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Secondary School Students' Motivation and Achievement in Combined Science

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This study investigated students' motivation and achievement in combined science. A sample of 324 Year 11 students from eight government secondary schools in Brunei Darussalam participated in the study. Of the sample, 141 were boys and 183 were girls and their average age was 16.4 years. The motivation instrument used was adapted from the science motivation questionnaire (Glynn, Taasoobshirazi, & Brickman, 2009) and consisted of 24 items. Results show that this group of students displayed a moderate level of intrinsic motivation, personal relevance, self-determination and self-efficacy and a high level of extrinsic motivation and assessment anxiety in learning-combined science. Results also demonstrate significant differences in motivational orientations towards learning-combined science between boys and girls and between high ability and low ability students. Furthermore, correlation analyses show that there were significant positive associations between students' motivational orientations and science achievement.

Keywords: achievement, combined science, motivation, secondary students

Introduction

The prominent place given to science in the school curriculum means that every Bruneian child has the opportunity to study science right from the primary to the secondary level of education. Concomitantly, much effort has been expended to enhance the quality of science education in schools. Despite the attention, as many as 75% of students fail to make the grade after completing 8-year-old of schooling to enter into the science stream. Instead, they are placed in the art stream and study combined science as one of the core subjects. A disturbing trend witnessed in recent years is the low percentage of less than 20% of these students who manage to obtain Grades A-C in combined science in the GCE (general certificate of education) ordinary level examination, a public examination for 16+ years old. In 2011, only 0.58% of students obtained Grade A, 5.42% obtained Grade B, and 11.8% obtained Grade C in combined science (Ministry of Education, 2012). This is a cause for concern, since this will not augur well with Brunei's vision of becoming a fully developed nation by 2035. Future progress requires citizens who are scientifically and technologically literate.

In recognition of science as the fundamental force behind social and economic development as well as a major contributor to citizenship and public understanding of scientific issues, the country responded by giving

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more emphasis to science education. The importance of scientific literacy is evident and highlighted in the learning outcome for science which, among others, to enable students,

> to reason, think creatively, make logical and responsible decisions and solve problems; and to understand the impact of science on the phenomenal technological changes that have accompanied it and its effects on medicine and to improve the quality of life, on industry and business and on the environment. (The National Education System for the 21st Century, 2008, p. 37)

As one of the researchers has been teaching combined science for more than 10 years, her observations and interactions with this group of students have made her aware of lack of motivation to study combined science as a possible reason for low attainment. This observation underscores the urgent need for such a study to be conducted to find out if indeed students' motivation is the main contributing factor for low achievement in combined science. In addition, compelling evidence of the importance of motivation and its association with achievement (Reynolds & Walberg, 1991; Skaalvik & Rankin, 1995; Volet & Jarvela, 2001; Wong & Csiksezentmihalyi, 1991) also adds impetus for such a study to be conducted.

The present study used the SMQ (science motivation questionnaire) adapted from Glynn, Taasoobshirazi, and Brickman (2009) as an instrument to measure students' motivation. The original questionnaire was first developed by Glynn and Koballa (2006). This instrument was chosen, because it has been widely used by researchers in over 70 countries illustrating its adaptability across cultural contexts. The first aim of the present study was to investigate students' motivational orientations towards learning combined science. The second aim of the study was to compare boys' and girls' motivation to find out if the two groups of students respond differently to different motivational orientations. The third aim of the study was to find out if students who achieve at a low and high level have different motivation. Lastly, the fourth aim was to establish the relationship between motivation and achievement in combined science.

The study is, therefore, significant as it provides useful information to teachers and educators in their efforts to improve achievement by fostering students' motivation to learn combined science.

Literature Review

Evidence documents motivation as an important determinant predicting students' achievement (Beal & Stevens, 2007; Broussard & Garrsion, 2004; Johnson, 1996; Sandra, 2002; E. M. Skaalvik & S. Skaalvik, 2006; Zhu & Leung, 2011).

Motivation, like other attitudinal behaviors, encompasses many aspects and one such aspect is motivational orientations. According to Steward, Bachman, and Johnson (2010), motivational orientations act as a driving force that encourages a person to engage in a task. Motivational orientations consist of several constructs and among these are intrinsic motivation, extrinsic motivation, personal relevance, self-efficacy, self-determination, and assessment anxiety.

