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Motivational Orientations and Performance in Science: A Study on University Students in Bangladesh

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Abstract

This study investigated the university students' motivation and performance in integrated science. A sample of 1316 students from public and private universities in Bangladesh participated in the study. Of the sample, 619 were male students and 697 were female students and their average age was 21.4 years. The motivation instrument used was the science motivation questionnaire that is consisted of 30 items. Results show that this group of students displayed a high level of intrinsic motivation, personal relevance, self-determination, extrinsic motivation and self-efficacy and a moderate level of test anxiety in learning science. The results also demonstrate significant differences in motivational orientations towards science concerning gender. Furthermore, correlation analyses show that there were significant positive associations between students' motivational orientations and science achievement.

Keywords: achievement, combined science, motivation, university students

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Introduction

As a fast-developing country, Bangladesh has taken many initiatives to transform its education system to match the needs of a knowledge-based economy. In line with the target above, while making various attempts to upgrade students' performance in science by different stakeholders of the Bangladeshi education system, massive disparities and drawbacks are reported based on national level assessment results. For instance, as published by the Ministry of Education, out of the total student population who sat for the H.S.C (Higher Secondary School Certificate) Examination – 2015, over 65% of students were only able to earn less than 60 marks out of hundred for science subjects. A disturbing trend observed in recent years is the drop in national averages, which remain just above the pass mark. It is noteworthy that the national standards have drastically dropped from 2008 to 2014.

The achievement levels of boys and girls also shows a disparity. In all four years 2005, 2008, 2012, and 2014 female students performed better than male students. For instance, female students have achieved an average of 52.80 while male students gained an average of 49.41 in 2014. The development of students' performance in science plays a crucial role. Besides the enormous efforts made by different stakeholders of the general education system to enhance the quality of science education, the existing contradictory situation is a considerable challenge needs to be overcome. The South Asian Development Sector of the World Bank makes the following recommendations for Bangladesh to overcome the current issues associated with science education.

For decades, the education systems all over the world have paid a significant emphasis on science subjects with a view that they are actively associated with many career opportunities and that they apply to the social development of all the societies (Cavas, 2011; Güçlüer and Kesercioğlu, 2012). Beside that the developmental decline in science motivation among students and the falling numbers of students choosing to pursue the study of science have been a pervasive phenomenon across the recent literature (Barmby, Kind and Jones, 2008; Gottfried, Marcoulides, Gottfried, and Oliver, 2009; Kiemer, Gröschner, Pehmer, and Seidel, 2015; Nyamba and Mwajombe, 2012; Vedder-Weiss and Fortus, 2011). Especially during university career, this developmental decline in students' motivation towards science has been reported (Galton, 2009; Osborne, Simon and Collins, 2003; Vedder-Weiss and Fortus, 2011). Motivation to learn science has become a matter of global concern (Osborne and Dillon, 2008) because it is strongly associated with students' performance in science.

As one of the researchers has 14 years of experience in the field of science education, especially in relation to curriculum development, writing textbooks, assessment, evaluation and teachers' professional development in university science at the national level, he finds it is a timely need to explore how students' motivation affects students' performance in science in tertiary education in Bangladesh. Lack of research evidence concerning the Bangladeshi context, the recommendations made by the World Bank and international level concerns over the developmental decline in students' motivation towards science lead to the current study which will shed light on the dilemma associated with students' performance in science. The study has a great significance as the research findings would be useful to teachers and curriculum developers and the other stakeholders of the education system to enhance students' performance in science by fostering students' motivation towards learning science.

Literature Review

Students' motivation for learning is regarded as one of the most critical elements that can be used to improve students' performance (Atta and Jamil, 2012). The importance of student motivation has varied from peripheral to central in psychological and educational research over the years (Pintrich, 2003). Motivation is recognized as probably the key factor that can be targeted to improve students' learning. Moreover, the importance of motivation concerning the occurrence of education by stating that "About students, very little if any learning can occur

unless students are motivated on a consistent basis."

