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Article

Self-Assessment of Students' Anxiety during High Stake Laboratory Work Examinations

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Abstract

The present study intends to explore the level of practical examination anxiety among secondary and higher secondary school students and its causes and remedies. A self-developed Perceived Science Practical Anxiety Scale (PSPAS) was used to collect quantitative data from 900 science students of two districts of central Punjab: Sargodha and Faisalabad. Moreover, 50 students were interviewed to explore their perceptions of the causes of science practical examination anxiety and the remedies to reduce it. All students had recently taken science practical examination and therefore had first-hand vivid experience of science practical examination anxiety. The analysis of responses in the questionnaire revealed that on an average more than half (61.50 %) of the students experienced anxiety during practical examination. Fourteen sources of anxiety during practical examination were ranked and synthesis of qualitative data from interviews recorded five categories of anxiety causes: shortage and unavailability of the materials, lack of practice, harsh behaviour of laboratory personnel, over loaded syllabus and lack

of guidance. The students' opinion regarding reducing anxiety was synthesized into four themes: relaxation during practical examination, individual level preparation, completion of practical syllabus well before time and training of laboratory personnel. The findings of the study may be beneficial for teachers, school mangers and policy makers and those who are responsible for the preparation and execution of examination policies, to reduce anxiety among students.

Introduction

Practical work in laboratory is the essence in the learning of science and is a compulsory component of science education (Hofstein & Lunetta, 2004). Examination of practical work in laboratory is part of the overall evaluation of students' academic achievement. Examinations and anxiety are closely related in general. Level of anxiety up to certain limit contributes positively, but beyond its threshold it usually affects students' performance negatively. Various factors may make students anxious leading to their low performance during practical examination (Al-Abri, 2010); these factors include physical conditions of the laboratory, shortage of equipment, shortage of chemicals, student's past laboratory experiences and laboratory safety rules.

Anxiety can be divided into trait anxiety and state anxiety (Clark & Beck, 2011). Trait anxiety refers to the anxiety that is chronic and pervasive across situations and is not triggered by an event. On the other hand, state anxiety refers to the anxiety that occurs in specific situations and usually has a clear trigger. In view of that, the practical examination anxiety may be labelled as a state anxiety. Not all people who have high state anxiety have high trait anxiety, but those who have high trait anxiety are more likely to experience state anxiety (Barnes, Harp, & Jung, 2002). For that reason, practical examination (state) anxiety may affect negatively the performance of those students who are used to experience (high) trait anxiety.

Practical examination anxiety is a widely researched area at present in the world. The researchers (Mazzone et al., 2007; Stöber, 2004; Woldeamanuel, Atagana, & Engida, 2013) have provided evidence supporting the link between practical examination anxiety and the performance. Despite the availability of

research studies far and wide, there is a dearth of literature in Pakistani context. The researchers have found a few studies about practical examination in medical sciences in Pakistani context (Hashmat, Hashmat, Amanullah, & Aziz, 2008). The present study may fill this gap in research literature in Pakistan. Employing the self-assessment of students' perception, the present study intends to explore:

1. How do students rank given sources of practical examination anxiety?
2. What are the causes of anxiety during practical examination?
3. What are the precautionary measures to reduce anxiety during practical examination?

Literature Review

Anxiety is a feeling of uneasiness and worry; it is an exaggerated response to a situation subjectively perceived to be threatening (Bouras & Holt, 2007).

Teigen (1994) explains that according to *Yerkes-Dodson Law[1]*, an optimum level of excitement is essential for better performance in a competitive event such as an examination. On the other hand, performance is affected negatively when the level of excitement exceeds that optimum, which then refers to anxiety.

Students' feeling of uneasiness or nervousness (fear of failing) is termed as the examination anxiety. Beidel and Turner (1988) wonder whether examination anxiety is a unique anxiety disorder or whether it is a specific type of social phobia (which is a type of anxiety disorder). Later in 1997, Rapee and Heimberg classified examination anxiety as a type of social phobia. It has been noted that we are living in a test-conscious, test-giving world of examinations, where; at least in part, our future course of life depends largely on our performance at the examinations. Anxiety as a determining factor of performance at the examinations has been documented by some researchers like Hembree (1988) and Seipp (1991).

Very recently it was found (Ballen, Salehi, & Cotner, 2017) that examination anxiety negatively impacted performance of only female students. Colbert-Getz,

1 In its original form, the law was intended to describe the relation between stimulus strength and habit-formation for tasks varying in discrimination difficultness.