Intrinsic motivation is an inner force that motivates students to engage in academic activities, because they are interested in learning and they enjoy the learning process as well (Schiefele, 1991). Harter (1978) explained that intrinsic motivation is the true drive in human nature, which drives individuals to search for and to face new challenges. Their abilities are put to the test and they are eager to learn even when there are no external rewards to be won. Students with learning goals of seeking understanding for mastery of science content and skills are said to be intrinsically motivated (Cavallo, Rozman, Blinkenstaff, & Walker, 2003). Csiksezentmihalyi and Nakamura (1989) stated that intrinsically motivated individuals possess the following

characteristics: They engage in both mental and physical activities holistically, they remain highly focused throughout these activities with clearly defined goals, they are self-critical, they self-reflect on their own actions realistically, and they are usually relaxed and not afraid to fail during learning. A research study done by Stipek (1988) concluded that intrinsically motivated students learn independently and always choose to do challenging tasks. They persevere to complete the tasks they have undertaken. They integrate their knowledge acquired in school with their experiences gained from outside school. They often ask questions to broaden their knowledge and learn regardless of any external push factors or help from teachers, and they take pride in their work and express positive emotions during the learning process. Highly intrinsically motivated students are able to learn new concepts successfully and show better understanding of the subject matter (Stipek, 1988).

Unlike intrinsic motivation, extrinsic motivation drives students to engage in academic tasks for external reasons. Extrinsic motivators include parental expectations, expectations of other trusted role models, earning potential to enrol in a course later and good grades. According to Benabou and Tirole (2003), extrinsic motivation promotes effort and performance with rewards serving as positive reinforcers for the desired behavior. Extrinsic motivation typically produces immediate results and requires less effort in comparison to intrinsic motivation (Ryan & Deci, 2000). The down side of it is that extrinsic motivators can often distract students from true independent learning. Another problem with extrinsic motivators is that they typically do not work over the long term. Once, the rewards are removed, students lose their motivation (DeLong & Winter, 2002). As extrinsically motivated, students tend to focus on earning higher grades and obtaining rewards, Biehler and Snowman (1990) believed that extrinsic motivational factors can diminish students' intrinsic motivation. Such observation has also been reported by Bain (2004) who concluded that extrinsic rewards have negative impacts on intrinsic motivation.

In the case of relevance, it has been commonly equated with students' interest in a task that they do (Hanrahan, 1998; Matthews, 2004; Osborne & Collins, 2001). Levitt (2001) interpreted relevance as importance, usefulness, or meaningfulness to the needs of the students. Keller (1983) defined relevance as a more personal interpretation, i.e., a student's perception of whether the content or instruction satisfied his/her personal needs, personal goals, and/or career goals. When students themselves decide on the topics of interest in school science, relevance takes on a personal meaning when students' hearts and minds are captured (Gardner, 1985; Osborne & Collins, 2001; Reiss, 2000). Thus, school science will only engage students in meaningful learning, if the curriculum has personal value and enriches students' cultural self-identities. According to Holbrook, Rannikmae, Yager, and De Vreese (2003), students perceive science education as relevant to them through three areas: Firstly, usefulness of science in the society which means they are more interested to learn if the content is related to societal issues; Secondly, students' interest towards science learning which means that students are motivated to learn and do the tasks and activities in science; and Lastly, importance of science in the course they are taking which means the science content learnt is meaningful and useful to them.

According to Bandura's social cognitive theory, self-efficacy is defined as individuals' beliefs about their own capabilities in learning and performing tasks at specific levels. Self-efficacy beliefs determine how people feel, think, motivate themselves, and behave (Bandura, 1997). Baldwin, Ebert-May, and Burns (1999) observed that self-efficacy is especially important in learning difficult subjects (such as biology and other sciences) given that students enter courses with varying levels of fear and anxiety. They also stated that self-efficacy becomes more important over the duration of the science course as the content becomes more complex. As the students'

self-efficacy may affect the learning process, choice of science, the amount of effort put into accomplishing science task, and persistence in learning science are some factors that are important in this respect (Kennedy, 1996). Self-efficacy beliefs influence on the choices individuals make and the courses of action they pursue (Pajares, 2001). Students with high self-efficacy are often confident enough to accept challenging tasks. They put in more effort and persist through difficult stages in learning. Goals are set in order to accomplish the tasks given. On the other hand, students of low self-efficacy may avoid the learning task and opportunities to seek for help. It is not surprising that many struggling learners have low self-efficacy in their studies, because they believe that they lack the ability to succeed. Low self-efficacy students tend to avoid challenging courses and give up quickly when difficulties arise (Margolis & McCabe, 2006). Many studies have reported that there is a relationship between self-efficacy and academic achievement (Andrew, 1998; Kan & Akbas, 2006; Graham & Weiner, 1996; Pintrich & De Groot, 1990; Zushou, Pintrich, & Coppola, 2003).

Self-determination is the ability of students to choose and control over what and how they want to learn (Reeve, Hamm, & Nix, 2003). An advantage of this approach is that when students are given the freedom to determine their academic tasks, they are more likely to benefit from them (Glynn & Koballa, 2006). Garcia and Pintrich (1996) found that the intrinsic motivation of college biology students increased when the students could select the course readings and term paper topics as well as the due dates for class assignments. Reeve et al. (2003) also concluded that when students believe that they have some degree of control over their learning, such as selecting some of their lab topics, overall motivation is increased. In a study conducted by Black and Deci (2000), results obtained supported the idea that self-determination leads to improvements in student learning. They found that students with a high desire to enroll in the course were significantly correlated with perceived competence, interest/enjoyment of the course, low anxiety, and were more focused on learning whilst those who enrolled due to course requirements were significantly correlated with dropping out of the course. Lavigne, Vallerand, and Miquelon (2007) posited that teachers who support self-determination in students' result in a positive impact on students learning toward science and pursuing a career in science.

