Relationships among Statistics Anxiety, Depression and Academic Performance

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Abstract

Statistics anxiety is one of the academic stresses faced by students. It has been identified in students with an adverse effect on their learning and performance. Statistics anxiety can adversely affect students' overall psychological condition and hence cause depression in them. Various measures have been developed in order to identify and assess statistics anxiety among students. Particularly no studies have focused on its relation with depression. Considerable amount of studies related to statistics anxiety has been done in English-speaking populations. However, no study has been done regarding this topic in Bangladesh. Therefore, this study aims to investigate the relationship between statistics anxiety, performance and depression among under-graduate students of Shahjalal University of Science and Technology, Sylhet, Bangladesh. Data was collected from a total of 411 undergraduate students who had enrolled Statistics course as a non-major course in their running semester during the months of January, 2019 to Jun, 2019 of SUST using statistics anxiety rating scale (STARS) and PHQ-9 (measure for depressive symptoms) questionnaires. It is found that 84.42% students were suffering from some sort of statistics anxiety. It is also observed that 85.4% students were dealing with some sort of depression. Among them 46% students were dealing with major depression. Statistics anxiety has been found to be significantly effecting students' performance and depression level (p-value <.001). Students suffering from high level of statistics anxiety were found to be suffering from high level of depression and attaining poor marks in academic exams. Statistics anxiety is found to affect students' performance and increase the level of depression in them. Findings of the present study would be helpful for the students,

teachers, even policy makers to design student friendly curriculum to reduce the statistics anxiety among students in future.

Keywords: Statistics anxiety, Depression, STARS, PHQ-9.

AMS Classification: 97C20.

1. Introduction

The need of basic statistics knowledge is increasing day by day as most of the development of our society relies on statistical studies. However, Statistics learning has become one of the greatest challenges among students at all levels of study (Maat & Rosli, 2016). Many students find it difficult to figure out statistical concepts and attain low levels of performance (Chiesi & Primi, 2010). High levels of anxiety can have an impact on reducing of working memory, distraction, discomfort and reasoning in students (Aronen, Vuontela, Steenari, Salmi, & Carlson, 2005). There is a form of anxiety found to be present in students related to Statistics learning (Zeidner, 1991). Statistics anxiety is defined as the feelings of anxiety confronted when taking a statistics course or when doing statistical analyses: that is, gathering, processing and interpreting data (Cruise, 1985). A huge proportion of students find statistics courses as the most anxiety-inducing courses in their curriculum (Zeidner, 1990). High levels of Statistics anxiety may lead students to experience learning difficulties, postpone taking statistics courses or statistics examinations, delay assignments, and attain lower academic achievements. Many authors have detected the presence of statistics anxiety in their students and documented a consistent negative relationship between statistics anxiety and course performance (Onwuegbuzie & Seaman, 1995; Valenzi & Zanakis, 1997; Zeidner, 1990). Zeidner (1990) described Statistics anxiety as a performance characterized by severe worry, unpleasant thoughts, mental disorganization, agonizing tension and physiological excitement when exposed to statistics content, problems, instructional situations or evaluative contexts. This academic stress or anxiety can lead students to depression, too.

Depression is relatively more common among adolescents, with the prevalence of clinic depression up to 28% and is increasing worldwide and depression maybe closely related to a student's academic performance (Dyson & Renk, 2006). Depression has a significant impact on an individual's ability to perform daily life

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activities (Chemers, Hu, & Garcia, 2001). Statistics anxiety can be a risk factor of both depression and lower academic performance.

Students with unfavorable experiences from mathematical or statistical courses or instructors are often scared and carry such memories in the form of anxiety. Students with adverse perspective toward statistics are thought to be highly anxious with regard to statistics (Baloğlu, 2007). Statistics anxiety can adversely affect student's performance and his or her overall psychological and physiological condition. Some psychological symptoms such as depression, frustration, panic, and worry are observed in students while expressing their concerns over statistics anxiety along with physiological signs of headaches, muscle tension, perspiration etc. (Onwuegbuzie, 1997). Anxiety and depression are salient threatening factors of lower academic performance. Statistics anxiety is a challenge for both the students and teachers of statistics. From the perspective of teaching, statistical anxiety, by definition, can be an a stumbling block to students' learning (Hamid & Sulaiman, 2014).

