EXPLORING IN-SERVICE TEACHERS ANXIETY TOWARDS CHEMISTRY

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ABSTRACT

This research paper explores the chemistry-anxiety of in-service teachers. The tool used for this study was piloted with 42 students in a different college than the study site. The main objective of the study was to determine in-service mathematics and environmental science teachers' anxiety of chemistry. The sample for this study consisted of 662 in-service teachers taking basic chemistry course, in sixteen groups. Of these 636 (Average age=21.8 yrs) completed the Derived Chemistry Anxiety Rating Scales properly. These were second-kiremt/summer Mathematics and Environmental science in-service teachers registered in basic chemistry course in Arbaminch College of Teachers Education, Southern, Nations, Nationalities and Peoples regional state (SNNPRS), Ethiopia in the year 2018 G.C. Anxiety rating scales were used for assessing anxiety of the in-service teachers in terms of the three subscales. Quantitative analyses were carried out to analyze the data. The results of analyses revealed that the in-service teachers were a little bit to moderately anxious in learning basic chemistry. However, the in-service teachers displayed relatively high level of anxiety in Handling Chemicals Anxiety followed by Chemistry Evaluation Anxiety and Learning Chemistry Anxiety. Males and Females were similar in anxiety in terms of Chemistry Anxiety (the whole scale), Chemistry Evaluation Anxiety and Handling Chemicals Anxiety. Nevertheless, statistically, Females are more anxious than males in Learning Chemistry Anxiety subscale. Correlation analyses indicate significant positive correlation coefficients among the subscales. Based on these results and discussions, conclusions were made.
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INTRODUCTION

Learning is dependent on complex web of factors. Unequivocally teaching is also reliant on different factors. Due to complex nature of teaching, instructors in general and chemistry instructors in particular should not give emphasis to subject matter knowledge alone. Teaching related problems in college settings, such as chemistry teaching, are usually related to the format used by instructors. A good number of college science instructors use lecture formats to convey the subject matter knowledge to their students [1]. The subject matter knowledge alone, which is delivered through lecturing, cannot ensure effectiveness of instruction. In fact, many factors coalesce including subject matter knowledge in ensuring effectiveness of learners. Ahead of the necessity to have a comprehensive understanding of their subject matter, teachers must be able to teach the contents of the subject matter at a level and in ways that their learners find understandable, engaging, challenging interesting and relevant [2]. Doing this may require changing the academic identity of instructors while attempting to modify their teaching practice [3]. The idea here shows that the teaching-learning process has many cognitive and affective variables to be considered by teachers, including anxiety levels of learners. Anxiety is more of affective type variable [4] and affects attitude of students towards chemistry [5].

Anxiety exists where there is education. It is the companion of education. Anxiety is a feeling of apprehension, worry, tension or nervousness [6]. Too much anxiety, aka debilitating anxiety, has the potential to meddle with motivation and diminish performance of students [2]. However, little anxiety, aka facilitating anxiety, can help in improving performance by motivating students to positive accomplishment [2]. Eddy [7] discussed chemistry anxiety/chemophobia in terms of fear of chemistry as a course, fear of chemistry evaluation and fear of chemicals but indicated absence of agreed up on definition. Many anxiety-related literatures [8] [9] [10] discuss

test related anxiety. Whatsoever the level and type of anxiety are, teachers can apply different strategies to reduce the negative impact of anxiety [9]. This is possible when teachers have empirical evidence on the anxiety of their students.

However, there is limited study that focuses on chemistry-anxiety [7] [11]. Thus, this study focuses on chemistry anxiety of in-service teachers.

Objectives and Research Questions

The objectives of the study were to determine in-service mathematics and environmental science teachers' anxiety of chemistry and the relationship among the subscales of chemistry anxiety. To achieve these purposes, the following research questions were addressed:

1. What is chemistry anxiety level of in-service teachers taking basic chemistry course?
2. Are there differences between males and females in chemistry anxiety of in-service teachers taking basic chemistry course?
3. Is there association among chemistry anxiety and chemistry anxiety subscales?

METHOD

Instruments

The instrument used in this study was Derived Chemistry Anxiety Rating Scale (DCARS). It is a 36-item instrument containing three subscales. The Pre-service teachers' ratings on DCARS served as the basis for assessing chemistry anxiety in this study. The DCARS (Appendix) used in this study was adapted from appropriate literature [7]. The DCARS [7] measures three subscales of chemistry anxiety/chemophobia: anxiety associated with learning chemistry, being evaluated in chemistry and handling chemicals. These subscales contain seventeen, nine and ten items

respectively. Anxiety levels in DCARS are measured on a 5-point scale where 1 represents "I am not at all anxious"; 2, "I am a little bit anxious"; 3, "I am moderately anxious"; 4, "I am very anxious"; and 5 means "I am extremely anxious". The DCARS were translated by experts in to Amharic to get credible response from subjects. The equivalence of translated version was checked by back translation in to the original English version.

