

Chapter #16

GENDER DIFFERENCES IN PHYSICS ANXIETY AT A SOUTH AFRICAN UNIVERSITY

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ABSTRACT

From literature, it is known that anxiety for physics amongst female students appears to be higher than for male students. This study is carried out to determine the role that gender plays in their preference to physics and the anxiety they experience in the subject. To measure the anxiety that students experience in physics, use is made of a modified physics anxiety questionnaire. This questionnaire has a rating scale from +1 (minimal anxiety) to + 5 (very high anxiety). 64 students participated in this study. Results for this study is presented both in numeric and in percentage form. From this study, it was revealed that female students have a significantly higher level of physics anxiety compared to their male counterparts. Besides the females having a higher level of anxiety in the thought of seeing their physics assessment marks, both males and females have a similar level of anxiety for the item relating to fear of failing their physics tests or examinations. The anxiety experienced by male students is their desire to excel in the subject and thus they appear to be more focused in their physics studies, while female students are overcome by the complexity of the subject and present a higher level of anxiety in the subject.

Keywords: physics, gender, questionnaire and anxiety.

1. INTRODUCTION

Physics is feared as a difficult subject but how both males and females perceive it might be different. If the emotions of fear are not properly checked then this could lead to anxiety in physics amongst the students (Manilito, Gardo, & Elio, 2016). The net effect of all this is a lack of success and a perceived fear for the subject. Gender could be a factor in determining students' anxiety levels in physics (Manilito et al, 2016). This concept "anxiety" has a variety of meanings. According to Sapir & Aronson (1990), Scovel (1978) and Sahin, Caliskan, & Dilek (2015), anxiety is defined "as an unpleasant emotional state of uncertainty, fear, worry, discomfort, loss of control, and expectation that something bad will happen". This can impact the way one learns. In this context, anxiety is perceived as a feeling of fear or worry that something will happen. Such a variable could be responsible for their underperformance in the subject. In a sense anxiety could be their fear or discomfort in attending something challenging such as a test or an examination. Most of the time anxiety reveals itself as a positive or a negative construct. In a positive sense, anxiety can lead to an enhancement in learning (positive stress), while on the other hand, it can impede one's learning process (negative stress) (Sahin et al., 2015).

It is generally accepted, from literature, that male students significantly outperform their female counterparts in physics (Agra, Fisher, & Beilock, 2017). However, some research points towards both males and females having similar anxiety levels in physics (Brownlow, Jacobi & Rogers, 2000). A subject such as mathematics, which is the backbone of physics, is responsible for higher levels of anxiety amongst female students and can be regarded as a good predictor for gender prescriptor of anxiety levels (Devine, Fawcett, Szucs, & Dowker, 2012; Agra et al., 2017). It is of interest to note that female students outperform their male counterparts in physics in the lower grades of school but that reverses itself in high school (Labudde, Herzog, Neuenschwander, Violi & Gerber, 2000; Sahin et al., 2015). Accordingly, this is reflected as lesser levels of physics anxiety for male students. Female students generally show avoidance for science-related subjects and indicative of a disregard or disinterest they have for the subject.

Science anxiety can be defined as a vague fear that arises from many learning situations (Mallow, 1978; Sahin et al., 2015). As side from the negative perceptions of anxiety, anxiety itself can reveal itself as an “intervening self-message” (Mallow & Greenburg, 1983) and in this context a person will be constantly saying negative statements about the subject, an example of which is: “I cannot understand physics”. Negative statements like these only serves to produce more anxiety and reduces performances in the subject. Further, science anxiety can also be affected by the family, school or environmental issues. Aside from the negative thoughts arising from science anxiety, unwanted negative memories of past can be ingrained in a person. In this sense, the student maybe insulted by a science teacher in the past, memory of a science experiment that went all wrong, discouraging comments about science from a parent, etc. (Mallow & Greenburg, 1983, Sahin et al., 2015).

According to literature, there is much research on mathematics anxiety and few researches on science anxiety and lesser research on physics anxiety (Agra et al., 2017), hence the aim of this paper is to shed more light on this topic with specific reference to the impact of physics anxiety as a function of gender amongst South African students. Most South African students have done badly in the TIMMS assessment, and in particular mathematics and physics. It is in this context that anxiety in physics is explored with gender being the added variable.

1.1. Research question

What are the differences in physics anxiety amongst South African university students as a function of gender?

1.2. Background

Gender differences in STEM subjects (Shepherd, 2017) have shown that women experience more anxiety in these subjects compared to men, with physics being the core of the subjects. This is taken in context of South African students at South African universities. It was shown in 2012 that less than 30% of the female students have enrolled for STEM subjects and show avoidance for these types of subjects in South Africa. However, it can be said that more female students have enrolled for non-STEM subjects. In comparison to other subjects like psychology, men also appear tend to experience lesser anxiety compared to women (Mwamwenda, 1993).