Furthermore, the considerable amount of studies related to statistics anxiety has been done in English-speaking populations. Therefore, only a limited amount of work exists to demonstrate if the phenomenon is found in other regions (Macher et al., 2013). According to Dunne et al., (2010), Asian students in particular often go through high academic burden, low satisfaction regarding their academic performances , intensive external pressure to study, and may suffer from more subject wise anxiety than their counterparts in English speaking countries. This burden of study can lead students to mental distress and has a detrimental effect on cognitive functioning and learning (Sultana, 2011). Pressure to succeed in school education is intense in East Asian countries, and appears to be increasing as society becomes more competitive (Dunne et al., 2010).

In Bangladesh, almost every student has to take statistics as a non-departmental course in their graduation period. They may go through mental stress caused by statistics anxiety which may lead to depression and affect their academic performances. As there is a negative relationship existing between statistics anxiety and achievement in statistics, it would be important for researchers and instructors to have a reliable and valid measure to identify students with statistics anxiety. Although, statistics anxiety scale was (SAS) adapted in Bangladeshi context and it is found to be psychometrically sound measure for identifying the

students with higher level of statistics anxiety (Paul, Parveen, Ahmed, & Aktar, 2018), no study has been done to identify the level of statistical anxiety with the help of Statistics anxiety ratings scale (STARS) in Bangladesh. Also, no study has been done to evaluate the effect of statistics anxiety on depression and students' performance in Bangladesh. Mental health of students is a neglected concern here. To reduce the amount of statistics anxiety confronted by undergraduate students, it is very important to address the relationships among statistics anxiety, depression and academic performance.

To the best of our knowledge, no study has been done up to this date in Bangladesh regarding this topic. This study aims to investigate the relationships among statistics anxiety, depression and students' performance in Shahjalal University of Science and technology (SUST), Sylhet, Bangladesh. Therefore, this study is going to be the first study regarding this topic in Bangladesh.

2. Method

2.1 Participants

To meet the objectives of this research, data was collected from a total of 411 undergraduate students who had enrolled Statistics as a non-departmental course in their running semester during the months of January, 2019 to Jun, 2019 of Shahjalal University of Science and Technology (SUST), Sylhet, Bangladesh. Students of seven departments participated in this study; they were from Economics (49), Public administration (51), Mathematics (66), Sociology (66), Economics special batch (15), Chemistry (40), Computer Science and engineering (70) and Social work (54).

2.2 Instruments

2.2.1 Statistics Anxiety Ratings Scale (STARS)

STARS developed by Cruise et al. (1985) is a self-report questionnaire which has 51 items, each scored on a 5-point rating scale to measure statistics anxiety. Higher scores on each scale are indicative of relatively higher levels of anxiety (Keeley et al., 2008). For calculating the scores, the responses are reverse-scored so that higher scores indicate more negative attitude or higher anxiety (Hamid & Sulaiman, 2014).

According to Cruise et al. (1985) STARS is a six-factor construct. They are:

- (i) Estimation of the worth of statistics (16 items),
- (ii) Anxiety regarding interpreting statistics (11 items),
- (iii) Test and class anxiety (8 items),
- (iv) Computational self-concept (7 items),
- (v) Fear of asking for help (4 items), and
- (vi) Fear of the statistics teacher (5 items).

The 51-items STARS consist of two parts. Part one consists of 23 items which assess statistics anxiety associated with situations where students come in contact with statistics. Individuals respond on a 5-point Likert scale that ranges from 1 = No Anxiety to 5 = Very much Anxiety. Part two consists of 28 items that measure the level of agreement with various statements about statistics and statistics teachers. Responses on these statements are made on a 5-point Likert scale that ranges from 1 = Strongly Disagree to 5 = Strongly Agree (Keeley et al., 2008). Item scores are aggregated for each factor and higher scores on each factor indicates higher levels of statistics anxiety (Chew, Dillon, & Swinbourne, 2018).

2.2.2 Measuring depressive symptoms

In this study, a depression assessment questionnaire named "PHQ-9" was used to assess the depressive symptoms of the students. The Patient Health Questionnaire (PHQ-9) is the depression module, which refers to symptoms experienced during the last two weeks (Yu, Tam, Wong, Hing, & Stewart, 2012). It includes nine items with individual score ranges from 0 (not at all) to 3 (nearly every day). The total sum score ranging from 0 to 27.

