Uncovering Malaysian Students’ Motivation to Learning Science

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Abstract  
This paper aims to highlight two pertinent points relating to science education in Malaysia; first identifying aspects underlying students’ motivation to learning science, and second outlining the profile of performance indicators leading towards successful science learning among upper secondary students in Malaysia. It is acknowledged that good science learning outcome does not only rely on the way teaching is carried out but also on other factors such as students’ ability and talent, language proficiency, and the right attitude toward science learning, just to name a few. Nonetheless, little do we know the extent to which these factors contribute towards students’ successful science learning. Through preliminary yet in-depth interviews with students, teachers and panel of experts, the researchers list various factors that influence science learning outcomes. Information pertaining to these factors is then used to develop a comprehensive yet psychometrically sound inventory that will help assess students’ potential to excel in science.

Keywords: Science learning; motivation, performance indicators; psychometric inventory

Introduction  
Malaysia’s vision to become a developed nation by the year 2020 has placed science and technology as important subjects to excel in. This is especially so since science and technology are often perceived as fundamental forces behind economic development in industrialized countries (Lee, 1989; Loo et al., 1997). Reports on performance in science learning, especially those that highlighted students’ lack of interest as well as declining ability to do science (Kong, 1993; Lee, 2001; MOE, 1998) sparked much concern about the ability to achieve the targetted goals. This is further exacerbated by the fact that enrolment in the sciences as compared to the art stream at higher secondary level is less than the expected 60:40 percent ratio (EPU, 2006).

Although there were researches examining factors that influence science learning in Malaysia, the studies were not comprehensive. Among the aspects investigated include language influence on students’ understanding (Nabilah, 2006; Loo & Sarmiento, 2005); problems with translating and analyzing text, pictures, charts and diagrams as well as failure to come up with the right conceptions of science objects or process (T. Subahan, 1996; Yee, 1998); difficulty arising from complexity of
terminology and its ideological or technological nature (Mohd Zakaria, 1992); inability to apply process skills (Mohammad Najib, 1999; MOE, 1998), and failure to classify, synthesize and evaluate information (MOE, 1994; MOE, 1995; MOE, 1996; MOE, 2001b). However none of the above aforementioned studies were comprehensive enough to cover the affective, language and cognitive ability determinants of science learning.

This study, which is part of a bigger research, attempts to outline a profile of indicators that secondary science students in Malaysia need in order to excel in science. Initial observation of science students with excellent academic performance suggests that apart from the way science is taught in classrooms and laboratories, good performance in science subjects is largely the result of numerous interacting factors, both internal as well as external to the students. Amongst others, these include the students’ English language proficiency (as science is currently taught in English), cognitive ability, talent, the right attitude towards science learning as well as their social support system. For the past twenty years, most research examining factors influencing science learning focused primarily on the cognitive domain, particularly investigations on conceptual understanding, and misconceptions held, of science concepts. However, in more recent years, attention has been paid on how students’ affective, social and value domains (Weinburgh, 1995; Bloom, 1992; 1995) affect their science learning outcomes.

**Background**

The identification of students with the potential to excel in science is crucial as we need to ensure the country’s human capital growth is in line with the targeted vision and mission of the nation. The practice of ‘open system’ in the Malaysian education system at the upper secondary level in particular have resulted in the enrolment of students taking arts-based subjects (such as economics, accountancy, Quranic studies, commerce and language-related courses, just to name a few) surpassing those who opted to pursue the science-based subjects despite the fact that a significant number of them are actually qualified to do so. Part of the reason why this happens is due to the claim that art-based subjects are supposedly ‘relatively easier’ to manage and score. And by taking ‘easier’ subjects, the students are more likely to ace exams and get good results, allowing them to gain easier path for university entrance. Meanwhile there are, on the other hand, students who were ambitious to pursuing science, technical and vocational courses although they did not fulfill the requirements.