Motivation has been reported in the primary, secondary and tertiary education to influence academic performance (Kusurkar *et al.*, 2013; Vansteenkiste *et al.*, 2005).Research studies carried out with a particular focus on students' motivation towards learning science also document that there is a correlation between students' motivation and their performance in science (Atta and Jamil, 2012; Glynn et al., 2009; Glynn, Lau and Roeser, 2002; Taasoobshirazi and Brickman, 2007).

Through social cognitive theory, Bandura describes the way people attain competencies, attitudes, values, styles of behaviour, and the way people motivate and regulate their level of functioning (Bandura, 2006). Within the social-cognitive framework, each is regarded as holding a self-regulating system, which affects his/her beliefs and supports the development of motivation that enables cognitive and affective behaviors (Pajares and Schunk, 2001). Intrinsic motivation, extrinsic motivation, relevance to personal goals, self-efficacy, self-determination, and test or assessment anxiety are considered as essential constructs within the self-regulatory system that strengthen an overall motivation to learn and subsequently, achievement (Bandura, 2001; Schunk, 2001). These constructs have been treated in research studies as dimensions of students' overall motivation to learn science (Glynn and Koballa, 2006; Glynn et al., 2009).

The doing of a task for its inherent contentment rather than for some other separable result is known as intrinsic motivation, and the doing of work for a separable outcome is referred to as extrinsic motivation (Ryan and Deci, 2000; Xie, Debacker, and Ferguson, 2006). By connecting motivational orientation to performance in science both intrinsic motivation and extrinsic motivation showed a positive relationship with students' performance. Walker, Greene, and Mansell (2006) further reported that intrinsically motivated students perform better academically. Also, it is revealed that there is a positive correlation between students' intrinsic motivation and academic performance in science (Gottfried *et al*., 2009; Lin, McKeachie, and Kim, 2002). Earlier researchers have concluded that extrinsic motivation hurts intrinsic motivation and academic performance (Pittman & Boggiano, 1992). However, recently researchers have reported that extrinsic motivation is somewhat complicated and it is on a continuum which ranges from the pressure exerted by external sources to behavior that an individual integrates within his or her set of goals and values (Deci and Ryan, 2000; Vansteenkiste *et al*., 2005).

Cavallo *et al*. (2003) defined personal relevance as the relevance of learning science to student's personal goals. In general, personal significance has been equated with student's interest in a task that he/she is engaged (Osborne and Collins, 2001). According to Eccles and Wigfield (2002) student should recognize the importance of a task that he/she is engaged and determine the support that extends to achieve either his/her personal goals or professional goals. Students find the relevance of learning science through three facets namely the importance of science in the society, personal interest towards learning science and significance of science in the course that they are following (Holbrook, Rannikmae, Yager, and De Vreese, 2003). While the personal relevance does not predict students' performance in both organic and inorganic chemistry, Zusho *et al*. (2003) report that it is a significant as well as a stronger predictor of students' success in chemistry courses. Osborne and Collins (2001) conducted a study in the UK to examine the views of a group of 20-year-old students about the existing science curriculum and the future science curriculum. Those students viewed science as an essential subject and wanted to have topics where they could identify an immediate relevance. Holbrook, Rannikmae, Yager, and De Vreese (2003) found that if the science content is understandable, relevant and exciting students get motivated to learn science.

A strong self-efficacy of a person intensifies his or her achievement of a task and well-being in so many ways (Pajares and Schunk, 2001). According to Bandura (1997), self-efficacy is "beliefs in one's capabilities to organize and execute the courses of action required to produce

given attainments" (p, 3). Self-efficacy affects students' performance by predisposing them to work harder, persist longer, and overcome obstacles when pursuing academic targets (Britner, 2008).More specifically concerning science Baldwin, Ebert-May, and Burns (1999) define the same as the belief of students' ability that they can perform well in science. Research evidence support that self-efficacy is associated with students' science achievement at all levels (Britner & Pajares, 2006). Zusho (2003) has reported self-efficacy as a significant predictor of students' performance in chemistry. Adnan and Akbas (2006) conducted a study in Turkey to examine the students' attitude and self-efficacy towards chemistry and how these constructs can be used to predict students' achievement in chemistry. The researchers reported that self-efficacy was a significant predictor of students' achievement in chemistry and also found that self-efficacy exerted the highest impact on performance compared to self-determination and intrinsic motivation.