Piloting

Derived Chemistry Anxiety Rating Scale (DCARS) was piloted in Bonga College of Teachers Education, SNNPRS, Ethiopia. Forty-two in-service teachers taking the same course were involved in piloting. Reliability check was made after piloting. Pilot data of DCARS resulted in Cronbach Alpha coefficient of 0.72, which was acceptable for the main study [12].

Subjects

Derived Chemistry Anxiety Rating Scale (DCARS) was administered at the middle of summer in-service program to 662 in-service teachers who were taking basic chemistry course in Arbaminch Teachers College of Education. Chemistry Anxiety Scale was administered in the middle of summer in service program in 2018 G.C. The in-service program takes eight solid weeks to finish course contents, where the basic chemistry course is accompanied with one three-hour lab work. In the eight weeks' duration semester activities are completed using doubled class hours. Of the 662 subjects 26 did not complete the DCARS properly. Therefore, analysis was based on responses from 636 subjects (246 Female and 390 Male). All subjects were second-kiremt/summer Mathematics and Environmental science in-service teachers registered in basic chemistry course in the same college. Basic chemistry course encompasses the contents of general chemistry.

Analysis

For data analysis purpose, statistical analysis SPSS 20 version was used. Both descriptive (Means, Standard Deviation) and inferential statistics (Independent samples t-test, Pearson product moment correlation) were used to analyze the data collected. Significance level was checked at 0.05 level of confidence using a two tailed test.

RESULTS

Aggregate Comparison of anxiety Scores of In-service Teachers

Table-1: Means, SD and Rank for Chemistry Anxiety Subscales

Subscale	N	Mean	SD	Rank
Learning Chemistry Anxiety	636	1.72	.46	3
Chemistry Evaluation Anxiety	636	2.17	.71	2
Handling Chemicals Anxiety	636	2.74	.66	1
Average		**2.21**	**0.61**	

The above table shows the mean scores for three subscales of chemistry anxiety. The mean scores for Learning Chemistry Anxiety, Chemistry Evaluation Anxiety and Handling Chemicals Anxiety were 1.72 (SD=0.46), 2.17 (SD=0.71) and 2.74 (SD=0.66) respectively. The average score of the subscales was 2.21 (SD=0.61), which indicates that in-service teachers were a little bit to moderately anxious in learning basic chemistry. Nevertheless, the in-service teachers displayed relatively high level of anxiety in Handling Chemicals Anxiety followed by Chemistry Evaluation Anxiety and Learning Chemistry Anxiety. The result indicates that the in-service teachers were relatively more anxious in handling chemicals in basic chemistry course.

Gender-wise Comparison of anxiety Scores of In-service Teachers

Table-2: Anxiety of In-service Teachers in Learning Basic Chemistry

Scales	Males (N=390)		Females (N=246)		t-value	df	P
	Mean	SD	Mean	SD			
Chemistry Anxiety	2.09	.45	2.16	.44	-1.74	525.8	.083
Learning Chemistry Anxiety	1.68	.47	1.78	.45	-2.84	634	.005
Chemistry Evaluation Anxiety	2.13	.71	2.24	.71	-1.95	518.9	.051
Handling Chemicals Anxiety	2.76	.66	2.71	.68	.99	507.6	.318

Independent samples t-test analysis shows that the differences between Chemistry Anxiety mean scores of the Male and Female in-service teachers were not significant (M_M =2.09 SD_M =.45, N_M =390 and M_F= 2.16, SD_F =.44, N_F = 246; t(525.8)= -1.74, p>0.05), Learning Chemistry Anxiety mean scores of the Male and Female in-service teachers were significant (M_M =1.68, SD_M =0.47, N_M =390 and M_F= 1.78, SD_F =0.45, N_F = 246; t(634)= -2.84, p<0.05), Chemistry Evaluation Anxiety mean scores of the Male and Female in-service teachers were not significant (M_M =2.13, SD_M =0.71, N_M =390 and M_F= 2.24, SD_F =0.71, N_F = 246; t(518.9)= -1.95, p>0.05) and Handling Chemicals Anxiety mean scores of the Male and Female in-service teachers were not significant (M_M =2.76, SD_M =0.66, N_M =390 and M_F= 2.71, SD_F =0.68, N_F = 246; t(507.6)= .99, p>0.05) implying that Males and Females were similar in anxiety in terms of Chemistry Anxiety (the whole scale), Chemistry Evaluation Anxiety and Handling Chemicals Anxiety. However, Male and Female in service teachers were different in anxiety in terms of Learning Chemistry Anxiety.