Oakes (1986) claim that performance indicators help evaluate and monitor quality of learning; they provide general indication of current learning and schooling conditions. By outlining the profile of performance indicators, students may be helped to improve their science performances in numerous ways. Or those uninterested in science be persuaded to show interest and even love the subject. For example, students with specific learning strategies and learning styles could be exposed to other approaches that would complement their learning; poor attitude towards the subject be rectified; perceptions toward individual ability and talent – depending on whether they are positive or negative - either reinforced or corrected; and language proficiency enhanced. Previous studies have shown that the understanding of how students attribute failure and inability to perform well in science subjects will be helpful for teachers when trying to motivate their students. In those studies, students do become demotivated and lose interest in a subject when they attribute poor (science) performance to internal locus of control when in fact the source of difficulty is elsewhere (Weiner, 1979, 1994; Hicks & Nabilah, 1998).

Studies on the performance indicators in science education through the development of questionnaires is of significant importance (Liu & Treagust, 2005). There are complex interaction of a large set of variables and processes in the study of science education improvement. Malaysia should learn from the international studies by examining which effectiveness factors are important in the local cultural contexts. Hulpia and Valcke (2004) categorized basic set of process variables relating to school improvement in terms of performance indicators into meso (i.e.: assessment and evaluation, parental
support, and internal and external support and pressure) and micro (i.e.: opportunity to learn and achievement orientation) aspects that may be of influence towards improvement in science learning in general. Tuan et al. (2005), on the other hand, looked into both cognitive and affective components to cognition that affect students’ motivation towards science learning. According to them, students’ motivation towards science learning may be influenced by factors listed under six scales, namely: self efficacy, active learning strategies, science learning value, performance goal, achievement goal, and learning environment stimulation.

Due to broad and varying factors, this study complements the research field with student-specific models of learning science effectiveness. The main focus of this study is to understand the factors influencing Malaysian students’ learning motivation in science via identification and development of the profile of good science students regardless of the way the science teaching is carried-out. This premise is important because good science students are believed to have some kind of personal quality which make them better in their performance regardless of who their teachers are, where their schools are and how they are taught.

**Characteristics of Good Science Students**

To identify potential students with the ability to excel in science, the researchers took a backward approach of examining the characteristics of good science stream students. The assumptions made is that the students must have the “right characteristics” to begin with, and with conducive classroom environment and effective teaching activities, their performance in the science subjects would even be better.

Good science students in this study refers to upper secondary science students (in Forms Four and Five) who maintained outstanding academic performances in three science subjects – Chemistry, Physics and Biology. They are also top scorers who obtained grades A1 and A2 for all three science subjects in their Malaysia Certificate of Education examination held at the end of the Fifth Form. It is believed that annually, only a small percentage of the pure science stream student population belong to this group. Aside from their consistent academic standing, good science students often are responsible, highly involved in any science activities and demonstrate exceptional ability or talent in science subjects at all times. Often, their performances in other subjects stand out as well.

Having identified characteristics of good science student, the task now is to determine the profile of student with the potential of excelling in science. The study is carried out based on the following diagram as its conceptual framework:

**Figure 1:** Simplified diagram of contributing factors leading towards the profile of student who excels in science
Objectives
The main objective of this exploratory study is to investigate various internal as well as external factors contributing towards superior performances in science learning. The understanding of how those factors influence the students’ performances in science is deemed crucial for the next phase of the research, namely to design an instrument that will help identify students with the aptitude to excel in science regardless of learning environment, instructional approach and other activities. It is hoped that the instrument - Profile of Outstanding Science Student (POSS), will help students discover and understand their true potential, and allow science teachers and policy makers in science education to extend appropriate guidance, activities and any other support needed to further nurture the students’ science learning.

Research Questions
Based on the above research objectives, the following research questions were posed:

- What are the factors that influence good science students’ performances in science subjects?
- How do the factors influence students’ performance in science subjects?

Methodology
This study uses the qualitative approach whereby in-depth interviews were carried out on three groups of research participants. The first group comprised twenty-five students undertaking science courses from two institutions of higher learning, namely a) selected matriculation centres and b) an international education center that prepares students who would be pursuing their studies abroad. All students passed their Malaysian Certificate of Education examination with flying colors. Not only did they obtain A1 and A2 grades in Chemistry, Physics and Biology but also in other subjects. Their age was between 18 to 19 years old. The two other groups of research participants were experienced science teachers (n=4) teaching in Malaysian national schools, and lecturers (n=2) who are renowned in the field of science education. All of the teachers and lecturers have more than 10 years of teaching experiences. The purpose of the interview is to obtain the respondents’ opinions regarding the profile of good science students.