Self-determination which is referred to as the control and choice that students have over the subject content, and the way that content to be learned is also a determinant of student's motivation towards learning a subject. As Self-Determination Theory advocates the fact that individuals with higher autonomous or self-determined motivation show better academic performance. Kusurkar, Ten Cate, Vos, Westers, and Croiset (2013) developed a model to determine whether motivation affects student performance through good study strategy and higher study effort. As they reported students with high self-determined motivation showed a positive association with the use of a suitable study strategy which had a positive association with high study effort and higher GPA. Boiché *et al*. (2008) also reported that students with high self-determined motivation outperformed their counterparts with high levels of extrinsic motivation in gymnastics and the level of self-determination is higher among the high ability students than that of the low ability students.

Test anxiety or in other words assessment anxiety is referred to as a psychological condition of mind in which a student indicates uncertainty, concern, fear, and helplessness before, throughout, or after a test (Olatoye and Afuwape, 2003). Emotionality which pertains to the physical symptoms such as sweat, dizziness, nausea and heart racing is one of the two dimensions of test anxiety. The other aspect, namely worry involves the thoughts students have about test such as comparison of his/her performance with the others, having low confidence, bothering over the consequences of failing and feeling of unpreparedness (Cassady and Johnson, 2002). In contrast to the dimensions of motivation described so far test anxiety is commonly reported to have a negative relationship with the academic performance. For instance, Cassady and Johnson (2002) investigated the relationships between test anxiety and student performance and they observed that higher levels of test anxiety were connected with significantly lower test scores on both course examinations and scholastic aptitude test scores of the students participated in the study. Another study conducted with a large number of undergraduate students, including over one-fifth of science majors revealed a negative relationship between test anxiety and grade point average (Chappell *et al*., 2005). Olatoye (2009) examined the influences of test anxiety for examinations on science achievement among University students in Nigeria. By administering a questionnaire on test anxiety and a test for science achievement for 360 students the researcher found test anxiety as an essential predictor of students' success in science. Further, this research reported a negative relationship which means that the higher the test anxiety, the lower the performance and vice versa. About a group of undergraduates, Lin *et al.* (2002) also found a negative relationship between their final course grades in biology and assessment anxiety.

Besides, Obrentz (2012) highlights the importance of determining differences in motivation to demographics of students because students' demographics are continuously changing. Although some researchers have paid attention to the differences in motivation with demographic variables, for instance, gender and ethnicity. Those variables have not been always taken into consideration (Atta and Jamil, 2012; Zusho *et al*., 2003). Therefore, in addition to the different

dimensions of motivation, it is vital to investigate how motivation affects students' performance in science between different groups within a sample.

The Present Study

The primary focus of the current study was to determine the relationships between the different dimensions of students' motivation towards learning science and students' performance in science by using the science motivation questionnaire which has been developed by Glynn and Koballa (2006) to measure how students are motivated in terms of their intrinsic and intrinsic motivation, self-efficacy, personal relevance, self-determination, and test anxiety. Besides, the study focuses on comparing differences in students' motivation towards learning science with gender. Another aim of the current study is to establish if there is any causal relationship between students' motivation towards learning science and their performance in science concerning term test marks. More specifically this research study will answer the following research questions.

1. How are the students motivated towards learning science?
2. If there is any, what are the differences in students' motivational orientations concerning gender?
3. What are the relationships between students' motivational orientations towards learning science and their performance in science?

Method

Sample

The population of interest in this study was the group of university students in December 2016. In the selection of the sample, a group of students from all divisions of the country were involved. In sum, the sample consisted of 1316 students from 54 universities representing the whole Bangladesh. Concerning gender, the sample consisted of 619 boys and 697girls students.