Assessment anxiety and test anxiety are common terms used in educational studies and both terms share the same meaning and are used interchangeably. According to Olatoye and Afuwape (2003) and Hurlock (1972), test anxiety is a psychological state of mind where a student expresses levels of worry, fear, uncertainty, concern, and helplessness before, during, or after a test. These behavioural responses are commonly related to possible negative consequences on a test or some other similar evaluative situations (Zeidner, 1998). Consequences of failing test, unable to finish test or being embarrassed due to low grades are some similar thoughts that run through highly test anxious students' minds (Schunk, Pintrich, & Meece, 2008). Many studies had found assessment anxiety to be an important predictor of academic achievement (Olatoye, 2009). For example, Thomas and Gadbois (2007) reported that assessment anxiety was a significant predictor of mid-term examination grades. Sgoutas-Emch, Nagel, and Flynn (2007) also reported in their study that the level of perceived preparedness, self-efficacy, previous exposure to course materials and test anxiety significantly predicted students' achievement in science. In another aspect, assessment anxiety can also negatively affect achievement and performance (Cassady & Johnson, 2002). As Cowden (2009) observed, students with high anxiety often show low confidence on their ability to cope with academic situations because they do not have the skills to cope, thus, they do not have control or are losing control of what they are doing. On the other hand, a moderate level of anxiety is in fact good as it helps motivate learning as observed by Cassady and Johnson (2002). They further explained that when students are motivated to learn, it may increase their anxiety as they

have high expectations and thoughts of the consequences of not meeting the expectations. Similarly, it has been reported in another study that the thoughts of failure disappointing the person who motivates them may also increase test anxiety (Olatoye, 2009). Students with high expectations and thoughts of perfection face assessment anxiety as well. They see the first position as so significant that coming in second place is considered as a failure (Oliver, 2006).

Gender differences in the motivation to learn science has attracted much attention during the last decade (Eccles & Blumenfield, 1985; Greene & DeBacker, 2004; Greenfield, 1998; Morrell & Lederman, 1998). Evidence accumulated thus far on gender differences in motivation is inconclusive. While many studies (L. H. Anderman & E. M. Anderman, 1999; Ayub, 2010; Lai, Chan, & Wong, 2006; Meece & Holt, 1993) reported that there are gender differences in extrinsic and intrinsic motivation between male and female students, studies by Rusillo and Arias (2004) and Glynn et al. (2009) reported otherwise.

In terms of self-efficacy, Britner and Pajeras (2006) found that middle school boys have higher self-efficacy than girls in learning science. This was found to be the case in studies by Cavallo, Potter, and Rozman (2004) and Taasoobshirazi (2007) in which they concluded that college male students had significantly higher self-efficacy compared to female students. In the case of self-determination, Meece and Jones (1996) found boys are more likely than girls to assume control for their own learning and to evaluate different problem solutions while girls tend to show greater avoidance of problem-solving situation, take fewer risks, and request more assistance than boys. While female students believed they had more control over their learning than male students, there were no gender differences in personal relevance in learning science between the two sexes (Glynn et al., 2009).

Studies have also found that male students have more confidence and less anxiety than female students in learning science (Glynn et al., 2009). In chemistry, Jegede (2007) and McCarthy and Widanski (2009) observed that female students have more anxiety toward learning chemistry than male students. In physics, Taasoobshirazi (2007) conducted a survey on college students from an introductory level physics course and reported that women had higher assessment anxiety than their male counterparts. Moreover, studies have also shown that motivational orientations are discipline-based depending on the subjects that the students have opted for their studies. Steinkamp and Maehr (1984) found that girls' motivational orientations toward biology and chemistry were more positive than boys, whereas boys have more positive orientations toward physical and general science. Girls' higher motivational orientations toward biological sciences were also reported by DeBacker and Nelson (2000).

Studies which specifically investigated students' ability have yielded interesting findings in relation to their motivation. Talib, Wong, Azhar, and Abdullah (2009) conducted an in-depth study on motivation of students with outstanding performance in academics and revealed that good science learning outcomes do not rely on the way teaching is carried out but on many factors which include students' ability. Feldhusen and Hoover (1986) identified self-concept and motivation as the most important factors for high ability students' academic achievement. Other studies report that high ability students have higher scores than low ability students on academic goals, valuing science, and perceived ability (Debacker & Nelson, 2000) and they have more positive attitudes toward science in terms of interest and career in science than low ability students (Adams, 1996).