The semi-structured interviews were used in this study because they allow for standardized but in-depth probing of and elaboration on the original response. It also enables one to follow a line of inquiry (Punch, 2001). The questions were prepared in advanced based on the theme being investigated. Most of the interviews were conducted in the national language, Bahasa Malaysia. Nevertheless there were a number of occasions whereby English was used as the respective respondents felt more comfortable using the language. Each interview took approximately 45 minutes, was audio-taped and then transcribed by the interviewer as soon as possible, as suggested by Osborne and Freyberg (1985). Immediate transcription allowed the interviewer to improve the technique of asking questions for the next interview.

Example of translated interview questions posed to the student respondents are as follows:

- Your results have shown that you are good in all three science subjects (Physics, Chemistry and Biology). Could you describe what are the contributing factors leading towards your excellence in the science subjects?
- What were the extra efforts you took that helped in your doing well in your science (Chemistry, Physics and Biology) subjects?
- In your opinion, are there any differences with respect to the factors that contribute excellent learning of Chemistry, Physics and Biology subjects?

Below are the example of translated questions prepared for experienced teachers and lecturer:

- Based on your experience teaching Biology / Chemistry / Physics, can you describe the characteristics of good science students?
How do you define good students in science?
What do you think of their attitudes towards science?
Can you elaborate factors that contribute to good performance in science subjects?
There were studies shown that students who are good in Mathematics often found to be equally good in their science subjects. What is your comment on those findings?

The answers given from the semi-structured interviews were then analysed in order to find out the dimensions needed for the development of the first draft of POSS.

Analysis of Data
Analysis of the interview transcript revealed numerous factors that contribute significantly towards the student respondents’ excellent performance in science. What was considered interesting is that although the responses given by the students, teachers and science experts were not poles apart, the dimensions reported by the students were more varied to include other factors not inherent to the student. The ensuing paragraphs discuss how all listed factors influence the students’ science learning performance. The results of the interview with the students will be discussed first, followed by the perceptions of teachers and experts on features of good science students.

I. Students’ Responses
The list of important factors contributing towards excellent science learning performance have been categorized into seven dimensions subsumed under two classifications, namely internal and external factors.

a) Internal Factors
Internal factors here refers to the students’ intrinsic aspects. These include their learning strategies/styles, attitude towards science, ability or talent in learning science, and their English language proficiency.

Learning Strategies/Styles
In general, almost all students were unison in their opinion towards the importance of adopting the right strategies when learning science. Among the responses given include:

“Revise early on and do a lot of exercises”
“(When learning) Be consistent and give 100% focus in class”
“Always ask teachers and peers when to clarify things and especially so when in doubt or when you don’t understand...”
“I always make short notes to facilitate revision”
“I conduct experiments first (prior to entering class)...”

In short, they all agreed that by in order to perform well in the science subjects, they need to pay full attention in class, consistently revise their lessons, come up with short notes, and ask questions. These activities that they engage in allow for not only elaboration and repetition of information that help promote storage of information in their long term memory but also assist in recall of information when needed at a later time. Another crucial learning strategy that they adopt to make sure they can perform well in science was to learn the right techniques to answer questions during examinations. These include understanding what the question wants and how to provide the best possible response with respect to sentence structure and science content as being nicely summarized by the following student:

“...understanding the techniques to answer questions helps in giving the right answer, sentence-wise and factually”

Most interestingly, one of the students’ responses towards the way science is learned actually had religious connotation whereby he claimed that one should not only study smart but also pray hard.
He believed that after putting all effort (in which he also listed the strategies listed above), one ought to leave things to God as God will help those who help themselves.

**Attitude Towards Science**
In addition to adopting the appropriate learning strategies, excelling in science also warrants that students have the right attitude toward the subject. Among the claims made by the students interviewed include:

- “I like science because it is interesting”
- “One must not easily get bored (hence give up) when learning science”
- “Science is difficult because it requires a lot of understanding of concepts”

Possessing the correct outlook here includes having unending interest for both science and learning of science. Having deep interest in science is important as interest here serves as the “pull” factor that sustains as well as propels other behaviors such as finding additional information from other sources, making sure complex concepts are understood, and learning the necessary terminologies, just to name a few. The interest in science also will drive students to find out the various techniques to study and to have better understanding of science concepts and processes.