Using the PHQ-9 scores, depression severity measures with cut-off point: 0-4 none, 5-9 mild, 10-14 moderate, 15-19 moderately severe, 20-27 severe (Shinn et al., 2009). For this study last two levels moderately severe and severe was combined in one named "Severe" for individuals who had depression score ranging in 15-27. Validity of PHQ-9 has been assessed against an independent structured mental health professional (MHP) interview. PHQ-9 score \geq 10 had a sensitivity of 88% and a specificity of 88% for major depression (Shinn et al., 2009).

2.2.3 Evaluation of students' performance

Average marks of mid-term examinations were used as the indicator of students' performance. Mid-term exams are usually taken out of 20 marks at SUST. Higher mark out of 20 is an indicator of good performance, the lower mark out of 20 is an indicator of poor performance.

2.3 One-way ANOVA

In statistics, one way analysis of variance (abbreviated one-way ANOVA) is a technique that can be used to compare means of two or more samples (using the F distribution). This technique can be used only for numerical response data, the "Y", usually one variable, and numerical or (usually) categorical input data, the "X", always one variable, hence "one-way".

The ANOVA tests the null hypothesis that samples in all groups are drawn from populations with the same mean values. To do this, two estimates are made of the population variance. These estimates rely on various assumptions. The ANOVA produces an F-statistic, the ratio of the variance calculated among the means to the variance within the samples. If the group means are drawn from populations with the same mean values, the variance between the group means should be lower than the variance of the samples, following the central limit theorem. A higher ratio therefore implies that the samples were drawn from populations with different mean values (Blair, 1981).

3. Results

Among 411 undergraduate students, the percentage of male students was 67.64% and that of female students was 32.36%. As there were students from both science and social science faculties, we categorized them into two groups: Science (176) and Social Science (235). The percentage of students from science faculties was 42.82% and that of social science faculties was 57.18%. The mean of the STARS score was 141 and standard deviation of 25.1. The minimum and maximum values of the total scores were 65 and 210, respectively. [Table 1]

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Descriptive Statistics	Value
Mean	141
Standard deviation	25.1
Minimum	65
Maximum	210

 Table 1: Descriptive statistics of STARS response

The total STAR score was classified into three categories of low, moderate and high to indicate the level of the respondents' anxiety towards statistics. Any score within 65 to 112 was categorized as 'Low', score within 113 to 161 was labeled as 'Moderate' and score within 162 to 210 was for 'High'. Table 2 shows the frequency of the different categories.

Category	Frequency	Percent	
Low	64	15.57	
Moderate	260	63.26	
High	87	21.16	
Total	411	100	

 Table 2: Classification of STARS levels

Among 411 students 64 (15.57%) students were suffering from 'low' level of statistics anxiety, 260 students (63.26%) were suffering from 'moderate' level of statistics anxiety and 87 (21.16%) students were suffering from 'high' level of statistics anxiety. It may conclude that 84.42% students were suffering from moderate to high level of statistics anxiety.

Table 3 presents the depression status of the students. It is seen that 14.6% students had no depression, 38.7% students had mild depression, 27.0% students had moderate level of depression and 19.71% students had severe depression. It may be concluded that almost 85.4% students were dealing with some sort of depression. It is also seen that for the students from science faculties, 7.54% students had no depression, 14.11% students had mild depression, 11.68% students had moderate level of depression and 9.49% students had severe depression. Whereas for the students of social science faculties, 7.06% students had no depression, 24.57% students had mild depression, 15.33% had moderate level of depression, 15.33% had moderate level of depression, 10.22% students were dealing with severe depression.

