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RESEARCH ARTICLE

Motivation and Achievement of Malaysian Students in Studying Matriculation Biology

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Abstract

The motivation of 19 year old Matriculation students to learn Biology was investigated within the framework of the social cognitive theory. One hundred and forty three students responded on the Science Motivation Questionnaire II (SMQII) on motivation components that included intrinsic motivation, self-efficacy, self-determination, career motivation, and grade motivation. This study is significant because it is a pioneer quantitative study on the motivation and achievement of matriculation students. The study revealed was that extrinsic motivation was higher than intrinsic motivation; and grade motivation significantly exceeded intrinsic motivation. Female students had statistically higher self-determination, career motivation and grade motivation. However, boys had higher self-efficacy, and higher achievement in Biology, but these were not statistically significant. Mean total motivation had the highest correlation to achievement, followed by self-efficacy. Mean total motivation accounted for 12.9% of the variance in achievement. The researchers recommend that extrinsic motivation needs to be used with thought and wisdom, in the given situation in this country where students are more extrinsically than intrinsically motivated, to motivate students to acquire knowledge and higher order skills that are much needed, if Malaysia is to achieve its vision of being a scientific country that contributes to the progress of science and technology.

INTRODUCTION

One of the challenges that Malaysia faces and must overcome to become a developed country is to establish a scientific and progressive society, a society that is innovative and forward-looking. Malaysia aspires to contribute to the scientific and technological civilization of the future, and not just to be a consumer of technology. This was stated as the sixth challenge of Vision 2020, the brainchild of a previous Prime Minister, Dr. Mahathir Mohamad (Rafikul & Yusof, 2011).

With this national goal, science has been given an even more prominent position in the curriculum at every level. The Economic Planning Unit (Economic Planning Unit, 2006) targeted an enrolment goal of 60:40 percent in student enrolment in science and arts at higher secondary level or years 10 and 11. In line with this, the present Prime Minister, Dato' Sri Najib Razak, recently confirmed that the ratio between STEM (Science, Technology, Engineering, and Mathematics) and the so-called non-STEM education should be raised to 60:40 from 25:75 in 2000 and 42:58 in 2014. The main comments of the Prime Minister in New Straits Times (NST) Online (Jalil, 2014) included the following:

> "We must have 60 per cent of our kids in our education system to be doing STEM. Once you have that 60 per cent, you will see more and more of your population will be the future leaders. There is a need for us to ensure the new generation of young children who are very passionate about STEM so that we really want to choose

STEM as a career. We got to make it happen because if you can create STEM to be more exciting, I think you will see a wave of young people of wanting to choose STEM as a career (NST Online, 23 September 2014, p.1)".

From the comments of the Prime Minister it was clear that he sees the role of students with STEM background as suitable future leaders of the country. He is concerned that STEM should be exciting and students passionate and excited about it, and should choose STEM as a career (Jalil, 2014). Briefly, the Prime Minister has commented explicitly upon career motivation in STEM, and implicitly touched upon intrinsic motivation when he used the words 'passionate' and 'exciting'.

However, there have been several disturbing research reports on the declining motivation, interest, ability and performance of students in science, in Malaysia that is also observed in US and Europe (Jack & Lin, 2014; Osborne, Simon, & Collins, 2003; Simpson & Oliver, 1990; Vedder-Weiss & Fortus, 2012). In PISA (Programme for International Student Assessment) 2009, Malaysia was in the bottom third, ranking 55 of 74 countries (Kang, 2013). And, in the PISA 2012 report, Malaysia ranked 52 out of 65 countries, in the bottom third as compared to other participating countries. The average 15 year-old Malaysian student obtained a reading score of 398 points compared to an average of 496 in OECD (Organization for Economic Cooperation and Development) countries. In mathematics, the Malaysian score was 421 compared to the OECD average of 496, and in science literacy, the Malaysian score was 420 while the OECD average was 501. In all three subjects, Malaysian girls performed statistically better than boys (OECD, 2013). The results of PISA 2012 sparked nationwide concern; and the Ministry of Education (2013) responded with the Malaysian Education Blueprint, 2013-2025, as it set its hope of placing Malaysia in the top third in international assessments by 2025 (Kang, 2013).

Nonetheless, civil society especially educators and researchers have a role to strengthen the education system. The main investigator in this study has been teaching Matriculation Biology for six years and her interaction with this group of students led her to question the low motivation to study Biology among students as a possible reason for a low achievement in Biology, slightly lower than the mean ranking among the Matriculation colleges in Malaysia. The teacher observed that students seemed to be motivated by grades or test scores, rather than career motivation (as expressed by the Prime Minister in 'wanting to choose STEM as a career') or intrinsic motivation ('very passionate about STEM', 'STEM to be more exciting', as expressed by the Prime Minister). The present researchers are aware that students who had participated in PISA 2009 and PISA 2012 are among the Matriculation and University students by 2015. Therefore, we would investigate intrinsic motivation, that is related to students' needs for competence and autonomy, that favours lifelong learning (Ryan & Deci, 2000a), and extrinsic motivation that may be used to enhance total motivation to learn and persist in learning (Centre For Excellence in Teaching, 1999).