Fleishman, Jung and Shilkofski (2013) revealed that female students with high anxiety scored higher and furthermore, they were more accurate in self-assessment as compared to their male counterparts with high anxiety; however, they found no gender differences for students with moderate or low level of anxiety.

Examination anxiety is categorised as state anxiety. Sansgiry and Sail (2006) say that it is a situation specific trait that refers to the anxiety states and worry conditions that are experienced during examinations. Researchers (Hashmat et al., 2008; Kurbanoglu & Akim, 2010) have been investigating into the negative effect of the examination anxiety on the academic performance. Anxiety symptoms are associated with impairment of memory and cognitive functions and can lead to poor performance and failure (Mazzone et al., 2007).

Therefore, reducing stress in laboratory conditions may add to improved learning of complex laboratory work (Bowen, 1999). It may be interesting to mention that before this, Zeidner (1998) had proposed three dimensional concept of examination anxiety on the pattern of taxonomies of education objectives i.e. cognitive (psychological conditions such as negative self-concept and lack of confidence during examinations); affective (physiological conditions like tension muscles and trembling); behavioural (developmental conditions as procrastination, avoidance, etc.).

Putwain (2008) identified that Orbach, Lindsay and Grey, (2007), Gregor (2005), Flaxman, Bond and Keogh, (2002) and Sarnoff, Lighthall and Waite, (1958) had made a seminal contribution to research literature on examinations anxiety in UK. After an extensive meta-analysis of 562 research studies, Hembree (1988) concluded that examination anxiety is a strong determinant of students' poor academic performance. In Turkey, Berber (2013) collected data from 245 prospective teachers on Physics Laboratory Anxiety Scale to determine their anxiety. The results showed prospective teachers feel anxiety in physics laboratory examination.

In Pakistan, there is a dearth of research studies regarding students' anxiety. The present study was planned to bridge the gap in literature. The study envisaged to explore level of practical examination anxiety among secondary and higher secondary school students. The study further explored the causes of practical

examination anxiety among students and proposed remedies to reduce it.

Methodology

The researchers in this study used the mixed method to explore the causes of practical examinations anxiety among secondary and higher secondary school students, and thereafter proposes measures to reduce it, thus making an additive effect to their overall performance.

Sampling

Conveniently selected sample comprised 900 students with the following details: 520 students of secondary school certificate and 380 from higher secondary school certificate, out of which 276 students were from rural and 624 students from urban background. 565 were female and 335 were male students. Due to time and financial constraints, this study was delimited to two districts - Faisalabad and Sargodha. The study targeted students who had recently taken practical examinations of SSC and HSSC under the Boards of Intermediate and Secondary Education (BISE) in the above said two districts.

The secondary school students were located through their colleges in which they were enrolled for HSSC (Grade 12) pre-medical and pre-engineering first year class. For this purpose, four public sector colleges (1 urban male, 1 urban female, 1 rural male and 1 rural female) were selected from each district through convenient sampling. First year students of HSSC pre-medical and pre-engineering at colleges were under focus for the selection of sample because they had recently taken practical examinations of SSC level. This ended up in selecting 520 students of SSC as first part of the sample.

The students from HSSC were located through the universities in which they were enrolled for any of the following BS programs: physics, chemistry, zoology or botany. For this purpose 2 public sector universities were selected conveniently. At second stage, 4 science departments (physics, chemistry, zoology and botany) were conveniently selected from each university. The students in BS first semester were selected because they had recently taken the practical examinations at HSSC examinations of BISE. This process produced second part of the sample containing 380 students from HSSC.

Instrument

Two research instruments were used for data collection: questionnaire for quantitative data and interview protocol for qualitative data. The questionnaire was developed on the lines of the research studies conducted by researchers like Berber (2013) and Bowen (1999). The questionnaire consisted of fourteen sources of anxiety during practical examinations: shortage of time, lack of practice, accuracy of practical, examiner phobia, quality of notebook, labelling specimens/slides, safety and physical conditions, handling of materials, drawing/labelling diagrams, dissection, collecting, recording /graphing data, drawing conclusion, working with other students and science laboratory. Students were expected to rank these sources of anxiety during practical examinations.

In order to establish the validity of the questionnaire it was discussed with five science teachers working in schools and eight research professor in a local university as suggested by (Leedy & Ormrod, 2010) and (Lewis & Cuevas, 1996). The experts were explained in detail the research questions of the present study. They critically reviewed the statements for the content, structure and language. The entire suggestions were scrutinised and discussed with the experts and necessary changes were incorporated.