According to Busato, Prins, Elshout, and Hamaker (2000), intellectual ability and achievement motivation were positively associated with academic success. Other reasons for the high academic success of high ability

students are their high level of motivation to continue their education (Kozochkina, 2009), their high intellectual ability, verbal ability, attribution of failure to stable factors and mood, academic self-concepts, attainment value, rehearsal, time management, and effort management than low ability students (Lau & Chan, 2001). Also, their high proficiency in English language, more time spent on studying, better test skills, and better skills in selecting the main ideas from spoken and written discourse than low ability students (Stoynoff, 1997).

The Present Study

The main aim of the present study was to investigate students' motivation to learn combined science using the science motivation questionnaire adapted from Glynn et al. (2009). This is to find out how motivated students in the art stream are to learn combined science in terms of intrinsic motivation, extrinsic motivation, personal relevance, self-efficacy, self-determination, and assessment anxiety. Another aim of the study is to compare student's motivation between boys and girls, and between high ability and low ability students in order to gain additional insight into student's motivation to learn combined science. The present study also attempts to establish if there is a causal link between student's motivation and achievement. This study will answer the following specific research questions:

(1) What are the motivational orientations of Year 11 art stream students towards learning-combined science?

(2) Are there any significant differences in motivational orientations between boys and girl in learning-combined science?

(3) Are there any significant differences in motivational orientations between high and low ability students in learning-combined science?

(4) What are the relationships between Year 11 art stream students' motivational orientations and achievement in combined science?

Method

Sample

The target population in this study were Year 11 students who were about to sit for their GCE "O" level examinations in October 2011. Altogether, 324 students were selected from eight government secondary schools in the Brunei-Muara district. Of the sample, there were 141 boys and 183 girls and their average age was 16.44 years.

Instrument

The first section of the instrument was designed to obtain the demographic profiles of students, such as participants' age and gender. The second section contained a questionnaire adapted from Glynn et al. (2009) and it consisted of 30 self-assessment items measured on a 5-point Likert type scale ranging from five for always, four for usually, three for sometimes, and two for rarely to one for never. The 30 items were not grouped into six separate variables but were randomly arranged. The items were categorized into six motivational scales, namely, intrinsic motivation, extrinsic motivation, personal relevance, self-efficacy, self-determination, and assessment anxiety. The description of each scale and an example of the test item are given in.

The survey instrument was first pilot tested on 45 Year 11 students studying combined science in a government secondary school in April 2011. This was necessary to establish the suitability of the instrument before it was used for the main study. The Cronbach's coefficient alpha for the 30 items was 0.86. When each

scale was analyzed, assessment anxiety was found to be low at 0.41. It was decided to remove the item "I hate taking science tests" to improve the alpha to 0.61. Other motivational scales have one item removed as well to make them consistent with four items each. An example of an item that was removed is "I am confident, I will do well on the science labs and projects". As students are seldom given the opportunity to do science labs and project, such an item is considered inappropriate to be included in the study. The reliability (internal consistency) obtained for the 24 items was 0.89 (see Table 1).

Table 1

Scales, Descriptions, and Sample Test Items

Scale	Description	Sample item
Intrinsic motivation	Extent to which students learn science for its own sake.	I enjoy learning the science.
Extrinsic motivation	Extent to which students learn science to meet ends.	I like to do better than the other students on the science tests.
Personal relevance	Extent to which students learn science for its relevance to their goals.	The science I learn relates to my personal goals.
Self-efficacy	Extent to which students are confident that they can achieve well in science.	I am confident, I will do well on the science tests.
Self-determination	Extent to which students believe they have some control over learning science.	If I am having trouble learning the science, I try to figure out why.
Assessment anxiety	Extent to which students feel tensed over their grading in science.	I am nervous about how I will do on the science tests.

In the main study, the 24-item SMQ was administered to the participants in May 2011, before they sat for the mock examination in August-September of that year. The Cronbach's coefficient alpha was 0.92 which is similar to 0.93 obtained by Glynn et al. (2009). The alpha values obtained for the different scales ranged from 0.58 to 0.81 when the individual student was used as the unit of analysis. The 24-item SMQ was, therefore, found to be valid and reliable, and suitable for use in Year 11 combined science classes in Brunei.

In this study, the level of students' motivation in each scale was calculated by summing the scores of all the four items in each scale. Since there are four items in each scale, the minimum score is 4 and the maximum score is 20. In interpreting the data, students who score from 4 to 9.3 are classified as having a low level of motivation, those who score from 9.4 to 14.7 are classified as having a moderate level of motivation and those who score from 14.8 to 20 are classified as having a high level of motivation for that particular orientation.

Students' Achievement in Combined Science

Students' achievement in combined science was determined by the marks obtained in the mock examination in August/September 2011. The marks obtained range from 10% to 84% with a mean of 40%. As many as 72% of the students failed the examination and obtained less than 50%. In terms of gender, girls' mean score was 40.89% (*SD* (standard deviations) = 16.35) and boys' score was 38.36% (*SD* = 16.91). There was, however, no significant gender difference in achievement between the two groups (*t*-value = -1.33, $p = 0.183$).