Statement of Problem

The performance of students in the final examination for Biology for the one-year matriculation program was below the mean performance of all the matriculation colleges throughout the country for several semesters in the past three years. However, there had been occasions when the performance of Biology exceeded the mean performance among all the colleges. What could be the reason for the recent drop? Students had been randomly placed into each of colleges and so the researchers do not question the ability of students, nor do we question the teaching quality. Could it be due to a lack of motivation to learn Biology in recent cohorts? Even the Prime Minister, who had once been a Minister of Education, had commented on career motivation and excitement to study STEM, or intrinsic motivation. On these bases, the researchers decided that it is now time to study the motivation of a sample of present students.

Significance of study

This study is a pioneer quantitative study on the motivation of matriculation students to study Biology. There has not been a research on this although Matriculation is a major avenue to university, and there are 15 colleges as of date (2015). Science students of modules 1 and 3 science students study Biology, while the others in module 2 do not choose Biology. In each cohort, about 60 – 70 % of students are in modules 1 and 3. In a situation where there is no present empirical data, this study is an initial exploration of students' motivation to study Biology, in terms of the factors or components: intrinsic motivation, self-efficacy, self-determination, career motivation and grade motivation, as reported in Glynn, Brickman, Armstrong, & Taasoobshirazi (2011). In view of lack lustre performance of students in Biology in this college as compared to other matriculation colleges, it is necessary to investigate motivation factors or components.

Conceptual Framework

The researchers decided to examine the motivation of the students within the framework of the Social Cognitive Theory (Bandura, 1986; 2001; Bryan, Glynn, & Kittleson, 2011; Pintrich, 2003), where motivation in learning is explained in terms of reciprocal interactions that involve personal characteristics (including motivation components), the environment influences (e.g. school, class, teachers, peers) and behaviour (e.g. achievement in Biology). The components of motivation in learning are intrinsic motivation (Eccles, Simpkins, & Davis-Kean, 2006); self-efficacy or the belief that they can do well (Bandura, 1977, 1995), self-determination or the control and responsibility that students exercise over their own learning (Black & Deci, 2000). Grade motivation and career motivation make up extrinsic motivation; it is learning to get a good grade or a career that may involve Biology (Glynn et al., 2011).

Literature review

The review of literature on motivation in learning shows that researchers traditionally classified motivation as intrinsic or extrinsic motivation, based on whether the learner behaviour is influenced, or not, by an external reward or inducement; or whether the desire for learning achievement is affected by the need of obtaining an external reward (Ryan & Deci, 2000a,b). Motivation in learning Biology is defined as the inner drive that directs and activates a student to engage in studying that includes reading, reading to learn and using the library for this purpose, asking questions and advice, and actively participating in collaborative study group discussions, tutorial, and practical sessions or classes and using strategies to facilitate their learning (Bryan et al., 2011; Yeoh, 2013b).

As researchers, we want to study motivation, besides the extent of intrinsic and extrinsic motivation for learning science among pre-university students as several previous studies have shown that students' motivation to learn science declined as children approached adolescence (Osborne et al., 2003; Simpson & Oliver, 1990), and in adolescent years (Vedder-Weiss & Fortus, 2012). Jack and Lin (2014) proposed that motivation to study science may be kindled by employing strategies that involved novelty, involvement and meaningfulness. The teacher had employed music mnemonics as a novel strategy to facilitate students' recall of difficult biochemical pathways (Yeoh, 2012, 2013a, 2014a, b, c, 2015a, b). But could students always depend upon teachers to kindle their motivation, at tertiary level? The researchers hoped that intrinsic motivation for learning science could be enhanced, that would produce high quality learning and creativity besides allowing students to become self-directed life-long learners (Ryan & Deci, 2000b). But the researchers were aware that the motivation of Malaysian students could be predominantly extrinsic (Thang, Ting, & Nurjanah, 2011), unless the learners developed an enduring propensity and interest to interact with science whenever they had an opportunity (Leibham, Alexander, & Johnson, 2013).

Furthermore, for a developing country that aspires to contribute to the science and technology, and not just a consumer of technology; there must be a lifelong commitment to study science in order to achieve this aim. The present Prime Minister has stated that scientific literacy is needed in the country's leadership. Decisions must be made on issues relating human activity to the natural environment, to be aware concerning environmental issues in this country including the pollution of air (Keywood, Ayers, Gras, Boers, & Leong, 2003), and pollution of rivers and waterways (Noor, Kamaruzzaman, Ahmad, Norantonina, & Mohamad, 2006). It has been advocated that all students should be scientifically literate (Roberts, 2007). With scientific literacy, there is hope that such environmental problems could be worked upon and solved. Hence, motivation to study Biology is needed by all students, not only by those who desire to be future doctors, surgeons, dentists, pharmacists, pharmacologists, and biotechnology researchers.