Anxiety is an affective variable that influences one’s performance and achievement in the subject (Sahin et al., 2015). A low level of anxiety maybe associated with a positive effect on achievement and performance while on the other hand high levels of anxiety may negatively impede such performances. These sentiments are further echoed by Czerniak & Chiarelott (1984), who have indicated that science anxiety is a factor that influences

achievement and that a high science anxiety may result in a result in lower achievement in the subject (Sahin et al., 2015). Underrepresentation of women in the hard core sciences, especially physics is a cause for concern. In general, girls have a higher interest for science than males at the lower grades but that interest fades once they enter the high school phase and this has an impact on their career choices (Sahin et al., 2015). Amongst the reasons for such a behavior is their negative attitude towards the subject (Sharma, Stewart, Wilson, & Gokalp, 2013) and the anxiety they develop during their schooling (Sahin et al., 2015). According to Beyer (1991), science anxiety is an obstacle that women face and that impedes them from making important career choices.

2. METHODOLOGY

To measure students' anxiety levels in physics, use is made of a questionnaire called the "Physics Anxiety Questionnaire", downloaded from the website, which was uploaded by Jamie Bagundol on the 8th September 2016 and retrieved from SCRIBD on the 2nd May 2019. This questionnaire was ideal as it contained questions that pertains to anxiety in physics. The questionnaire was comprised of fifteen items and scored on a Likert-type scale ranging from +5 (very high anxiety) to +1 (minimal anxiety). The participants in this study have enrolled for a six-month semester module (basic science in physics) in Emergency Medical Care and Podiatry at the University of Johannesburg in South Africa. With slight modifications to the original questionnaire, this questionnaire was then administered to 27 males (42%) and 37 females (58%). Thus, a total of 64 students participated in this study. These students come from different ethnic groups (Indians, Whites and Africans) in South Africa. The questionnaire itself consisted of some anxiety questions such as: "I sweated a lot whenever I took my physics exams/tests" and "I feared failing my physics exams/tests". Besides the questionnaire being given to elicit students' anxiety levels in physics, students' anxiety levels as a function of gender is also gathered. Before administrating the questionnaire, permission was sought from the students and an explanation as to why this research is done. Participation in the survey was voluntary and the students did not have to fill in their names, except to indicate male or female. It was explained to the students that the data collected was used for scientific research. Results are presented in both the numeric and percentage form. A higher percentage is reflective of a higher response and a greater anxiety towards the subject physics.

3. RESULTS AND DISCUSSIONS

The results between the genders on the issue of anxiety levels in physics is shown in table 1 below.

Table 1.

Differences in the anxiety levels between male and female students. Note that the categories very high anxiety and high anxiety levels have been combined, as well as partial and minimal anxiety. There are a total of 27 males and 37 females. The first row within each of the rows represents the number of students, while the second sub-row represents its respective percentages.

No	Physics anxiety	Men			Females		
		Number: Very high anxiety to high anxiety	Number: Moderate anxiety	Number: Partial to minimal anxiety	Number: Very high anxiety to high anxiety	Number: Moderate anxiety	Number: Partial to minimal anxiety
1	I was worried when I was informed that physics was a requirement for my course	5	6	16	8	7	22
		19%	22%	59%	22%	19%	59%
2	I felt a lot of pressure/stress/burden in my physics subject	3	7	17	8	11	18
		11%	26%	63%	22%	30%	49%
3	I felt my heartbeat faster whenever I went to my physics class	1	1	25	3	6	28
		4%	4%	92%	8%	16%	76%
4	I was worried about being called in my physics class	2	4	21	7	3	27
		7%	15%	78%	19%	8%	73%
5	I cringed when I had to go to my physics class	4	1	22	8	4	25
		15%	4%	81%	46%	11%	67%
6	I felt uneasy when asked to recite in my physics class	2	6	19	6	10	21
		7%	22%	70%	16%	27%	57%
7	I could hardly concentrate in my physics class	2	3	22	3	6	28
		7%	11%	82%	8%	16%	76%
8	I could not do my physics assignment alone	2	2	23	4	7	26
		7%	7%	86%	10%	19%	71%

9	I had difficulty understanding physics concepts	1	2	24	7	4	26
		4%	7%	89%	19%	11%	70%
10	I could not sleep well before every physics test/exam	1	6	20	11	2	24
		4%	22%	74%	30%	5%	65%
11	I feared failing my physics tests/exams	10	3	14	14	8	15
		38%	11%	52%	38%	22%	41%
12	I sweated a lot whenever I took my physics exams/tests	3	5	19	6	7	24
		11%	19%	71%	16%	19%	65%
13	My mind seems to go blank during physics assessments	3	1	26	6	5	26
		11%	4%	85%	16%	14%	71%
14	I fear to see my assessment marks	3	6	18	13	4	20
		11%	22%	67%	35%	11%	54%
15	My fear of physics makes me unable to focus in class	3	3	22	4	4	29
		11%	11%	78%	11%	11%	79%

This study was undertaken to determine students' anxiety levels in physics as a function of gender. Analysis of the results reveals that there are gender differences in anxiety between males and females for the subject of physics. Females have a higher level of anxiety compared to the males. This concurs with the research undertaken by Mallow (1994), Udo, Ramsey, Reynolds-Alpert, & Mallow (2001) and Sahin et al., (2015). It is generally observed that male students have displayed minimal anxiety for most items of the questionnaire, except for item 11 (38%) and below a moderate level for item 2 (26%) in their anxiety levels for physics. For the females there appears to be a significantly higher levels of anxiety experienced by them in comparison to their male counterparts. In this respect, a relatively high level of anxiety was observed for items 5, 10, 11 and 14 in the questionnaire.