Analysis of Data

The analyses of data were carried out using SPSS (Statistical Package for the Social Sciences) for Windows version 11.0. Both descriptive and inferential statistics were used to analyze the data collected. The descriptive statistics used were means, whereas, the inferential statistics used were *t*-tests for independent samples and Person product moment correlation. All research questions were answered at 0.05 level of confidence using a two-tailed test.

Results

Students' Motivational Orientations Towards Learning-Combined Science

Table 2 shows the mean scores for each of the six motivational orientations ranged from 13.35 to 15.60. The mean total motivation score was 14.31 (*SD* = 3.34), which indicates that students were moderately motivated to learn combined science. However, they displayed a high level of assessment anxiety and extrinsic motivation in rank order (see Table 3). This indicates that students, first and foremost, were very anxious about how they will perform in the science tests. They were evidently worried about not being able to get good grades in science and were nervous about sitting for the science tests.

Results also show that this group of students displayed a high level of extrinsic motivation in learning-combined science (see Figure 1). Students considered earning a good grade in combined science is important in helping them to get a good job and in helping them in their career.

Table 2

Scale Means and SD for Motivational Orientation Scales

Scales	Scale mean	*SD*	Rank
Intrinsic motivation	14.20	3.29	3
Extrinsic motivation	15.36	3.49	2
Personal relevance	13.83	3.32	4
Self-determination	13.35	3.19	6
Self-efficacy	13.52	3.89	5
Assessment anxiety	15.60	2.86	1
Average	14.31	3.34	

Note. $N = 324$.

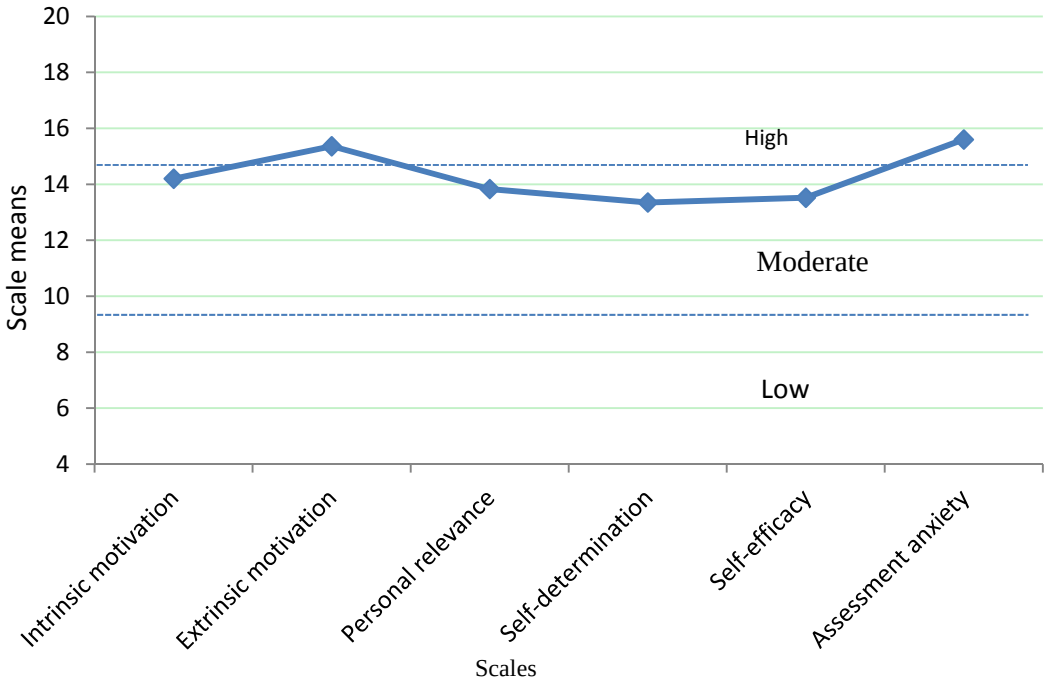

Figure 1. A line graph showing scale means of the six motivational orientations.

The mean scores for the other four motivational orientations range from 13.36 to 14.20 (see Table 2) which are at moderate level of motivation (see Figure 1). In terms of intrinsic motivation, the students responded that they did not fully enjoy learning-combined science and they did not find learning science very interesting or challenging for them. In terms of personal relevance, they considered learning-combined science not highly relevant to their personal goals and as having little significance or practical value to them. The moderate level of self-efficacy in learning-combined science suggests that they were not fully confident in mastering scientific skills, in accomplishing the science tasks and in performing well in the science tests. In the case of self-determination, students seem not to take combined science seriously enough and were not putting sufficient effort in it.