To enhance motivation and improve achievement in Biology, first, we need to measure motivation. We would do this by using a bilingual questionnaire. The Science Motivation Questionnaire II, or SMQ II (Glynn et al., 2011) that was translated into Malay, the national language, in case a translation was needed by a handful of students. The students had studied English for 11 years in school. Moreover, mathematics and sciences are taught and tested in English in this college, and students could have sufficient proficiency to understand the items of SMQ II in Glynn et al. (2011).

Permission for the use of the questionnaire was already given by the authors, Glynn et al. (2011), and the permission extends to substituting Biology for Science (p.1165). Besides that SMQ II has good content validity, criterion-related validity and improved construct validity. The authors, Glynn et al. (2011) had also obtained factor loadings that exceeded a criterion of 0.35 on their targeted factor; most of the factor loadings were above 0.70, up to 0.84 (p.1167). The five factors or components of motivation were intrinsic motivation, self-efficacy, self-determination, career motivation and grade motivation). The reliabilities as measured by Cronbach alphas were: career motivation (0.92), intrinsic motivation (0.89), for self-determination (0.88), for self-efficacy (0.83) and grade motivation (0.81). Cronbach alpha for all 25 items was 0.92; meaning that all the coefficients obtained by Glynn et al (2011) were very good. This is according to DeVellis (2003) who stated that Cronbach alpha coefficient above

0.80 is very good; values from 0.70 to 0.80 are respectable; values from 0.60 to 0.69 are undesirable to minimally acceptable; but values below 0.60 are unacceptable.

Besides that, Bryan et al. (2011) had obtained alpha reliabilities of 0.85 for intrinsic motivation, 0.83 for self-efficacy and 0.75 for self-determination. These values ranged from respectable to very good (DeVellis, 2003). Pearson correlations of 0.68 were obtained between self-efficacy and intrinsic motivation, 0.54 between intrinsic motivation and self-determination, and 0.55 between self-efficacy and self-determination. All the values of p were < .001. The correlations with achievement were 0.37 for intrinsic motivation, 0.56 for self-efficacy, and 0.31 for self-determination; all the values of p were < .001. Britner (2008) had also found that self-efficacy correlated with students' science grades, and Bryan et al. (2011) found the correlation for self-efficacy and achievement to be 0.56, the highest value of the three factors studied, the other two being intrinsic motivation and self-determination. Korpershoek et al. (2011) had used regression analyses to show the importance of ability in math and motivation to achieve good grades in science subjects, but could not confirm a positive effect of homework time.

In the next few paragraphs, we reviewed three studies by Malaysian researchers concerning motivation in learning. Talib et al. (2009) carried out a qualitative study to uncover the motivation of Malaysian students to learn science, and factors that contributed to superior science learning, by interviewing 25 of Year 12 students and four teachers. Four internal factors were found to contribute to superior science learning: the use of learning strategies, possessing a correct attitude towards science, ability/talent, and proficiency in English that enabled students to understand questions well. Three external factors were identified that contributed to superior science learning: family involvement, collaborative interaction with teachers and peers, and extra classes or tuition as an avenue to reinforce understanding of science concepts. The researchers had included Year 12 students but their study was qualitative and different from the present study.

Saleh (2014) investigated the motivation of Malaysian students to learn Physics, a subject that is perceived as difficult. The respondents were 337 Form Four (Year 10) students and the instrument used was QSMPL, the Questionnaire of Students' Motivation towards Physics Learning that was developed by adapting items from the IMI, Intrinsic Motivation Inventory. The results showed that more than 75% of students perceived that school Physics was boring and that the methods of instruction did not attract their attention. 82.63% of the students perceived that learning Physics would not help them achieve their ambitions. Students who were not satisfied with their Physics achievement were at 53.57%. Only 66.88% admitted that they participated fully in Physics learning activities, and a large 79.87% felt they were compelled to carry out the tasks in the Physics classes. This data revealed that learning Physics in Malaysian schools was not enjoyable. Male students had a better understanding of Physics concepts at 2.77 when compared to females, at 2.71, on a four point Likert scale. But females had higher mean motivation to learn Physics seemed moderately high, at 2.90 for males and 2.98 for females, on a four point Likert scale. Saleh (2014) reported that girls had a higher motivation, but this was not statistically significant. Besides that, the results of PISA 2012 showed that Malaysian girls performed better in a test of scientific literacy than boys with a statistically significant difference of 11 points, but this was not the norm for OECD countries where the boys only had 1 point higher than girls (OECD, 2013).