The questionnaire was discussed with 16 students studying at the final stages of SSC and HSSC level. They were asked to mark any word or sentence they found vague, imprecise and/or difficult to understand. This concluded into restatement of 11 items making them more precise and understandable for the respondents.

Researchers believe that pilot testing of the instrument reduces ambiguity of items and therefore enhances the reliability (Barnes, Harp & Jung, 2002; Donoghue, Nishisaki, Sutton, Hales, & Boulet, 2010; Gao, Krogstie, & Siau, b; Norman, Watson, Murrells, Calman, & Redfern, 2002; Oluwatayo, 2012). Thereafter, the questionnaire was pilot tested on a conveniently drawn sample of 100 students taken from one college and one university. From the college, 30 pre-medical (15 male and 15 female) and 30 pre-engineering (15 male and 15 female) first year students were selected for pilot study. From the university 10 BS physics students (5 male and 5 female), 10 BS chemistry students (5 male and 5 female), 10 BS zoology students (5 male and 5 female) and 10 BS botany students (5 male and 5 female) were included in for pilot testing of the questionnaire. These 100 questionnaires were not included

in the final dataset. The reliability of questionnaire calculated through Cronbach alpha was 0.834 based on the data collected for pilot study.

Data Collection

After that, the data were collected by personal visits to four colleges and four universities of district Chiniot and Sargodha. It took about five weeks to collect the quantitative data. Before administration of tool, the respondents were explained the purpose of the study. Only the students willing to volunteer were included in the study. It took about 20 minutes of the respondents time to respond the questionnaire.

The interview was focussed on mainly two questions: the reason of prevalence of high examination anxiety and the measures to reduce it. Followed by the data analysis of the questionnaire, interview transcription produced the following results.

Findings

This section was divided into three parts. Part I explains how students ranked the given sources of practical examination anxiety. Part II was concerned with the causes of anxiety during practical examinations and part III included the suggestions to reduce anxiety during practical examinations.

Ranking the Sources of Practical Examination Anxiety

Students were asked to rank 14 sources of practical examination anxiety identified in the research literature. This part deals with their ranked list of these sources.

Table 1
Level of Anxiety during Practical Examination

Rank	Source of Anxiety	SA+A%	SA%	A%	UD%	DA%	SDA%	Mean
1st	Shortage of time	75.50	33.40	42.10	1.90	14.10	08.40	03.78
2nd	Lack of practice	71.85	26.75	45.10	3.65	15.90	08.60	03.65
3rd	Accuracy of practical	70.00	26.40	43.60	3.45	16.75	09.80	03.60
4th	Examiner Phobia	66.87	30.37	36.50	4.42	17.30	11.40	03.60
5th	Quality of notebook	66.60	32.40	34.20	5.87	17.33	10.30	03.60

6th	Labelling specimens/ slides	66.50	20.75	45.75	3.30	19.95	10.15	03.50
7th	Handling materials	66.16	24.50	41.66	4.77	18.03	11.03	03.50
8th	Safety & Physical condition	65.25	27.40	37.85	3.93	18.28	12.58	03.50
9th	Drawing / labelling diagrams	58.10	19.15	38.95	3.55	24.25	14.10	03.25
10th	Dissection	54.95	22.25	32.70	5.55	25.95	13.60	03.25
11th	Collecting, recording / graphing data	55.10	18.02	37.08	3.40	25.24	16.22	03.15
12th	Drawing conclusion	53.70	15.85	37.85	4.15	28.05	14.15	03.13
13th	Working with other students	48.17	23.00	25.17	3.27	26.40	22.17	03.00
14th	Science laboratory	42.57	17.40	25.17	4.83	25.73	26.87	02.81
	Total	61.53	24.12	37.41	4.00	20.95	13.53	03.38

Table 1 shows the level of anxiety among 14 sources of anxiety (ranked) experienced by the students in present study. These 14 sources are referred in the literature by the researchers like Berber (2013) and Bowen (1999). Nearly 62% of students in present study (Mean=3.38) reported that they experienced anxiety during their practical examinations.

1. About 76% students said that shortage of time was the 1st and the highest source of anxiety (Mean=3.78); whereas, lack of practice was at 2nd (Mean=3.65) as reported by about 72% of the students.

2. Accuracy of practical was ranked at the 3rd level (Mean=3.60) by about 76% students; and 70% students reported examiner phobia as the 4th source of anxiety (Mean=3.60).