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Characteristics		Depression Level N (%)				Total N (%)	p- value
		None	Mild	Moderate	Severe		
Gender	Male	42(10.22)	110(26.76)	73(17.76)	53(12.90)	278(67.64)	.887
	Female	18(4.38)	49(11.92)	38(9.25)	28(6.81)	133(32.36)	
Group	Science	31(7.54)	58(14.11)	48(11.68)	39(9.49)	176(42.82)	
	Social Science	29(7.06)	101(24.57)	63(15.33)	42(10.22)	235(57.18)	.140
STARS Score		126.68±24.05	137.95±23.83	145.30±22.26	151.85±25.79	393	<.001
Performance		13.0714±4.83	13.051±4.57	13.96±3.78	14.777±3.95	411	.701

Table 3: Descriptive Statistics for depression

The Chi-square test between gender and depression category showed that there is no association between the different levels of depression and gender at 5% level of significance (p-value = 0.887). The Chi-square test between faculties (Science and Social Science) and depression category (None, Mild, Moderate, Severe) also showed that there is no association between them at 5% level of significance (p-value = 0.140).

One-way ANOVA between depression category and STARS Score showed that the mean STARS Scores were different for different levels of depression at 5% level of significance (p-value < 0.001). Students who had no depression had a mean STARS Score 126.68 with SD 24.05. The students who had mild depression had mean STARS Score 137.95 with SD 23.83. Again, student having moderate depression had mean STARS Score 145.30 with SD 25.79. One-way ANOVA also showed that the performance of the students were not affected by the level of depression (p-value = 0.701).

Figure 1 shows that as the depression level is increasing the STARS scores is also increasing. Mean plot of STARS scores for different levels of depression clearly indicated that the students having higher mean STARS scores were dealing with higher level of depression.



Figure 1: Mean plot of STARS scores for different levels of depression

Among the students 4.38% female and 10.22% male students had no depression during the study period, 11.92% female students and 26.76% male students had mild depression. 9.25% female students and 17.76% male students were moderately depressed, 6.81% female students and 12.90% male students were dealing with severe depression. [Figure 2]

Severe	6.81%			
Moderate	9.25%			
Mild	26.76% 11.92%			
None	4.38%			
0.0	00% 5.00% 10.00% 15.00% 20.00% 25.00% 30.00% 35.00% 40.00% 45.00%			
• Male = Female				

Figure 2: Stacked bar chart showing percentage of male-female for different levels of Depression

Table 4 presents the One-way ANOVA to compare the means. It is showed that there is significant difference between the means STARS scores among two groups (Science and Social science) at 5% level of significance (p-value < 0.001). The students of science had a mean STARS score 135.04 with SD 23.37 and the students of social science had a mean STARS score 145.83 with SD 25.46. One-way ANOVA between gender and performance showed that the mean performance of male and female were significantly different (p-value < 0.001). For female students, the mean of performance was found to be higher (13.95) than that of male students (12.57). It is also showed that there was no significant difference between the mean STARS Scores of male and female students (p-value = 0.201). For male and female students the mean statistics anxiety score was 140 and 143.36, respectively. One-way ANOVA between STARS anxiety level and Depression Score showed that the mean of depression score was significantly different between the groups of 'low', 'moderate' and 'high' level of anxious students at 5% level of significance (p-value < 0.001).

	Independent variable/Grouping factor	Dependent variable	p-value
One-way ANOVA	Group	STARS Score	< 0.001
One-way ANOVA	Gender	Performance	< 0.001
One-way ANOVA	Gender	STARS Score	0.201
One-way ANOVA	Statistics anxiety level	Depression Score	< 0.001
One-way ANOVA	Statistics anxiety level	Performance	< 0.001
One-way ANOVA	Gender	Depression score	0.580

Table 4: One-way ANOVA

Again, for STARS anxiety levels and Performance, it is showed that the mean of Performance was significantly different between the groups of 'low', 'moderate' and 'high' level of anxious students at 5% level of significance (p-value < 0.001). One-way ANOVA between depression score and gender showed that there was no significant difference between the mean depression scores of male and female

students (p-value = 0.580). More specifically, male and female students both had been facing the same depression level at that time.

Mean plot of Statistics anxiety level vs. depression score in Figure 3 clearly showed that the depression score was increasing with the level of anxiety. While, mean plot of Statistics anxiety level vs. Performance in Figure 4 showed that the mean performance was decreasing with the level of anxiety. So, we could conclude that the mean performance of students were decreasing as the level of anxiety was increasing



Figure 3: Mean plot of depression score according to Statistics anxiety level



Figure 4: Mean plot of Performance according to Statistics anxiety level

Table 5 shows Pearson correlation analysis to see if there is any relationship existing between STARS Scores and performance. The null hypothesis was rejected at 5% level of significance (p-vale < 0.001) and the value of Pearson correlation coefficient was found to be -0.219. Therefore, it may be concluded that though the relationship between STARS Scores and academic performance is low, it is negative.