Table 3

Motivational Orientations of Boys and Girls in Learning-Combined Science

Scales	Boys (N = 141)		Girls (N = 183)		t-value	p	ES
	Mean	*SD*	Mean	*SD*			
Intrinsic motivation	14.16	3.54	14.23	3.10	-0.21	0.831	-
Extrinsic motivation	15.13	3.47	15.54	3.51	-1.04	0.300	-
Personal relevance	13.77	3.44	13.88	3.24	-0.31	0.760	-
Self-determination	13.16	3.22	13.50	3.17	-0.95	0.340	-
Self-efficacy	13.87	4.05	13.25	3.75	1.44	0.151	-
Assessment anxiety	14.76	2.87	16.25	2.69	-4.81	0.000	0.54

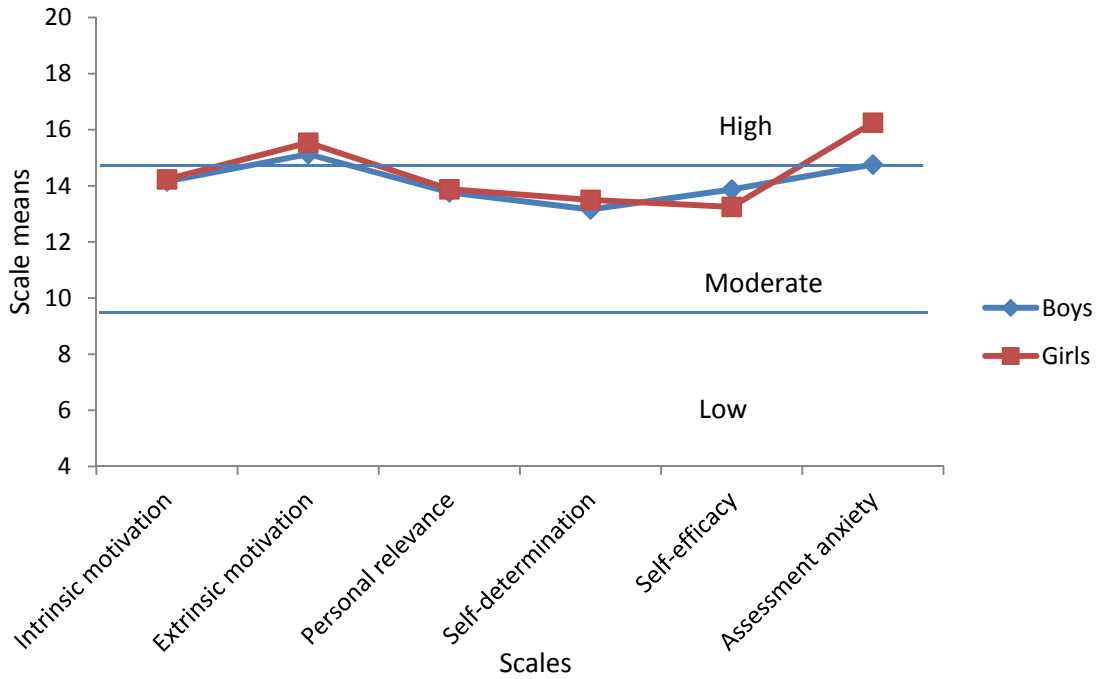

Figure 2. A line graph showing scale means of the six motivational orientations for boys and girls.

Motivational Orientations of Boys and Girls

Gender differences in motivational orientations were analyzed using independent *t*-tests and the results are presented in Table 3 and Figure 2. As the means indicate, both boys and girls have high levels of extrinsic

motivation and assessment anxiety, and moderate levels of intrinsic motivation, personal relevance, self-determination, and self-efficacy in learning-combined science. Of the six motivational orientations, significant gender differences were observed in assessment anxiety where girls were more anxious than boys (t = -4.81, $p < 0.000$; ES (effect size) = 0.54). As the ES is within the medium range, this difference is meaningful. In other words, teachers should take this difference into consideration in teaching and learning combined science. No statistically significant gender differences were found in the other five motivational orientations, hence, they were considered comparable between boys and girls.

Motivational Orientations of Low and High Ability Students

In this study, the top 30% and the bottom 30% of students in the mock examination results were taken and classified as high ability and low ability students respectively.

Results in Table 4 and Figure 3 show high ability students have high levels of motivational orientations in all the six scales except for personal relevance which is at the moderate level. Low ability students, on the other hand, have moderate levels in all the six scales except assessment anxiety which is at the high level. Significant differences were found between these two groups of students in all the six motivational orientations. It seems that high ability students were more motivated intrinsically and extrinsically to learn combined science and were more willing to learn combined science for its own sake than low ability students. High ability students also seem to have more control and responsibility over their own learning and a strong belief of having the confidence to do well.