Instrument

A questionnaire was used as the research instrument which contained three sections, namely Part A, Part B and Part C. Part A consisted of Science Motivation Questionnaire (SMQ) developed by Glynn *et al*. (2009). The SMQ composed of 30 self-assessment items which were marked with a 5-point Likert type scale evolving from one for *never*, two for *rarely*, three for *sometimes*, and four for *usually* to five for *always*. The SMQ items were developed based on the six dimensions of motivation described earlier in this article. Five items were coming under each dimension, and they were randomly arranged. Part B was designed to gather students' demographic profiles. Part C contained a table be completed by the faculty members to accommodate students' term test marks for science. Because data were collected from Bangladeshi students, translation of questionnaires was needed. To make sure that the language of the translated instrument was understandable and meaningful to the students and their responses were similar to those received from the original questionnaire; four stages in translating questionnaires described by Spielberger and Sharma (1976) were followed to translate from English to the Bengali language. Bengali language versions of SMQ have undergone pilot testing with 64university students in July 2016. This was done to assure the suitability of the questionnaires before the main study. In the pilot study, the overall Cronbach's coefficient alpha for the 30 items was 0.873.

In the current study, students' motivation level in each dimension was determined by adding up the scores of all the five items coming under each aspect. Because five items are representing each dimension, the minimum score that a student could obtain was 5, and the maximum was 25. In interpreting the data, students who scored from 5 to 11.6for a particular dimension were considered as having a low level of motivation, those who scored from 11.6 to 18.2 were

regarded as having a moderate level of motivation, and those who scored from 18.2 to 25 were considered as having a high level of motivation in terms of the particular dimension. Since there are 30 items in the SMQ, the minimum score that a student can get is 30, and the maximum score is 150 concerning their overall motivation. Therefore, in representing data, students who scored from 30 to 70 were treated as having a low level of motivation, those who scored from 71 to 110 were treated as having a moderate level of motivation, and those who scored from 111 to 150 were treated as having a high level of motivation in terms of their overall motivation.

Analysis of Data

Statistical Package for the Social Sciences (SPSS) for Windows version 17.0 was used to conduct data analysis. The data collected were analyzed using both descriptive statistics and inferential statistics. The descriptive statistics calculated were means and SD, whereas, the inferential statistics were independent sample t-test and one-way ANOVA. Pearson correlation was used to measure the strength of association between motivation and students' performance. The two-tailed test was used at 0.05 level of confidence to answer all the research questions.

Results

Students' Average Scores concerning gender

The average percentage marks obtained by the students ranged from 10 to 98 with a mean of 41.7 and a standard deviation (SD) of ± 17.9. Concerning gender, girls' mean score was 45.4 ± 18.0 and boys' mean score was 37.5 ± 16.8. To see if there is a statistically significant difference in mean scores of girls and boys independent sample t-test was administered. Here, the homogeneity of variances assumption was violated as assessed by Levene's Test of Equality of Variances ($p<0.05$). Hence, the nonparametric Mann Whitney Test, based on ranks was used. The p-value of the test was less than 0.001. Therefore, there was a significant difference in students' performance in science between the two groups where female students outperformed male students.

Students' Motivational Orientations Towards Learning Science

The mean total motivation score of the students was 111.99±16.27, which indicated that students were just above the lower range of the level of highly motivated to learn integrated science. Mean scores for each one of motivational dimensions with SD and the rank based on the mean score are tabulated in Table 1. Mean scores of the dimensions ranged from 15.27 to 19.96. As indicated in Table 1 the rank order of mean scores of motivational dimensions suggests that students are highly extrinsically motivated.