Statistically, Females (M=1.78) are more anxious than males (M=1.68) in Learning Chemistry Anxiety subscale. The bar-graph below depicts the above differences clearly.

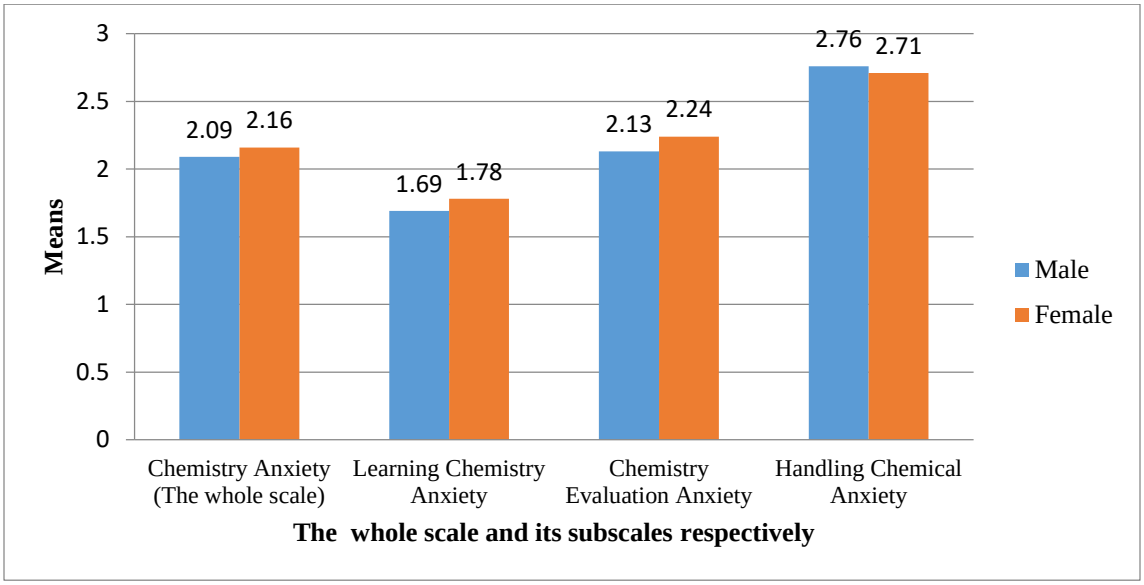

Fig: Bar-graph for Comparing Males and Females in terms of Chemistry Anxiety and Chemistry Anxiety Subscales

Relationships among chemistry anxiety subscales

Table-3: Correlations among anxiety subscales

Subscale	1	2	3	M	SD
Learning Chemistry Anxiety	-	.582**	.243**	1.72	.46
Chemistry Evaluation Anxiety		-	.356**	2.17	.71
Handling Chemicals Anxiety			-	2.74	.66

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

A Pearson correlation coefficient was calculated to test the relationship between the in-service teachers Learning Chemistry Anxiety and Chemistry Evaluation Anxiety. From the output in the table, the correlation between Learning Chemistry Anxiety and Chemistry Evaluation

Anxiety scores for the in-service teachers was r=0.582, P<0.01. Besides, a Pearson correlation coefficient was calculated to test the relationship between the in-service teachers Learning Chemistry Anxiety and Handling Chemicals Anxiety. From the output in the same table, the correlation between Learning Chemistry Anxiety and Handling Chemicals Anxiety scores for the in-service teachers was r=0.245, P<0.01. In addition, a Pearson correlation coefficient was calculated to test the relationship between the in-service teachers Chemistry Evaluation Anxiety and Handling Chemicals Anxiety.

From the output in the same table, the correlation between Chemistry Evaluation Anxiety and Handling Chemicals Anxiety scores for the in-service teachers was r=0.356, P<0.01. The correlations among anxiety subscales were significant. Both correlations indicate the in-service teachers who rated high in either anxiety subscale also rated high on the other anxiety subscale score as the r values are positive. The in-service teachers' anxiety subscale correlation values did not pass or attain threshold value of multicollinearity confirming the appropriateness of the subscales to measure chemistry anxiety. Gujarati and Porter [13] confirmed that correlation coefficient values in excess of 0.8 are considered to be with serious multicollinearity problem.

DISCUSSION

This section is devoted to findings of chemistry anxiety and correlations of chemistry anxiety subscales in relation to appropriate literature. The data revealed that, the mean scores for Learning Chemistry Anxiety, Chemistry Evaluation Anxiety and Handling Chemicals Anxiety were 1.72, 2.17 and 2.74 respectively. The average score of the subscales was 2.21, which points out that in-service teachers taking basic chemistry were a little bit to moderately anxious in learning basic chemistry.