According to the males, their greatest fear is the fear of failing their physics tests or examinations. To a smaller extent, they appeared to worry about being informed that physics (non-major) was a requirement for their course curriculum. On a positive note, they have experienced partial to minimal anxiety for items in the questionnaire relating to their excitement in attending their physics classes (such as item 3, 92%). For the female students, a similar but to a lesser level of anxiety was experienced (item 3, 76%). Male students appear to be devoid of a cringe in their behavior when they must attend a physics class (item 5, 81%). Their physical appearance appears to be one of excitement and not walking around with

drooping heads. Such a behavior is not observed amongst the female students, where high levels of anxiety or stress was observed (item 5, 46%) when they walked to their physics classes. Despite their differences in anxiety, both males and females display a high level of concentration when they are in a physics class (item 7, males 82% and females 76%). On the aspect of understanding of physics concepts, the males take a lead in this regard and have a minimal anxiety (item 9, 89%) while the females appear to lag slightly behind with a minimal anxiety level of 70% in this aspect. In terms of working independently, male students aim to work more independently than the females and this is reflected in their comparative anxieties for this item in the questionnaire (item 8, males 86% and females 71%). A similar level of anxiety was observed for item 13, where students appear to be more focused and alert in class during physics assessments (males 85% and females 71%). Likewise, both males and female students have little anxiety when it comes to being focused in class and thus have little fear for the subject and this is a little surprising for the female students (item 15: males 79% and females 78%).

A relatively large number of female students (item 10, 30%) have sleepless nights before their physics assessments. In comparison with their male counterparts, it is observed that at least 74% of them are relatively more relaxed before such assessments. These anxiety levels amongst the females could be accountable for their underperformance in the subject. This item correlates well with item 11 for the females, in their fear of failing such assessments (38%). A relatively small number of females appear to have minimal anxiety before such assessments (41%). In this instance, at least half the male students also appear to have minimal anxiety levels before such tests and assessments (52%). Another item, item 12 indicates that both genders appear to have sweated less when they took their physics tests or examinations (males 71% and females 65%). In this respect, it means that they have experienced minimal anxiety during such assessments. A lack of sleep can be a positive or a negative factor in terms of test preparation. Some may be stressed to do well, or some may be stressed due to under preparation in the subject. In tandem to this item is item 14, where 35% of the females appear to have a lot fear in seeing their assessments marks compared to the males where only 11% of them have such a fear. Of interest to this item is that 67% of the males have a minimal fear for observing their marks compared to 54% for the females.

Further analysis of the results reveals that females have particularly minimal levels of anxiety for three items of the questionnaire and they are items 3, 7 and 15. In comparison to the males, they have a relatively much higher percentage for most of these items except for item 15, meaning lesser anxiety levels. Item 3 when compared with item 2 reveals that despite the female students having a minimal fear of being in a physics class, they still have a moderate to high anxiety of the burden and stress of being in a physics class (about 50%) compared to the males that have a minimal anxiety (63%) of being in those classes. Surprisingly, both males and females have a similar level of anxiety (78% for the males and 79% for the females) in the fear of the subject, which results in them being unable to focus. Despite all this, both males and females are always alert in class without their minds going blank during physics lessons (item 13: males 85% and females 71%) and thereby experience minimal levels of anxiety. In terms of their confidence in the physics class, both genders appear to have great confidence in class, and this is reflected from the minimal anxiety scores between them for item 4 (item 4: males 78% and females 73%).

However, if the students were required to recite in a physics class, the males would take the lead (item 6: males 70%) and would have experienced a minimal amount of anxiety for this item compared to the females who would have rather experienced a little more stress (item 6: 57%).

4. CONCLUSION

This study was undertaken to determine the differences in physics anxiety amongst South African students as a function of gender. It is observed from this study that there are many similarities and disparities between the genders with respect to physics anxiety. Males have displayed minimal anxiety for most items of the questionnaire except for the item relating to the fear of failing their physics tests or examinations. Comparatively females have displayed higher levels of physics anxiety in this study. However, there are many items for which both genders have displayed similar levels of physics anxiety and they are: fear of being called to the front of the class, confidence in studying the subject physics, lack of concentration in class and fear of being unable to focus in class. The results of this study will contribute to a better understanding of anxiety in physics amongst genders, which is important for physics practitioners in putting steps forward to bring back the confidence of women in physics.

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