3. Approximately 67% students placed quality of notebook (Mean=3.60), labelling specimens/slides (Mean=3.50) and handling materials (Mean=3.50) at 5th, 6th and 7th level respectively.

4. About 66% students said safety & physical condition as the 8th source of anxiety (Mean=3.50); and, drawing / labelling diagrams (Mean=3.25) was ranked at the 9th level by about 58% of the students.

5. About 55% students positioned dissection (Mean=3.25) and collecting, recording /graphing data (Mean=3.15) at 10th and 11th level respectively;

whereas, about 54% students told drawing conclusion as the 12th source of anxiety (Mean=3.13).

6. Working with other students (Mean=3.00) and science laboratory itself (Mean=2.81) was ranked at *13th* and *14th* level by about 48% and 43% of the students, respectively.

Causes of Practical Examination Anxiety

The previous part included the analysis of quantitative data, which yielded the ranked list of 14 sources of anxiety experienced by the students during their practical examinations. To investigate into the causes that make students anxious during practical examinations, 50 students (25 male and 25 female) were interviewed. Data from semi structured interviews were transcribed which resulted into following five categories after thematic analysis.

1. Shortage and unavailability of the materials
2. Lack of practice
3. Harsh behaviour of laboratory personnel
4. Over loaded syllabus
5. Lack of guidance

The first category encompassed causes related to the shortage and unavailability of materials including chemicals and equipment. In this category, respondents had mentioned that due to unavailability of the equipment and the chemicals students were unable to perform experiments and only one or two students performed experiment in a group, while the remaining students in the group remained silent observers. One student mentioned that,

> *"Physics experiments were excluded for which the materials were not available."*

Another student said that,

> *"Laboratory equipment were available but were not in working condition, as a result we got wrong readings."*

The second category contained causes of anxiety during practical examinations related to the lack of practice as practicals were not regularly performed at school level. Students further explained that due to lack of exposure to practice they could not identify different equipment and materials required for performing practicals which cause anxiety. Respondents mentioned practicals were not performed in their institutions and as a consequence they felt anxiety in practical examinations. The third category included causes related to the examiner's or teacher's harsh behaviour and strictness. Students added that improper behaviour of lab attendants is also a cause of anxiety. The fourth category enclosed causes related to the over loaded syllabus. Log list of experiments was a source of anxiety as each experiment was required to be written in the practical notebook. The completion of notebook and carrying out the experiments in the end of the year (when the students were busy in preparing their theory paper) induced anxiety.

The fifth category comprised causes related to the lack of guidance. Students mentioned that teachers did not cover practical syllabus before the start of the final examinations and during practical sessions the teachers did not check/observe students individually to make sure if all individuals in the group were performing experiments or not. Three students stated that the teachers kept on focussing only on theory paper and did not demonstrate experiment. Seven students reported that after the instructions, teachers left the laboratory and the students did not perform the given experiment.

Measures to Reduce Anxiety during Practical Examination

The students' suggestions to reduce anxiety during practical examination have been classified into four themes namely:

1. Relaxation during practical examination
2. Individual level preparation
3. Completion of practical syllabus well before time
4. Training of laboratory personnel

In the first category, it is interesting to note that most of the students suggested to be confident or relaxed and to work without pressure to exhibit best performance in the examinations. The students said that they were confident in any

situation. Nine students were of the view that they always work out of pressure in every situation. Respondents suggested to recite any holy verse or any calming word when feeling anxious to relieve stress during examinations. Increase in time for practical examination was also suggested to reduce the practical examination anxiety. Getting social help by sharing worries with teachers, family and parents was suggested to reduce practical examination anxiety. Furthermore, eating or drinking something refreshing and were recommended to reduce practical examination anxiety.

In second category students mentioned that it was important to concentrate on practical preparation and practice well in laboratory during the laboratory periods. The main problem students mentioned was in practical preparation as according to them, they performed experiment(s) once and in addition to this, they did it in the groups mainly as a silent observer. Consequently, the majority of them, especially the weaker ones were among the most vulnerable. On the other hand, teachers must involve all the students during practical sessions and observe as well as check them to ensure that each and every student is performing the experiment. Students demanded that all students must be given a chance to perform experiments individually, so that students are able to perform well during practical examinations, which is taken individually. Hence, sufficient equipment be installed in the lab. They suggested that the teachers must be trained enough to demonstrate the experiments and instruct properly for appropriate understanding.

In the third category, students suggested that teachers must complete practical syllabus before examinations. They further added that the teacher should perform practical work with related theory topic on regular basis so that the students can better understand what they learn in theory classes.

