 36.6% *Bumi*: 25%; *Non-bumi*: 40%	UiTM (N=1343) overall:21.4% UiTM's American Degree Foundation Program (N=47) overall: 38%
Russia: 46.5 %	UPM: 21%, [*]23%	

[+]: Studies done by author of this article. [*] Study done by Zainal and Zaidan (2006) at UPM

An example of the question in FCI is shown below:

Dua biji bola A dan B <u>mempunyai saiz yang sama tetapi bola A beratnya dua kali ganda berat B</u>. Bola-bola tersebut dijatuhkan serentak daripada bumbung sebuah bangunan dua tingkat. Masa yang diambil untuk bola-bola tersebut sampai ke tanah ialah:

(A) bola A mengambil masa separuh sahaja masa yang diambil oleh bola B.
(B) bola B mengambil masa separuh sahaja masa yang diambil oleh bola A.
(C) lebih kurang sama.
(D) bola A lebih cepat sampai tetapi tak semestinya separuh masa yang diambil oleh bola B.
(E) bola B lebih cepat sampai tetapi tak semestinya separuh masa yang diambil oleh bola A.

Many students (46% of the students) consistently chose *option D* before and after a formal mechanics course as shown in Figure 1. This is not because of the lack of proficiency in BM to learn the concept well (Prof Ishak's study claim that students learn concepts well if they are taught in BM) but instead driven by their observation (experience) or their firm Aristotelian belief. The Newtonian or scientific option is *option C* (only about 19% of the students chose this option after a formal mechanics course) and their unchanged belief even after one semester of formal mechanics (the post-FCI mean score of between 22% - 34% for N = 1123) class may be attributed to the absence of cognitive conflict and maybe due to the use of traditional instructional method in the classroom (an informal interview with the respective lecturers show a lecture-lab-recitation type instructional method). Of course, more studies with larger samples and done over a period of a few years must be done to further confirm this finding.

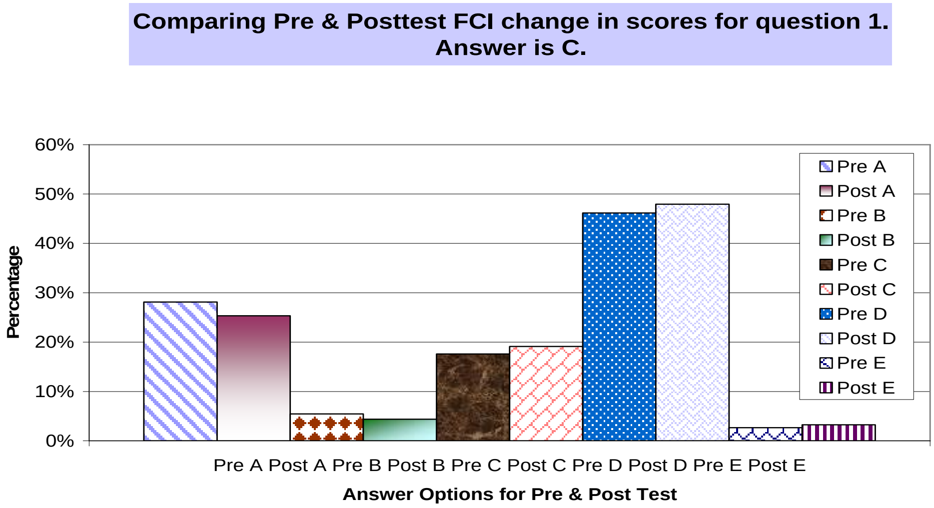

Figure 1

Another example that exemplifies the lack of meaningful learning that led students to use their observation or use their Aristotelian beliefs in choosing their answer can be found in the following item:

RUJUK KEPADA KETERANGAN DAN RAJAH DI BAWAH UNTUK MENJAWAB SOALAN SOALAN 15 DAN 16.