Thang et al. (2011) revealed that tertiary Malaysian learners were extrinsically motivated by grades, and opportunities for further studies and careers. The studies showed that extrinsic motivation did not translate to better performance in English. Thang et al. (2011) proceeded to investigate attitudes of Malaysian secondary school students towards learning English and showed that secondary school students were also more extrinsically than intrinsically motivated to learn English. The results of Thang et al. (2011) showed that intrinsically motivated students had more positive attitudes and less of negative attitudes in learning English when compared to extrinsically motivated peers. Hence, intrinsically motivated students are more likely to be successful learners as they possess positive attitudes to drive them to success (Thang et al., 2011). Thang et al. (2011) suggested that the obvious extrinsic motivation among Malaysian students is a problem that cannot be easily resolved. The present authors wonder if this phenomenon could be due to the condition of the developing country where citizens are still having problems to meet basic physiological needs and safety needs on Maslow's hierarchy of needs (Maslow, 1943). Thang et al. (2011) suggested that Malaysian teachers may be able to improve intrinsic motivation by helping students to become independent learners who take responsibility for their own learning. Turner (1989) had also stated that it is the responsibility of teachers to facilitate their students to gain autonomy, and self-directed collaborative learning is being practiced in this college (Yeoh, 2013b). But, while working towards the goal of student autonomy, we aim to enhance intrinsic motivation in students as this will move them to continue to learn even when grades and praise are clearly out of the picture. Intrinsic motivation characterizes lifelong independent learners. But we may use students' desire for good grades (extrinsic motivation) to spur them to learn by giving good grades for higher order thinking skills that students display in tests and projects (Centre For Excellence in Teaching, 1999).

However, Reiss (2013) completely removed the distinction between intrinsic and extrinsic motivation. Indeed, Reiss and Havercamp (1998) examined human needs and validated 16 universal goals or intrinsic motives that are deeply rooted in human nature (Reiss, 2013, p. 24). For Reiss, 'extrinsic motivation does not exist' (p. 34). Reiss suggested that extrinsic rewards and incentives including grades and praise are within the intrinsic human need for 'Status' that is one of the 16 intrinsic universal human goals. The other universal goals include Acceptance, Curiosity, Eating, Family, Honour, Idealism, Independence, Order, Physical activity, Power, Romance, Saving, Social contact, Tranquillity and Vengeance (Reiss, 2008, 2013). Reiss concluded that Ryan and Deci's (2000a, b) claim that intrinsic needs are about autonomy, competence and relatedness is invalid. Reiss (2013) placed 'competence' under the basic need for 'Power'; autonomy under the basic need for 'Independence'; and relatedness under several basic needs including 'Family' and 'Social Contact'. Reiss did not differentiate between biological needs and psychological needs as was done by Ryan and Deci (2000a, b). Instead, Reiss (2013) emphasized that each of the 16 needs is partly biological and partly psychological. Each need cannot be permanently satisfied but comes and goes. As viewed by Reiss (2013), it probably makes little difference whether motivation is intrinsic or extrinsic, but we will compare intrinsic motivation with career motivation, and with grade motivation, in the first research question.

In this section we briefly reviewed gender in relation to achievement. In the past 30 years, female students have made great progress in secondary and tertiary education in Malaysia. According to Online Desk (2013), the Prime Minister of Malaysia said, 'A girl in Malaysian school is more likely to go to university than her male classmates as the country is reaping results of investing in education without gender discrimination'. The ratio of girls to boys in this college is 1500:500, the same percentage as in university, as stated by the Prime Minister. The same phenomenon has also been observed in other countries. Females earn about 50% of the science undergraduate degrees in the US, especially in the life sciences; and more women have science careers in recent years (National Science Foundation, 2009). The research reviewed by Jacobs, Finken, Griffin, and Wright (1998) suggested that females are more likely to be interested in biology than in physical science. Leibham et al. (2013) reviewed research that suggested that science ability or aptitude did not differ much for male or female students, and that under-representation of women in science careers was mainly due to societal attitudes, socialization processes, and the value placed on these careers. The results of PISA 2009 suggested that women are making significant gains towards careers in biological sciences and less progress in areas of physical systems and earth and space systems (Leibham *et al*., 2013). But the PISA 2012 results for Malaysia had found girls performing statistically better than boys in Reading, Mathematics and Scientific Literacy (OECD, 2013). The students in this research were already in K12, just a step from university. The ratio of girls to boys was the same as in local universities (Online desk, 2013). In this study, our second question is concerning the achievement of matriculation students and we examine if there are significant differences in achievement among males and females. We also investigate the differences of male and female students in the five motivation components in our third research question, as in Glynn et al. (2011). And like Bryan et al. (2011), we also question the relationships between achievement and motivation components for the whole sample of students in our fourth research question. To summarize, the study will answer the following specific research questions.

1. How does intrinsic motivation compare with grade motivation and career motivation for the sample of matriculation students?
2. What is the achievement of this sample of Matriculation students and are there significant differences in achievement among male and female students?
3. What are the differences of male and female students in the five motivation components?
4. What relationships are there between achievement and motivation components of matriculation biology students?