**Ability or Talent in Learning Science**
A number of the student respondents also directly and indirectly indicated that to be able to do well in science requires certain ability or talent. Their reactions include:

- “I believe that only certain people can do science.”
- “I find solving science problems easy as I can visualise what was asked.”
- “I am gifted in the sense that I am good at memorizing and have excellent ability to recall things.”
- “I have the talent to do science and mathematics. My mathematical ability helps me to do well in science subjects like Physics.”

Apart from possessing certain “innate” talent that helped in facilitating understanding of science process or concepts, another central characteristic that majority of good science students is endowed with is the competitive nature to be the best there is, particularly with respect to learning. This competitive disposition of theirs serve as the internal drive that thrust them to making sure that they know and understand all there is to know.

**English Language Proficiency**
Less than half of the respondents accentuated the importance of being proficient in English language is crucial for students to excel in science. This is probably due to the fact that when they sat for their Malaysian Certificate of Education, the medium of instruction for the all science subjects – Biology, Chemistry and Physics – were in the national language, Bahasa Malaysia. Nonetheless, after having gone through a semester of matriculation and preparatory program, there were those who stressed the importance of having good command of the English language to do well in science. For these students, they realized that

- “English is vital because a lot of (science) resources are in English”
- “English helps me understand the various terminologies used...”
- “Proficiency in English allows me to understand the (science) lessons well and helps in answering questions more accurately and effectively.”

Being proficient in English requires the students to become aware that the language plays crucial role towards the learning of science and that they need to put in more effort to learn and practice using the language.
b). External Factors
Three dimensions external to the students yet fundamental to their performing well in the science subjects are engendered based on their interview responses. These include family involvement, interaction with others and extra classes.

Family Involvement
All twenty-five students agreed that family involvement, particularly parental support and participation were key factors that drove them towards excellence in science. Among the responses underlined were:
“\text{They observed me while I do my revision, made me comfortable that I have someone accompanying me. They also sacrifice a lot of money}”
“\text{My parents always encourage me to learn science..}”
“\text{My parents always check on my science performance and are constantly encouraging me to study hard}”
“\text{Parents help monitor my diet and food intake}”
“\text{...they helped in getting revision and reference texts}”
“\text{They send me to tuition center}”

The above reactions suggested that parental involvement may range from taking the trouble to actually sit together with the child and extend help with their science work to finding the best people to help teach their children. The respondents also believed that all sacrifices made by their parents, be in monetarily or in terms of time spent helping, were vital towards their excellent science performance. Apart from parental involvement, a small number of respondents also listed siblings’ help as equally important. For these respondents, they view their siblings as their role model whose success they would like to emulate.

Interaction with Others
Interaction with others here specifically refers to the importance of having productive interaction with teachers and peers. For the majority of the respondents, peers do not only help to clarify concepts they were uncertain of through group discussions, but they also become the primary source of information (via exchanging information with respect to how best to study). Friends also serve as motivator whereby they promote healthy competition in ensuring who would perform the best amongst them.

“The interface between teacher and students is equally important as highlighted by these students:
“Effective teaching occurs in the form of discussion”
“Explicit explanation (by the teacher) is important to ensure students’ understanding and subsequently will attract students’ interest to learn”

As previously pointed out, communication is vital if one were to have clear understanding of science concepts taught. The direct interaction with teacher and peer also provides the avenue for scaffolding to take place, hence allowing for personal construction of knowledge to take place.

Extra Classes
Aside from the aforementioned factors, the student respondents also drew the attention to the importance of extra classes in facilitating science learning outcomes. More than half indicated that they benefit by attending the extra classes, often in the form of personal or group tuition.
“Tuition helps me to be disciplined”
“I treat my tuition class as a venue to carry out additional revision”
“During tuition was where I was exposed to and learnt the techniques of answering past year questions”

The fact that these good science students actually relied – to a lot of extent – on extra classes, particularly tuition was rather surprising as one would expect that students with the ability, talent and attitude to do well in science would not require, much more depend on, extra instruction or lessons.
Nonetheless, looking at the responses given, most of these students actually perceived tuition classes as a venue to help strengthen their understanding, as means of getting additional source of information and as a measure to disciplining themselves (via managing their time) instead of totally relying on the tuition centers to help them understand the science lessons.