Table 1: Mean score and SD for motivational dimensions

Dimension of motivation	Mean score	SD	Rank
Intrinsic motivation	19.59	3.86	5
Personal relevance	19.33	3.60	4
Extrinsic motivation	19.96	3.64	6
Test anxiety	15.27	4.67	1
Self-determination	19.14	3.66	2
Self-efficacy	19.23	3.99	3

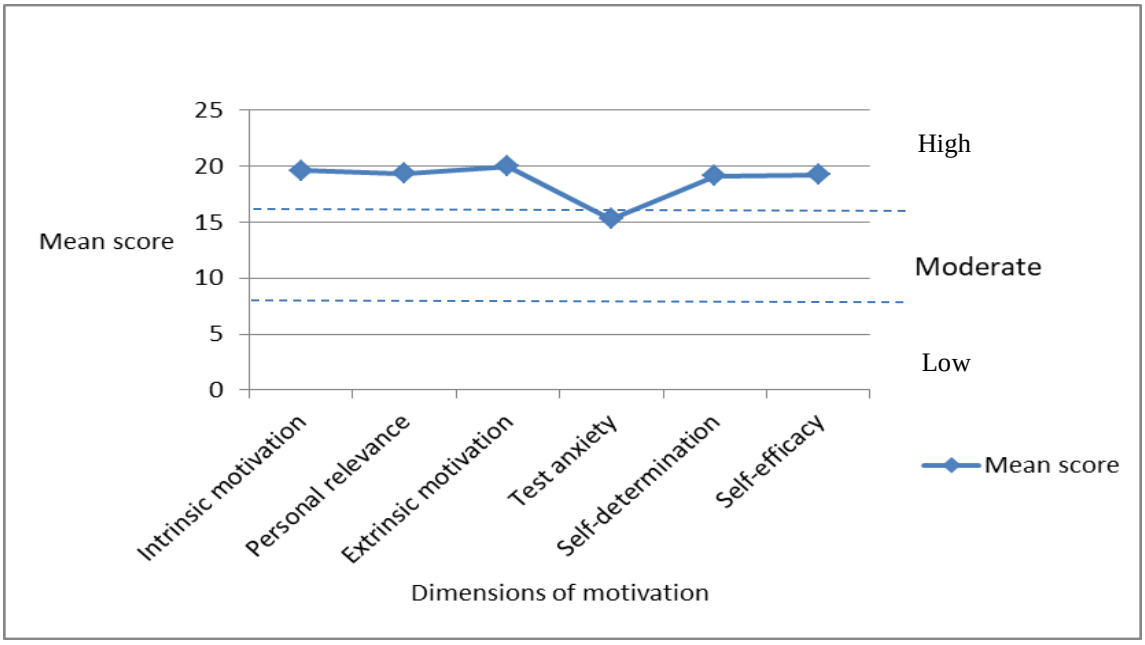

Figure 1. A graph showing scale means the six dimensions of motivation.

Motivational Dimensions of Boys and Girls

About the gender differences in mean scores for motivational dimensions were analyzed using independent sample t-test. Both male and female students were found to have a high level of motivation towards learning science concerning all dimensions except test anxiety. Their mean score for test anxiety was at a moderate level. Regarding gender, girls' mean scores for all the motivational dimensions were higher than that of the boys. According to the independent sample t-test results, the equality of variances assumption was violated as tested by Levene's Test of Equality of Variances ($p<0.05$). Then, followed by the nonparametric Mann Whitney Test based on ranks it was revealed that the p-value of the tests concerning each dimension was less than 0.001. The results are presented in Figure 2 and Table 2.