Table 4

Motivational Orientations of Low and High Ability Students in Learning-Combined Science

Scales	Low ability (N = 97)		High ability (N = 97)		t-value	p	ES
	Mean	*SD*	Mean	*SD*			
Intrinsic motivation	12.93	3.29	15.74	2.88	-6.12	0.000	0.91
Extrinsic motivation	14.45	3.55	16.54	2.72	-4.45	0.000	0.67
Personal relevance	13.11	3.26	14.92	2.88	-3.97	0.000	0.59
Self-determination	12.32	3.12	14.52	3.04	-4.81	0.000	0.71
Self-efficacy	11.71	3.88	15.20	3.31	-6.52	0.000	0.97
Assessment anxiety	14.91	2.84	15.73	2.69	-1.98	0.046	0.30

In terms of assessment anxiety, the means indicate that both high ability and low ability students were very anxious about their performance in combined science. The ES for the scales ranged from 0.30 to 0.91 which indicate that these differences are of educational importance which teachers should take notice of when they teach combined science.

Correlations Between Motivational Orientations and Science Achievement

Partial correlation coefficients were calculated to find out the relationships between motivational orientations and achievement in combined science. Results in Table 5 show positive and significant correlations between all the six motivational orientations with achievement and the values obtained ranged from 0.14 (assessment anxiety) to 0.37 (self-efficacy). These are below 0.50 which are considered low (Oosterhof, 1999). The positive and significant relationships, to a certain extent, can be considered meaningful and taken as evidence for possible causal relationships between these variables. This information is useful to teachers in fostering their students' motivation in order to impact better teaching and learning of combined science.

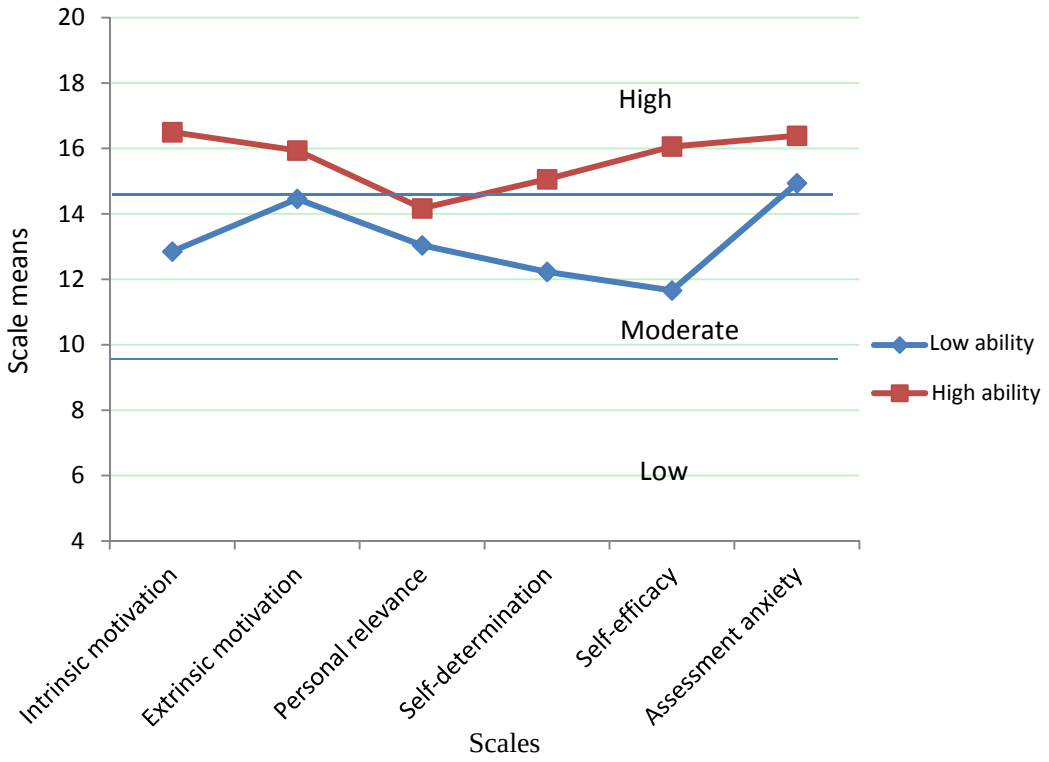

Figure 3. A line graph showing scale means of the six motivational orientations for low and high ability students.

Table 5

Correlations Between Motivational Orientations and Achievement in Combined Science

		Intrinsic motivation	Extrinsic motivation	Personal relevance	Self- determination	Self-efficacy	Assessment anxiety
Achievement	Pearson correlation	0.35**	0.23**	0.21**	0.28**	0.37**	0.14*
	Sig. (2-tailed)	0.000	0.000	0.000	0.00	0.000	0.001

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

Discussion

The findings of the study reveal that art stream students were moderately motivated to learn combined science. The results are congruent with those reported by Glynn and Koballa (2006) and Glynn et al. (2009) with non-science majors. The present study also reveals that students have a high level of assessment anxiety and extrinsic motivation and a moderate level of intrinsic motivation, personal relevance, self-determination, and self-efficacy.