Methodology

Permission to carry out the study was requested, and was given by the college director (for the sample, N=143), through an email. The study involved 143 students (50 males, 93 females) that is representative of the gender ratio of the college. The total enrolment of the college was 2650 students, aged 19 years. Gender is a variable of interest in the second research question. The ethnic ratio was quite representative of the ethnic composition of students in this college with 110 Malay students (76.9%), 16 Chinese (11.2%) and 17 Indians (11.9%). However, ethnicity was not one of the variables that we would investigate. Previous researchers including Glynn et al. (2011) and Bryan et al. (2011) had also investigated gender but not ethnicity. The 143 respondents were from the teacher's lecture class of 103 students and two tutorial classes (40 students) last semester. Students signed that they were willing to participate on a hardcopy, and the purpose of the research was explained to them, after they had given their responses on the questionnaire.

Procedures

In this study on motivation of Matriculation Biology students, the relationship between achievement and the five motivation factors was studied for the whole sample of 143 students. It was not studied separately for male and female students in this study nor in Bryan et al. (2011).

Students were required to provide info on a questionnaire. Since it was near the semester end, we collected the minimum required data: gender and ethnicity. We had translated the SMQ II into the native language, and the translation was proof-read by three Malay teachers of the institution. Students had a choice if they wished to use the English or Malay version, and 93% preferred to use the original SMQ II. The items were very brief and easily understood. Students completed the exercise in about 15 minutes. To get some more information concerning the students, they were allowed to make voluntary comments on matters that they considered important to their motivation and/or achievement.

The grade of a test that the students took near the end of semester was taken as a measure of their achievement in learning Biology. The grades were based on this scale A = 4.0 (or 80-100%), A- = 3.7 (or 75-79%), B+ = 3.3 (or 70-74%), B = 3.0 (or 65-69%), B- = 2.7 (or 60-64%), C+ = 2.3 (or 55-59%), C = 2.0 (or 50-54%), D+ = 1.7 (or 45-49%), D = 1.3 (or 40-44%), E = 1.0 (or 35-39%) and F = 0 (or 0-34%).

Results and Discussions

Using SPSS 16, we obtained the internal consistencies as Cronbach alpha, of the motivation factors/components. Each component is measured using 5 items. The values were 0.754 for intrinsic motivation; 0.756 for career motivation; 0.735 for self-determination; 0.815 for self-efficacy; and 0.720 for grade motivation. For the whole set of 25 items, the Cronbach alpha was 0.894. These values ranged from respectable to very good, according to DeVellis (2003). Besides that, these Cronbach values were quite comparable to those obtained by Bryan et al. (2011) and Glynn et al. (2011), already discussed in the brief review. To us, it meant that the translated questionnaire was just as reliable to serve the same purpose in the context of this study, as the original SMQ II had done in the contexts of Bryan et al. (2011) and Glynn et al. (2011).

The first research question was: 'How does intrinsic motivation compare with grade motivation and career motivation for the sample of matriculation students?' The study revealed that grade motivation was significantly higher than intrinsic motivation. The mean difference was -1.1189 and a t-test gave a value of t (284) = -3.393, p = .001. Levene's test showed that equal variances could be assumed (Table 1).

Table 1. Results of t-test for whole sample when comparing Intrinsic Motivation with Grade Motivation

	N	Mean	SD	Levene's test		t	2-tailed p
				F	p		
Intrinsic Motivation	143	15.9231	2.9576				
				2.683	.103	-3.393	.001
Grade Motivation	143	17.0420	2.6079				

However, there was no significant difference between intrinsic motivation and career motivation, t (284) = -1.144, p= .254. A possible explanation is that the students were still in the 12th year, and a career could seem far away, at least four years down the road. This was not in agreement to what the Prime Minister hoped; he had stated that he wanted students to be excited and passionate about STEM or science and select careers based on science (Jalil, 2014). However, grades were considered more than career in this sample of students.

The traditional view of scholars including Ryan and Deci (2000a, b) was that grade motivation moves students to study for good grades and this means that when grades are no longer in the picture, students would not be motivated to study. Extrinsic grade motivation may not work over the long term to produce independent and lifelong learners, who are willing to continue studying beyond a first degree. To develop a pool of scientific and innovative talent in order to contribute to progress of technology and not just to be a consumer of technology, as expressed in the sixth challenge of Vision 2020, Malaysia is likely to need scientists whose mind is close to their work and continue to be lifelong learners. Thang et al. (2011) had suggested that teachers may be able to enhance intrinsic motivation by facilitating independent learning among students. Self-directed students who take responsibility for their learning are likely to become lifelong learners. However, Reiss (2013) may take the view that grade motivation is based on the intrinsic universal need for Status, that is partly biological and partly psychological, that is never permanently satisfied but comes and goes. Based on these considerations and our results, we believe that

grade motivation is still a source of motivation, and may be wisely used to improve the skills and knowledge of students so that good grades are given to students who have the ability to perform higher order thinking tasks.

The second research question was: 'What is the achievement of this sample of matriculation students and are there significant differences among male and female students?' As shown in Table 2, in terms of achievement as measured by the Biology grade, the boys had a slightly higher mean grade (3.5000; standard deviation = 0.6578) than the girls (mean of 3.3045; standard deviation = 0.7087). It would seem that on this test, all the students performed well. A grade of B+ was equivalent to 3.3. However, the performance in the finals over the past few semesters showed our students performing less well compared to students from other matriculation colleges.