Completion of practical syllabus well before final examination can reduce practical examination anxiety. In fourth category, students indicated that the examiner must be polite, kind, friendly and helpful instead of showing strictness to the students. Almost all the respondents had consensus that the laboratory attendants must be cooperative and trained, so that students can get the required materials timely to complete experiments within the given time without any hesitation and anxiety.

Discussion

In this study, 14 sources of anxiety were required to be ranked. These sources were believed to be affecting students' academic performance during their practical examinations. These were (in order): (a) shortage of time, (b) lack of practice, (c) accuracy of practical, (d) examiner phobia, (e) quality of notebook, (f) labelling specimens/slides, (g) safety and physical condition, (h) handling of materials, (i) drawing / labelling diagrams, (j) dissection, (k) collecting, (l) recording/graphing data, (m) drawing conclusion, (n) working with other students, and (o) science laboratory. Our findings had been supported by Bowen (1999), and also by Berber (2013) who established relationship of anxiety in physics laboratory examination and students' academic performance.

We identified five causes of practical examinations anxiety among the participants. These were: (a) shortage and unavailability of materials, (b) lack of practice, (c) harsh behaviour of laboratory personnel, (d) over loaded syllabus, and (e) lack of guidance.

We noted four broader suggestions by the participants to reduce their anxiety during practical examinations. It may be inferred that all these four factors lead to an improved performance of students in their practical laboratory examinations. These suggestions contained: (a) relaxation during practical examination, (b) individual level preparation, (c) completion of practical syllabus well before time, and (d) training of laboratory personnel. Adkins and Linville (2017) revealed that more frequency of examinations was helpful to reduce student examinations anxiety and increase their confidence and motivation to study. Besides these psycho-pedagogical measures, some researchers have suggested nutritional treatment to reduce anxiety. For example, Magnesium may have a positive effect on human beings to reduce their anxiety. Existing evidence (Boyle, Lawton, & Dye, 2017) is suggestive of a beneficial effect of Magnesium (an element of chemical, clinical and nutritional value) on subjective anxiety among anxiety vulnerable peoples. It is recommended that highly anxious students may control their anxiety by taking nutrients containing Magnesium; however, it must be advised by an expert psycho-clinician.

This study established a definite relationship between students' anxiety and their academic performance. There is enough research literature endorsing that this relationship, beyond its optimal boundaries is negative. This is true in both

directions, that is, the cause as well as the effect. Hembree (1988) revealed that better student academic performance is a reliable factor to decrease their anxiety during examinations.

In order to make efficient use of time and resources during practical laboratory work, particularly when materials and apparatus are less available, the group work is found to be a workable way out of it. On the other hand, only one member had an opportunity to practically perform the task(s) for the rest of the members who remained passive participants. Passive participation to demonstration makes no additive value to practical work if it is not substantiated with actively performing the task(s) by themselves. This condition aggravates students' performance in actual laboratory work examination hence adding to increased anxiety far beyond its optimal limit. Consequently their academic performance is severely curbed; therefore, it is logical to find group work an obstacle, probably causing amplified anxiety during practical examinations. This study finding also reports the same.

Contradictory to what was found in the present study, Colbert-Getz, Fleishman, Jung and Shilkofski (2013) revealed that female students with high anxiety scored higher. This may be observed within the threshold limit. However, they found no gender differences for students with moderate or low level of anxiety. Surprisingly, Jung, Wranke, Hamburger, and Knauff (2014) evidenced that there is no relationship between examinations anxiety and the participants' performance at their examinations. Whereas, Ballen, Salehi, and Cotner (2017) discovered that examination anxiety negatively influences performance of female students. Crisan, Albulescu and Copaci (2014) revealed a negative significant correlation between test anxiety and self-perception of evaluation. This may be a limitation of the present study.

Conclusion and Recommendations

The findings of the study may be beneficial for teachers, school mangers and policy makers, and those who are responsible to revise the practical preparation and examination policies to reduce anxiety among the students. The students may get benefit out of this study by enhancing their preparation for practical examinations and keeping their personal causes of anxiety at lower level during practical examination.

Early identification of examination anxiety among students is highly difficult, particularly at early stages; it may not be manifested until high stakes examinations (such as SSC and HSSC examination of BISEs). However, certain characteristics, like procrastination and disinterestedness in academic work may help practitioners to look out for signals. Making examination conditions more conducive to make students less stressed may result in better grades in practicum.

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