II. Teachers’ and Experts’ Responses
Unlike the students who placed equal emphasis on both external as well as internal factors influencing science learning, the teachers and experts’ were more inclined to pointing out aspects internal to the students themselves. For example, when asked about the characteristics of good students, three of the experienced science teachers and one expert gave the following response:

Teacher 1:
“To become a student who excels in science, they should not rely 100% on the teachers; rather they ought to possess high level of curiosity (the need to know and understand) and should be focused in class”

Teacher 3
“I am of the opinion that a good science student must always ask questions, do not take what is taught as it is, consistent in writing his lab report and is not only capable but also proactively seeking information from sources other than the prescribed textbook”

Teacher 4:
“An excellent science student is one who has the drive to study, listen to (teachers’) advice and not too sociable. They like to ask questions and have the initiative to find information from other (external) sources”

The above responses clearly highlighted that two characteristics deemed important for a good science student are inquisitiveness and the propensity to ask questions. These characteristics are related to one another as those who are interested in something would want to know more, which in return would lead to their asking questions when the need arise.

Other traits of students who excel in science include the ability to think critically and creatively when confronted with complex problems to solve, as indicated by the following respondents:

Expert 1:
“An excellent science student has natural talent to think critically and creatively. They are quick to capture the essence of what was learned and has the capability to understand as well as memorise information needed, like when they learn Biology”

Teacher 4:
“A student who excels in science has the gift of conducting experiment and is able to think logically and abstractly”

These responses concur with students’ responses pertaining to the perception that good science students do have innate talents, without which they may not be able to excel. Among the talents listed include the ability to think critically, creatively, logically and/or abstractly. In addition to the above responses, Expert 2 and Teacher 1 were also in agreement with the students’ responses about the importance of family support towards producing good science students. Surprisingly, they too reiterated the need for students to attend extra classes, including attending tuition as highlighted below:

Expert 2:
“Students whose parents are always monitoring their children’s success often become excellent science students. They are the ones who would have attended tuition since primary level”

Teacher 1
“Most outstanding students have the full support of their parents in the form of continuous monitoring, individualised classes or tuition.”

These two individuals strongly believe in the various support extended to students, especially those by family members, are crucial towards their learning outcomes in general. The students tend to be more motivated, and would be more eager to make sure that their ongoing performance meets the expectations of parents. Often, supportive parents would also take all necessary measures within their means to ensure their children succeed academically including sending them for tuition.

Implications for Teaching

- Teachers need to identify the learning preferences and learning styles of their students. The understanding of how best the students learn could then be matched with pedagogical approaches deemed appropriate for learning to take place at optimal level;
- Students should be challenged with tasks and projects of varying levels of difficulty. They need to discover issues and uncover answers for themselves, by applying knowledge learned in class. Among the pedagogical approaches that teachers could use include problem-based learning, discovery learning and constructivism;
- Teachers must learn to pose engaging, thought provoking questions to students. Questioning is an important craft to acquire as it is the door of knowledge. Although good students tend to, by nature, raise plenty of questions, there are still many others who are often unsure of what and how to ask;
- Understand what motivates the students in class. Students, especially those who grasp subject content easily if not effortlessly, still need to be motivated to keep them alert and to allow for learning to take place in the classrooms. However, how to motivate them requires some research to be carried out by the relevant science teachers;
- When interacting with students, there is a need to communicate using English. Language is an important aspect of learning any content subjects because as much as it is used as medium of knowledge transmission, improper use of language and incorrect definition of science terminology may lead to misconceptions.
- Students, no matter how good they are, tend to prefer to have extra classes. Sometimes additional classes in the form of formal tuition or informal group discussions may not so much be required to enhance their content knowledge but more so as means to make them become disciplined learners.

Conclusion

By profiling individual students’ ability to learning science, educators will become more aware of the students’ attitude, perception and ability towards science and science learning. Drawing on the students’ profile, the teachers on personal level, or the school on a more general ground, could come up with appropriate intervention strategies to address specific problems in aspects the students are found lacking. These include the provision of specific guidance or help such as alternative pedagogical approaches that will complement their existing learning strategies and learning styles, change of perception towards individual ability and attitude in science learning, and additional classes to improve English proficiency. Finally, relevant aspects pertaining to factors influencing science learning outcomes could and should be incorporated into the curriculum and when developing textbooks.
Bibliography