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Variable 1	Variable 2	p-value	Pearson correlation coefficient
STARS Score	Performance	<.001	-0.219
STARS Score	Depression	<.001	0.290
	Score		
Depression Score	Performance	.748	-0.016

 Table 5: Correlation analysis

Again, Pearson correlation analysis was done between STARS Scores and depression to see if there was any relationship existing between them. Null hypothesis was rejected at 5% level of significance (p-vale < .001) and it is found that there exists a positive relationship between statistics anxiety and depression. There was no significant correlation found between Depression Score and performance. (p-value = 0.748).

4. Discussion

The purpose of this study was to see the relationship among statistics anxiety, depression and academic performance of undergraduate students. As expected, and in line with previous research (Berk & Nanda, 1998; Earp, 2007; Hamid & Sulaiman, 2014; Keeley et al., 2008; Macher, Paechter, Papousek, & Ruggeri, 2011; Macher et al., 2013; Onwuegbuzie & Wilson, 2000; Schneider, 2011; Zeidner, 1990, 1991; Zimmer & Fuller, 1996), our analyses also showed that statistics anxiety is negatively related with students' academic performance in statistics. Students who were identified with high statistics anxiety were tended to attain low performance in statistics mid-term exam with respect to those who were identified with low statistics anxiety. Statistics anxiety level according to gender has been studied by various researchers (Harvey, Plake, & Wise, 1985; Mogull, 1989; Ware & Chastain, 1989). In particular, women tend to report higher levels of anxiety in statistics anxiety levels were not found to be significantly different among male and female.

To the best of our knowledge no study had compared the statistics anxiety levels of students for science and social science faculties. This study took into account three departments from Science faculties and four departments from Social science faculties. The results showed that the statistics anxiety level in social science faculties is significantly higher than that of science faculties.

According to some researches males and females do not differ in their statistics performance (Baloğlu , 2002). However, this study showed that mean performance was significantly different between male and female students. Particularly, female students achieved more marks in mid-term statistics exam than male students.

Although in a qualitative study, Onwuegbuzie, Ros, and Ryan (1997) found that students affected by statistics anxiety experience from mild discomfort to depression, the present study combined two questionnaires STARS and PHQ-9 questionnaires to get a clear insight to that relationship between statistics anxiety and depression. This present study showed that statistics anxiety has a significant effect on depression. Students who were identified with high level of anxieties were also suffering from high level of depression compared to them who were identified with low level of anxieties.

Studies on risk factors associated with depression have yielded varying results. Depression has always been found to be frequent in women (Bostanci et al., 2005). However, for this present study depression was not found to be more frequent for female students compared to men. More specifically, both male and female students were going through same level of depression.

This present study showed that the depression level of students of both science and social science faculties were found to be similar. There was no significant difference between the depression levels of students of these two faculties. Although there was negative correlation identified between academic performance and depressive symptoms (Bostanci et al., 2005), this present study could not address any significant relationship between them. Statistics anxiety is found to have negatively correlated with academic performance and positively correlated with depression.

To summarize, there is an inverse relationship identified between statistics anxiety and academic performance of undergraduate students. Statistics anxiety has also been found to affect students' mental health condition and may be risk factor acting behind depression in students, too. As the level of statistics anxiety in students increased, the level of depression also increased and thus the performance of students decreased. The students with high level of statistics anxiety were tend to have high level of depression and thus attained low marks in statistics exam.

Findings of this research about the role of statistics anxiety in statistics achievement and inducing depression might be of great value to the instructors. An educator plays an important role in helping students to reach their highest potential that they worth. The awareness of this finding may be useful for educators to consider teaching strategies that help both low and highly anxious students. Educators may engage in a variety of student friendly techniques to manage their students' anxiety which would be very helpful for the students in future. Practical course works i.e. field works may be helpful for the students to understand statistics clearly. These would help students to perceive statistics as a less anxiety inducing subject. Supportive learning environment can help students to get over their anxieties and actually make them love what they learn. Findings of the present study would be helpful for the students, teachers, even policy makers to design student friendly curriculum.

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