Sebuah lori mengalami kerosakan dan menerima tolakan dari belakang oleh sebuah

kereta kecil untuk menghantarnya ke bandar seperti yang digambarkan di bawah.

Sewaktu kereta kecil tersebut menolak lori dan <u>memecut</u> untuk mencapai kelajuan seragam;

(A) daya tolakan yang dikenakan oleh kereta terhadap lori adalah sama dengan daya lori menolak kereta.

(B) daya tolakan yang dikenakan oleh kereta terhadap lori adalah lebih kecil berbanding dengan daya lori menolak kereta.

(C) daya tolakan yang dikenakan oleh kereta terhadap lori adalah lebih besar berbanding dengan daya lori menolak kereta.

(D) oleh kerana enjin kereta hidup, maka ia mengenakan tolakan terhadap lori tetapi lori tidak mengenakan tolakan terhadap kereta kerana enjin lori tidak dihidupkan. Lori tersebut ditolak hanyalah kerana ia mengganggu laluan kereta.

(E) tidak ada daya dikenakan oleh kereta dan oleh lori. Lori tersebut ditolak hanyalah kerana ia mengganggu laluan kereta.

The popular wrong answer chosen by students as shown in Figure 2 is *option C* (more than 56% of the students chose this answer before and after a formal mechanics course). Again, it reflects their firm Aristotelian belief (non-science belief) about motion rather than the language proficiency. The Newtonian option is *option A* and only 12% of the students chose this option even after a formal mechanics course. (Readers are welcome to read the article confirming the students' strong belief on their wrong choice by downloading it from my website; *http://www2.uitm.edu.my/drjj/fci-cri-ijl2007.pdf*. The article used the Certainty Response Index, CRI, in determining students' firm Aristotelian belief.)

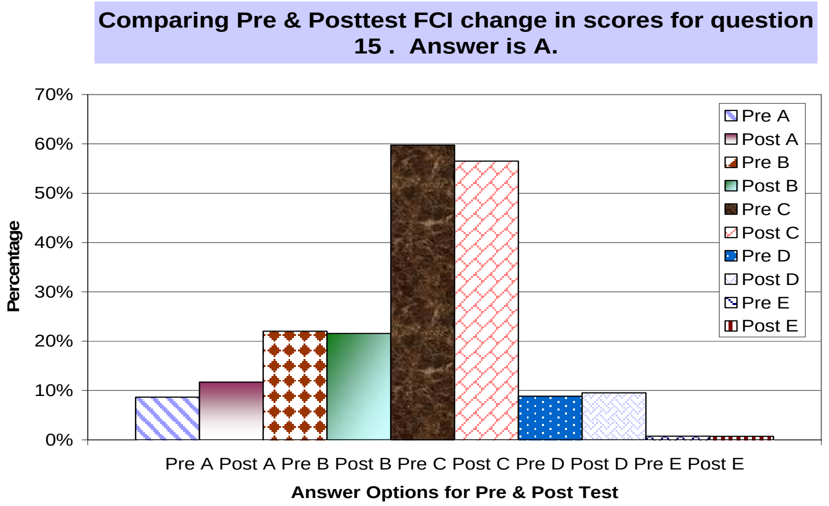

Figure 2

There are volumes of research that show how instructional strategies play a major role in determining success of meaningful learning and students' achievement in learning science and math. What I showed in this article pertained only to the mean scores of FCI (many other conceptual inventories have been and continue to be developed in other disciplines of physics, chemistry, biology, astronomy, mathematics and engineering fields) which is only a glimpse of those reported evidences. The purpose is to convince you that language proficiency alone does not guarantee learning and understanding of concepts especially in the sciences and math.

Rather than conjecturing, I am advocating that teachers, academician, curriculum designers, policy-makers and assessors to seriously consider the flaws and lack of the proper use of instructional strategies (contextual) in classroom activities in the learning of science and math. While the learning outcomes have been written well for all the lessons, the instructional strategies that teachers employ in the classroom and the assessment implemented, need to be aligned with those learning outcomes at all levels of formal education. At present, there are evidence that teachers and students alike are so into traditional teaching (hence the *"hard to follow"* and *"understand"* perspective proposed by the UPSI report) where students are passive learners, *listening* to teachers and taking the role of stenographers, while teachers are expected to *"talk" to* the students proficiently in English.