Table 2. Results of t-test for achievement of male and female students

	N	Mean	SD	Levene's test		t	2-tailed p
				F	p		
Males	50	3.5000	0.6578				
				0.537	.465	1.612	.109
Females	93	3.3045	0.7087				

The maximum mean is 4.00

The results of a t-test on achievement (Table 2) showed equal variances could be assumed ($F = 0.537$, $p = 0.465$). Males had a higher mean than females but it was not statistically significant, $t(141) = 1.612$, $p = 0.109$ (>0.05). Although not statistically significant, it was interesting, because females had made great gains in education (Online Desk, 2013). In PISA 2013, 15 year old girls had performed statistically better than boys in science literacy. But at a more mature age of 19 years, the boys in this study did slightly better although this was not statistically significant.

In terms of achievement or the Biology grade, males had a higher mean that was not statistically significant. Females have already made great gains in terms of the numbers admitted into this college. In the 2014/2015 cohort, the ratio of females to males is 1500 to 500, and the 3: 1 ratio was also observed in the previous 2013/2014 cohort. It would seem that this ratio was preserved until university level. This could mean that at matriculation level, the boys were already mature enough for higher education and work hard at it, so the ratio of males to females was preserved until university level. Another behaviour shown by the boys that could account for their obtaining higher mean achievement scores (although not statistically significant), was that they were able to study calmly and coolly at the last minute. Among the boys' behaviours that we appreciated was their ability to play Soccer or Rugby, most evenings after classes, even during the fasting month of Ramadan. However, the girls did not show this stamina. As discussed earlier, we have noticed that the boys who performed well on exams did so with more composure than the girls.

In terms of achievement, Bryan et al. (2011) had reported that boys and girls who aspire to be in advanced placement program scored similarly in motivation factors or components. In terms of achievement, boys and girls who aspired to be in advanced placement classes did not differ significantly in their achievement. The mean achievement score for boys was 86.71 with a standard deviation of 8.43 and the mean achievement of girls was 85.15 with a standard deviation of 9.79. In that study, the mean score of males exceeded females although it was not statistically significant; just as we observed in this study. Differences in achievements of non-aspirant boys and girls were also not statistically significant, but the non-aspirant girls had a higher mean of 77.77 with a standard deviation of 10.20, compared to the non-aspirant boys with a mean achievement of 76.48 and a standard deviation of 10.85 (Bryan et al., 2011). However in Bryan et al. (2011), there were significant differences between aspirants and non-aspirants in terms of IM, where aspirants had higher scores, $t(286) = 7.64$, $p < .001$, Cohen's $d = 0.96$. This was also seen between the 2 groups (aspirants and non-aspirants) in terms of self-determination, $t(286) = 4.78$, $p < .001$, Cohen's $d = 0.59$.

The third research question was: 'What are the differences of male and female students in the five motivation components?' The results are presented in Table 3. A quick glance at Table 3 showed that in all the t-tests, equality of variances could be assumed. In three of the five motivation components (self-determination, career motivation and grade motivation) where the comparisons between males and females were significant, Cohen's d was obtained. According to Cohen (1992), effect sizes range from negligible (0 to 0.19), small (0.20 to 0.49), medium (0.50 to 0.79) and large (0.80 and above).

Females had a higher mean than males in intrinsic motivation but it was not statistically significant, $t(141) = -1.619$, $p = 0.108$ (>0.05). Males had a higher mean than females in self-efficacy, but it was not statistically significant, $t(141) = 0.375$, $p = 0.708$ (>0.05). Females had a higher mean than males in self-determination and it was statistically significant, $t(141) = -2.443$, $p = 0.016$ (< 0.05). Cohen's d was 0.4146, and this was a small effect

size (Cohen, 1992). Females had a higher mean than males in career motivation and it was statistically significant, t (141) = -3.526, p = 0.001 (< 0.05). Cohen's d was 0.5991; this was a medium effect size (Cohen, 1992). Females had a higher mean than males in grade motivation and it was statistically significant, t (141) = -2.417, p = 0.015 (< 0.05). Cohen's d was 0.4334, and this was a small effect size (Cohen, 1992). For this sample, higher means were obtained for career motivation and grade motivation, the extrinsic motivation components, and this is parallel with Thang et al., 2011, and the studies reviewed concerning motivation of Malaysian secondary and tertiary students, by Thang et al. (2011). But the statistically higher means in career motivation, grade motivation and self-determination did not result in a statistically higher achievement for girls in this study. It was boys who obtained a slightly higher achievement although this was not statistically significant (Table 2). This result concerning significantly higher self-determination among girls was in line with Glynn et al. (2011), where among science majors females had higher self-determination than males, t (365) = 2.06, p < 0.05; Cohen's d = 0.22. Among non-science majors in Glynn et al. (2011), women had higher self-determination than men, t (311) = 4.91, p < 0.001, Cohen's d = 0.60.