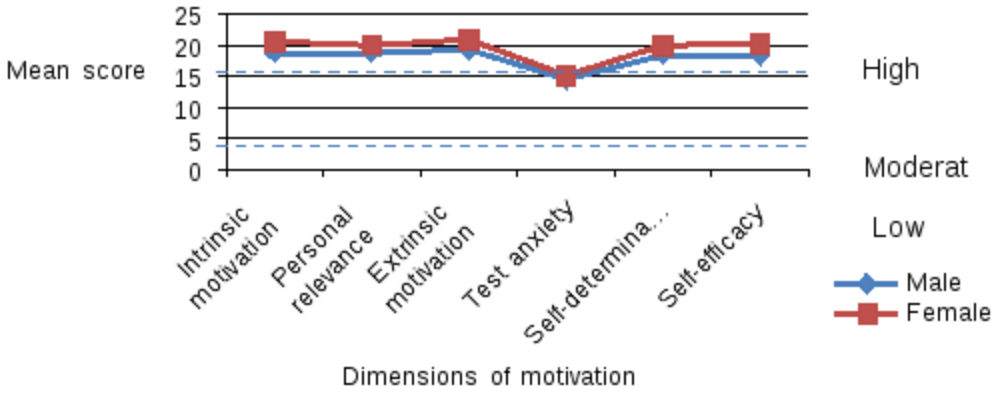

Figure 2: Graphical illustration of mean scores for motivational dimensions of girls and boys

Table 2: Mean scores for motivational dimensions of girls and boys

Dimension	Gender	N	Mean	SD	Leneve's test	p-value
Intrinsic motivation	Male	619	18.65	4.04	0.000	0.000
	Female	697	20.43	3.52		
Personal relevance	Male	619	18.65	3.69	0.015	0.000
	Female	697	19.94	3.41		
Extrinsic motivation	Male	619	19.05	3.79	0.000	0.000
	Female	697	20.77	3.30		
Test anxiety	Male	619	14.36	4.46	0.000	0.000
	Female	697	15.05	4.84		
Self-determination	Male	619	18.35	3.82	0.00	0.000
	Female	697	19.84	3.42		
Self-efficacy	Male	619	18.15	4.18	0.000	0.000
	Female	697	20.20	3.55		

Based on the results tabulated in Table 2 it was confirmed that there was a significant difference in students' motivational orientations towards learning science between girls and boys. Girls' level of motivation concerning each dimension of motivation was higher than that of boys.

Correlations between Motivational Orientations and Students' Performance in Science

Bivariate data analysis was conducted to find the association between overall motivation and its dimensions with students' performance in science regarding average term test scores for science. Pearson correlation coefficients were calculated to find out the strength and direction of relationships between the variables mentioned above. Results in Table 3 show significant and positive correlations between overall motivation and all the six motivational dimensions with students' mean performance. The values obtained ranged from 0.119 (test anxiety) to 0.359(overall motivation). As these values are less than 0.50 the existing relationships are considered low (Oosterhof, 1999). However, these significant and positive relationships, to a certain extent, can be taken into consideration as evidence for possible causal relationships between these variables.

Table 3: Correlations between overall motivation and motivational dimensions with average term test score for science

		Overall motivation	Intrinsic motivation	Personal relevance	Extrinsic motivation	Test anxiety	Self-determination	Self-efficacy
Average Term test scores	Pearson correlation	0.359**	0.286**	0.234**	0.289**	0.119**	0.256**	0.334**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000

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

Discussion

The average term test marks of science obtained in the three terms of 2015 and the first two terms of 2016 by the students in the sample ranged from 10 to 98 with a mean of 41.7 and a standard deviation (SD) of ± 17.9. Here, the average term test score is just above the pass mark. The findings of the study revealed that students were highly motivated to learn science. But this level is slightly higher than the level 'moderate.' Regarding motivational dimensions, the present study also uncovered that students have a high level of extrinsic and intrinsic motivation towards learning science. The high level of extrinsic motivation of the students is an indication of the doing of a task for a separable outcome, such as achieving a good grade, getting praise and rewards from parents and teachers. Particularly, as the group of the first year, undergraduate students participated in the study found whether to continue or leave their university career, their level of extrinsic motivation was at a climax. To maintain the higher level of extrinsic motivation Davis (1993) proposed teachers should give frequent, constructive feedback, praises and rewards to build students' confidence that they can perform well. From the perspectives of Self-Determination Theory, extrinsic motivation is described as a construct which consists of less autonomous and more autonomous components in a continuum (Ryan and Deci (2000). According to the theory quality of motivation which is predominantly autonomous or self-determinant is more important than quantity. Hence, if students' extrinsic motivation is enriched with highly autonomous aspects together with high intrinsic motivation would be very much fruitful in uplifting students' performance in science. Chirkov and Ryan (2001) point out that teachers and parents can facilitate students to experience the autonomy and social environments that promote autonomy which is crucial for optimal learning and achievement. Although students' relevance, self-determination, and self-efficacy are at higher levels, there is a need for further enhancement of those orientations to facilitate better performance in science. Probably, teaching science in such a way that students find it interesting and enjoyable will be the best attempt to further enhance students' motivation towards learning science concerning the above-mentioned dimensions. To provide students with such a learning environment, one best of the best teaching method that teachers can follow is group method. However, in Bangladeshi university system, especially at the junior level, such teaching methods are rarely being practiced because science curriculum is overloaded. Besides, it had been claimed that the activities relating to the competency levels identified in science subject are directed towards learning content and not so much to promote student-directed inquiry. Thus, it is vital to increase the proportion of student-centred teaching methods being practised in teaching science at the junior level.