My own research on learning preferences or learning styles (readers can refer to the work of Kolb, Dunn & Dunn and Felder) of university students and university educators in Malaysia showed that 87% students and university lecturers in Malaysia are visual learners (learn best when information is presented to them in the form of pictures, charts, diagrams, videos, animation or color schemes) compared to only 13% verbal (audio or spoken and textual information) learners. In addition, 60% of the students process information best when they are actively doing something physical with the information (hence the name *active learning* which involves a lot of self dialogue, asking questions and peer dialogue) as compared to only 40% who prefers to do the information processing in their heads reflectively. All this is saying is that *"talking to the students"* rather than "*with the students"* is the least effective way to produce meaningful learning. I submit to you that scientific research into cognition and the human dimension has shown that it is the inability of teachers and students to realize how they best convert information to knowledge (especially declarative knowledge) and act on the necessary changes, as being a setback to learning and hence to academic achievement.

Final Words

Based on my evidence and discussion in the previous section, I am very doubtful that it is the use of English as the medium of instruction in science and math alone that caused the low science and math achievement among Malay and Malaysian students in general. I am in favor for a continuation of PPSMI but with SOME CHANGES made to its structure, content and especially the classroom implementation (changing the curriculum by aligning the learning outcomes with the learning activities and assessment methods) of teaching and learning.

I strongly support that PPSMI be continued but not in its present format. Instead, some changes especially in the implementation MUST be made. Ungku Aziz and NUTP suggested learning grammar beginning from kindergarten up until Year 3. I totally agree with them. In fact, the learning of science and math MUST be done in BM in the first 4 years (kindergarten through Year 3) of a pupils' primary education. There are ample scientific education research and cognitive research to support the theory that pupils at the early stage, can learn numeracy and science skills well if it is done using their first language (see for example, Dan Hilman's PhD dissertation on *http://www.quahog.org/thesis/.* and UNESCO. 2003: Education in a Multilingual World. Paris, UNESCO. Quoted in Advocacy Kit for Promoting Multilingual Education; Including the Excluded Policy Makers Booklet)

A transition year from BM to English could be introduced in Year 4 of the pupils' education and then maybe more English can be used beyond that level for teaching and learning science and math without loosing the BM especially during the active engagement classroom activities or during any form of Socratic Dialogue probing of declarative and procedural knowledge.

In addition, as suggested by Prof. Ishak (I agree with him), the learning activities in English classrooms must be varied according to teaching and learning best practices and taking heed from research in cognitive psychology. This variation can be done by embedding science and math activities, perhaps through games and songs, into the English subject as early as the kindergarten level. Of course, this will require an increase in contact hours for the English class. As for the teachers, they must be given plenty of motivation, a lot of practice and encouragement to use English in and out of a classroom, numerous and continual content and pedagogical-content knowledge training through regular in-service workshops, reliable and continuous instructional strategies support system, continuous moral support and strong and continual training and support in the use of technology and multimedia for implementing active learning activities in the classroom.

I believe that a modified PPSMI can change the English proficiency shortcomings faced by universities and the workforce but most importantly, the revised PPSMI can raise the standards of knowledge level of Malaysian citizens if the instructional strategies are carefully aligned with the learning outcomes. It is a promising policy to turn Malaysians into knowledge generators and knowledge exporters rather than just end-users of knowledge. I believe by involving experts in all areas of human dimensions, by employing research-based teaching and learning best practices in the classroom, by recruiting and encouraging teachers who will internalize and commit to be life-long learners, by helping and training teachers to align their vision with that of the country's vision, by guiding teachers to use technology wisely and if given sufficient time, PPSMI can and will achieve its purpose.