Table 3. Motivation component scores of male and female students and comparison between males and females

Component		Male (n=50)	Female (n=93)	Total (n=143)	F, p	t	df	2-tailed p
Intrinsic motivation	Mean	15.3800	16.2151	15.9231	F = 1.415,	-1.619	141	0.108
	Std Deviation	3.2819	2.7420	2.9576	p = 0.236			
Self-efficacy	Mean	14.8000	14.6022	14.6713	F = 0.781,	0.375	141	0.708
	Std Deviation	3.2262	2.8823	2.9971	p = 0.378			
Self-determination	Mean	13.3400	14.5269	14.1119	F = 3.106,	-2.443	141	0.016*
	Std Deviation	3.1468	2.5478	2.8187	p = 0.080			
Career motivation	Mean	15.2200	16.9032	16.3147	F = 3.187,	-3.526	141	0.001*
	Std Deviation	3.0792	2.5111	2.8295	p = 0.076			
Grade motivation	Mean	16.3200	17.4301	17.0420	F = 1.804,	-2.417	141	0.015*
	Std Deviation	2.5590	2.5640	2.6079	p = 0.181			

However, the boys did not have a statistically higher mean for self-efficacy, although statistically higher self-efficacy was reported by Glynn et al. (2011). Glynn et al. (2011) had reported that among science majors, males had statistically higher self-efficacy than females, t (365) = 5.58, p < 0.001; Cohen's d = 0.62. This was also observed for non-science majors. Men had higher self-efficacy than women, t (311) = 3.21, p < 0.001; Cohen's d = 0.40.

The fourth research question was: 'What relationships are there between achievement and motivation components of matriculation biology students?' The Pearson correlations of motivation factors and achievement are shown in Table 4. The correlations of intrinsic motivation, self-efficacy, self-determination, career motivation and grade motivation with achievement were .299, .357, .202, .244 and .288 respectively. All these correlations were significant at .01 or .05 level. The values of p are given in Table 4. It is seen that the motivation component having the highest correlation with achievement was self-efficacy. Among the motivation components, self-efficacy was also the highest predictor variable of achievement in Britner (2008), and in Bryan et al. (2011).

Next, we observed correlations between the motivation components. From Table 4, moderate correlation values were observed between intrinsic motivation and self-efficacy (r=.557**, p=.0005), intrinsic motivation and self-determination (r=.519**, p=.0005); and self-efficacy (r=.536**, p=.0005). This was also in line with Bryan et al. (2011). However, with the extrinsic factors, intrinsic motivation had a lower correlation. Between intrinsic motivation and career motivation, the correlation was r=.511**, p=.0005; and between intrinsic motivation and grade motivation, it was r=.337**, p=.0005. This seems to show a difference between intrinsic and extrinsic motivation factors. Extrinsic factors were career motivation and grade motivation. Career motivation correlated

with grade motivation at r=.445**, p=.0005; but career motivation and intrinsic motivation correlated at r=.511**, p=.0005 implying that students career motivation could be based on intrinsic motivation including interest in Biology, and career motivation could also be affected by consistent good grades in Biology.

Table 4. Pearson correlations between achievement and motivation components

	1	2	3	4	5	6	7
1. Achievement	1						
2. Intrinsic motivation	r=.299** p=.0005	1					
3. Self-determination	r=.202* p=.015	r=.519** p=.0005	1				
4. Self-efficacy	r=.357** p=.0005	r=.557** p=.0005	r=.536** p=.0005	1			
5. Career motivation	r=.244** p=.003	r=.511** p=.0005	r=.374** p=.0005	r=.397** p=.0005	1		
6. Grade motivation	r=.228** p=.006	r=.337** p=.0005	r=.329** p=.0005	r=.411** p=.0005	r=.445** p=.0005	1	
7. Mean total motivation	r=.359** p=.0005	r=.794** p=.0005	r=.743** p=.0005	r=.788** p=.0005	r=.731** p=.0005	r=.663** p=.0005	1

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Taking Reiss (2013) into consideration, that human motivation is based on the 16 universal goals or intrinsic motives, we computed the Pearson correlation between mean total motivation (or the total of all 5 components whether intrinsic or extrinsic), and obtained an r-value of .359, p = .0005. This was slightly more than the correlation between self-efficacy and achievement, and self-efficacy had the highest correlation of .357 as discussed; and it was also much higher than the correlation produced by intrinsic motivation (r=.299, p=.0005). This seems to indicate that teachers should value both intrinsic and extrinsic motivation and make use of whatever motivation present within our students (Centre for excellence, 1999). When a stepwise multiple regression analysis was computed, putting all the motivation components and mean total motivation as independent variables and achievement as the dependent variable, the only predictor variable selected was mean total motivation, and all the other motivation components were excluded. Mean total motivation accounted for 12.9% of the variance, and the regression equation was: Achievement = 1.532 + 0.118 x mean total motivation. Stepwise linear regression shows that the main predictor variable was mean total motivation that included intrinsic and extrinsic motivation components.