Test anxiety among students towards learning science is at a moderate level. This indicates that

students are nervous and anxious at the feeling of not being able to achieve higher scores and better grades in science tests. It is reported that higher levels of test anxiety hurt students' performance (Cassady and Johnson, 2002) because it lessens students' confidence to cope with their learning tasks (Cowden, 2010). To reduce students' test anxiety teacher can take measures such as the provision of revision materials for the exams, reviewing subject contents that are more likely to be tested in exams, conducting mock exams and discussing most appropriate techniques to handle problems given in science exam papers.

Concerning gender, a statistically significant difference was observed between male-female students in mean term test score as well as in motivational dimensions. Girls who achieved a mean term test score of 45.4 ±18.0 outperformed boys whose mean term test score was 37.5 ± 16.8. This observation is in agreement with the national level studies conducted in the recent years and international level studies, for instance, TIMMS – 2011 (Martin, Mullis, Foy, & Stanco, 2012). Concerning gender, girls' mean scores for all the motivational dimensions were also higher than that of the boys. While girls express a high level of motivation for all the dimensions except test anxiety mean scores for boys were only at a high level of intrinsic motivation, extrinsic motivation, and personal relevance. The rest was at a moderate level. Zusman, Knox, and Lieberman (2005) have pointed out that girls are more likely than boys to engage in behaviour such as being present in class on time, sitting in the front desks of the class, studying the textbook, taking notes, and studying in a well-organized manner. Teachers can choose measures in teaching science so that boys also engage in such behaviors that would lead to developing their motivational orientations such as self-efficacy.

In sum, findings of the current study are significant as those findings provide a comprehensive picture about students' motivation regarding its dimensions and its impact on students' performance in science. Teachers' attention needs to be paid on motivational dimensions as they are reported to have a positive correlation with students' performance. If teachers are capable of fostering and enhancing students' motivation towards leasing science, it will increase the overall performance that indirectly enriches the young population to succeed in science and Technology stream in the world of work and their social lives.

Suggestions for Future Research

Benavot and Amadio (2004) state that when students are provided with proper curricula, learning materials, capable teachers, safety and security of the learning environment their achievement increases. Gillies and Quijada (2008) argue that while these factors are appropriate and relevant for all countries, the most immediately relevant considerations for developing countries have not yet been captured. The failure to focus on these factors undermines all investments in higher level interventions. Hence, in the broad sense, research studies that bring about the broad and deep understanding of the effect of different factors on students' performance in science is undoubtedly useful and recommended. The current study is one out of the few studies carried out in Bangladesh by referring to a representative sample of the whole Bangladesh.

It is recommended to follow an eclectic approach, for instance, both questionnaires and interviews that may yield a more elaborated view on students' motivation towards science. Also, longitudinal studies on motivational dimensions are also recommended so that changes in motivational orientations with time can be explored.

Conclusion

The current study provides information for teacher and the other stakeholders of the education system on students' motivation towards learning science. Understanding the effect of the motivational dimensions on students' performance in science will shed light on how to enhance the quality of university science to achieve more benefits out of the investment in tertiary education.

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