The reason for students' high level of assessment anxiety is because they were anxious and nervous at the thought of not being able to get good grades in science tests. Anxiety of this magnitude has been reported to negatively affect students' achievement (Cassady & Johnson, 2002), because it undermines their confidence to cope with their tasks (Cowden, 2009). One way teachers can help alleviate students' assessment anxiety is by providing them with relevant materials for revision and teaching them the right techniques of tackling science examination questions. Another way is to review science topics that are more likely to cause problems. Such interventions will be more likely to bring improvement to students' achievement if teachers can develop their

confidence and reduce their fear of science assessment.

The high level of extrinsic motivation displayed by the students indicates that earning a good grade is important in helping them to get a good job in their career. This observation suggests that it is not the relevance of combined science to their careers per se that is important to them but getting a good grade will increase their chance of meeting the entry requirements to advance to Year 12 or pre-university education, hence, the possibility of better job prospects in the future. Similarly, non-science majors were observed to have the same preoccupation (Glynn et al., 2009) who desired good grades for the purpose of getting a scholarship to enter a graduate school. There are several strategies to enhance achievement among students who are extrinsically oriented. Davis (1993) suggested teachers should give frequent, positive feedback and praises to support students' beliefs that they can do well. Another strategy is to assign tasks that are slightly above the students' current ability level. As Adams (1998) observed, when the tasks are too difficult and students see them as unattainable, they become anxious and lose interest. When students are able to perform tasks successfully and get good grades, they will be motivated and willing to put more effort into their work (Bainbridge, 2011).

There is also the need to raise students' intrinsic motivation, personal relevance, self-determination, and self-efficacy to enhance better learning outcomes in combined science. Perhaps, the most important of all, teachers should teach combined science in such a way that it is interesting and enjoyable for students. McKinney (2011) suggested teachers should create a conducive learning environment that is challenging, stimulating and relevant to boost students' interest and motivation, for instance, promoting cohesiveness among students using small group cooperative learning strategies. This is a powerful pedagogical tool that enhances students' self-efficacy (Raelin, Reisberg, Whitman, & Hamann, 2007), motivation (D. W. Johnson & R. T. Johnson, 1999), and achievement (Kose, Sahin, Ergun, & Gezer, 2010). Teachers should explore and use this strategy to make students more determined and efficacious to learn combined science instead of using the teacher-centered expository approach that is so prevalent among science teachers. Teachers should also attempt to link science concepts to students' experiences, so that they can realize the relevance of what they learn to their everyday lives, thus making learning more meaningful and relevant.

In terms of gender, a significant difference was found between boys and girls in assessment anxiety while other motivational orientations were comparable between the two groups. Girls were more anxious than boys on assessment and this finding concurred with those studies carried out elsewhere (Ergene, 2011; Glynn et al., 2009; Jegede, 2007; McCarthy & Widanski, 2009). In this study, both boys and girls performed equally poorly in the mock examination and it seems that this affects girls more than the boys.

Another important finding discerned from this study is that students' motivational orientations seem to vary with ability. High ability students unlike their low ability counterparts exhibited significantly higher level of motivation in all the six dimensions. The findings are significant as they provide insight into the importance of each dimension in impacting students' motivation to learn combined science. Teachers should pay attention to these motivational orientations as they are found to have positive relationships with achievement. When teachers are able to foster and increase students' motivation to learn combined science, it is likely that many more students will be able to successfully complete their secondary education and advance to higher education. They will form a significant proportion of the future workforce who will help propel the country forward to becoming a fully developed nation by 2035.

Suggestions for Future Research

The present study is the first of its kind being conducted in Brunei, hence, more research studies need to be conducted in order to gain a better understanding of the relationships between the motivational orientations and students' achievement in combined science. It is recommended that a larger sample of students from all the four districts in Brunei should be used to generate more credible results that will provide a clearer picture of the relationships between students' motivation and achievement in combined science.

The use of triangulation approach, for example, interviews, may yield further information on students' motivation to learn combined science. Interviewees should be carefully selected using stratified random sampling to represent a wide range of students' ability so that their motivation could be carefully scrutinized. It is also recommended that a longitudinal study should be conducted to measure students' motivational orientations over time. The scope of the study should also be widened to include other subject areas, such as mathematics, biology, chemistry, physics, and English language. Another direction for future research is to compare art stream students with science stream students' motivation to learn science. Future studies should also consider other assessments as a measure of students' achievements. Besides, mock examinations marks, public examination grades, and school-based assessment should be included to present a more accurate record of students' ability and achievement.

Researchers should also consider employing structural equation modeling to determine the relationships between students' motivational orientations and their performance in combined science. This would provide vital information on the variance of the different motivational orientations on students' achievement which may be influenced by factors, such as grade level, gender, ethnicity, and subject area.

Conclusion

The present study provides teachers and educators valuable information on students' motivation to learn combined science. Understanding of how each of the motivational dimensions influences learning will place teachers and educators in a better position to help and support this group of students who have long been struggling with combined science.

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