Furthermore, from the voluntary comments of respondents we found that 82 students (57.3%) mentioned that they benefited from attempting homework tutorial questions, although the positive effects of homework on achievement have not been confirmed (Korpershoek et al. (2011). There were also 25 comments (17.5%) on ecology issues like our college being built on palm oil land, and 34 students (23.8%) mentioned that they were concerned about medical issues like SARS, H1N1, and dengue fever, that had been recent threats to the country. These were factors could have stimulated their motivation and/or achievement.

Conclusions and Implications

This study showed that of the five motivation components, female students had statistically significant higher self-determination, and the two sources of extrinsic motivation: grade motivation and career motivation, and yet the boys had a slightly higher mean achievement that was not statistically significant. This could be due to the particular sample of students that participated in this study for the reasons that have been discussed. The same had been reported by Bryan et al. (2011) concerning advanced placement (AP) aspirants involved in that study, where the boys had higher mean achievement than girls.

Consistent with Bandura's (1986) learning by social modelling, we should be more concerned that a teacher represents a role-model for students to learn about self-directed learning, and lifelong learning. The students are aware that we are lifelong learners, researching and learning, while the teacher tried to facilitate their learning. To bring other scientists into the role of scientific models, we could recruit veterinary doctors, engineers and scientists in various fields to talk to the students about their educational and professional histories that include career challenges, experiences and responsibilities and careers in science.

A question that arises from this study is whether it would be possible to encourage extrinsically motivated students to be more intrinsically motivated. Local Malaysian studies that were reviewed and the research by Thang et al. (2011) had shown that extrinsic motivation, especially grade motivation, was predominant among Malaysian tertiary and secondary students. Thang et al. had commented that it was a problem that could not be easily resolved. Thang et al. (2011) had also suggested helping students to be more independent and take responsibility for their learning as this would enhance and strengthen intrinsic motivation. The teacher has been implementing collaborative learning in all her classes where the processes of thinking and learning are emphasized, and not just the correct answers to questions, in view that the natural curiosity and enjoyment of learning by students would help to promote intrinsic motivation (Yeoh, 2013b).

The present study shows that while the correlations of self-efficacy to achievement was highest among the motivation dimensions ($r = .357$) followed by intrinsic motivation with $r = .299$; the correlation of career motivation at $r = .244$ and grade motivation with $r = .228$ should not be viewed lightly. In this study, self-determination had a lower correlation ($r = .202$) than career motivation and grade motivation. Stepwise linear regression showed that the main predictor variable was mean total motivation that included both intrinsic and extrinsic motivation components. On this basis, we suggest that extrinsic motivation needs to be used with thought and wisdom, in the given situation in this country where students are more extrinsically than intrinsically motivated. We recognize that some students are most concerned about grades due to family pressure, and from a desire to get the university courses that they want. Reiss (2013) would probably view this as an intrinsic motivation to satisfy the universal goal of 'Family'. The Centre for excellence in teaching (1999) suggests that when grades are important to our students, teachers can make use of tests and assignments to motivate them acquire analytical abilities, and synthesis of ideas, the higher order skills that are so much needed, and has been shown to be lacking in Malaysian students by PISA (2012). Being lifelong learners, the researchers would prefer students to be intrinsically motivated, but we view that students are in a state where they are learning and changing. They are learning from the models that they see and interact with; if they interact with teachers who are excited and passionate about lifelong learning and research, they will imitate the models (Bandura, 1986).

In view of the small variance from motivation (12.9%), our experience suggests that research should be carried out on the effects of other variables. The effects of homework, including homework time, should be looked into, since 57.3% of students voluntarily mentioned about it, although the positive effects of homework have not been confirmed (Korpershoek et al. (2011). If students prepared themselves before classes by reading, and attempted their homework, independently before tutorials, it is likely to add value to their learning because they would be facilitating the constructivism of new knowledge for themselves. Perhaps doing homework contributed to the students' achievement.

In conclusion, it was necessary to objectively measure student motivation to learn science with a valid and reliable instrument. The SMQ II may be used when students enter the college to examine their initial motivation. It may be administered after a semester to examine changes in motivations to study science. It is useful for teachers in this college who teach as many as 200 students in a large lecture classroom that it is not possible to know everyone personally. Fostering and enhancing student motivation is the duty and privilege as a teacher. Fostering motivation in learning Biology could lead the students to careers based on life sciences as well as to scientific literacy, to understand and make scientific decisions that regulate our human activity for the good, to solve problems related to the sustainability of the natural environment in our country and for our planet. Fostering motivation, independent learning and lifelong learning may create a society that is able to contribute to the scientific and technological progress as expressed in the sixth challenge of Vision 2020 of Malaysia. Finally, we think that it will be useful to repeat this research in the next few years, in order to evaluate whether intrinsic and extrinsic motivations of students may be positively enhanced when the country has progressed to become a more developed nation.

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