However, relatively high level of anxiety was manifested by the in-service teachers in Handling Chemicals Anxiety followed by Chemistry Evaluation Anxiety and Learning Chemistry Anxiety. The in-service teachers were relatively more anxious in handling chemicals in basic chemistry course. The in-service teachers' anxieties in terms of Chemistry Learning and Chemistry Evaluation are relatively modest. Gender-wise, the difference between Chemistry Anxiety mean score of the Male and Female in-service teachers was not significant at P=0.05 level. Also, the differences between Chemistry Evaluation Anxiety and Handling Chemicals Anxiety mean scores of the Male and Female in-service teachers were not significant at P=0.05 level. However, the difference between Learning Chemistry Anxiety mean score of the Male and Female in-service teachers was significant at p=0.05 level. Statistically, Females are relatively more anxious than males in Learning Chemistry Anxiety subscale. High scores on anxiety scale could be interpreted as showing debilitating levels of anxiety [14] [15]. The significant difference in terms of this subscale might be associated to the insight of females. Females believe that mathematics and hard sciences are for males [16] [17]. Bertiner [14] associates this with social influence. Correlations among anxiety subscales were significant and positive, indicating the in-service teachers who rated high in one anxiety subscale also rated high on the other anxiety subscale score. Correlation coefficient results concord with the results of other similar study [18].

CONCLUSIONS

The results of this study revealed that chemistry anxiety exists among in-service teachers taking basic chemistry course. The analyses showed that the in-service teachers were more anxious about handling chemicals followed by chemistry evaluation and learning chemistry learning. Besides, analysis revealed that Female in-service teachers are more anxious about learning

chemistry than their Male counterparts. However, the result indicated that statistically Females and Males are not different in terms of chemophobia (the whole scale), chemistry evaluation and handling chemicals. There is significant positive correlation among the three Chemophobia/Chemistry Anxiety subscales. This confirms that the subscales measure different constructs as these correlations are moderate correlations. Being cognizant of chemistry anxiety is fundamental in shaping learners' attitudes towards chemistry, as this has implications on academic success.

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APPENDIX

Derived Chemistry Anxiety Rating Scales Questionnaire [7]

Dear respondents, I am doing a study to explore in-service teachers' chemistry anxiety in relation to the title: **Exploring In-service Teachers Anxiety towards Chemistry**. The data obtained from this Questionnaire will be used for academic purpose. Your honest answer to each item has meaning for my study. So, you are kindly requested to respond to all questions based on the instruction given. Your cooperation and contribution towards this research is crucial and very much appreciated. All information given will be kept confidential.

Thank you for your cooperation

Part-I: General information

1. Sex (Put √ mark): Male_____ Female _____
2. Age (write on the space): _____
3. Summer/Year (write here): _____
4. Department (write here): _____

Part-II: Anxiety towards chemistry (Put √ mark or encircle each item response)

In order to better understand your anxiety level, please respond to each of the following statements from the perspective of anxiety levels provided here. Anxiety levels are measured on a 5-point scale where 1 represents "I am not at all anxious"; 2, "I am a little bit anxious"; 3, "I am moderately anxious"; 4, "I am very anxious"; and 5 means "I am extremely anxious".

As a science student,		I am				
		not at all anxious	a little bit	Moderately anxious	very anxious	extremely .
1	While reading and interpreting graphs or charts that show the results of a chemistry experiment	1	2	3	4	5
2	While starting a new chapter in a chemistry book	1	2	3	4	5
3	While reading a formula in chemistry	1	2	3	4	5
4	While picking up a chemistry textbook to begin working on a homework assignment	1	2	3	4	5
5	While watching a teacher work a chemistry problem on the blackboard	1	2	3	4	5
6	While walking into a chemistry class	1	2	3	4	5
7	when told how to interpret chemical equations	1	2	3	4	5
8	While signing up for a chemistry course	1	2	3	4	5
9	While listening to a lecture on chemicals	1	2	3	4	5
10	While using the tables in a chemistry book	1	2	3	4	5
11	While looking through the pages in a chemistry text	1	2	3	4	5
12	While reading the word “chemistry”	1	2	3	4	5
13	While walking on campus and thinking about a chemistry course	1	2	3	4	5
14	While walking on campus and thinking about chemistry lab	1	2	3	4	5
15	To buy a chemistry textbook	1	2	3	4	5
16	While listening to another student explain a chemical reaction	1	2	3	4	5
17	While listening to a lecture in a chemistry class	1	2	3	4	5
18	While working on an abstract chemistry problem	1	2	3	4	5
19	While waiting to get a chemistry test returned in which you expected to do well	1	2	3	4	5
20	While taking a quiz in a chemistry class	1	2	3	4	5
21	While taking an examination in a chemistry course	1	2	3	4	5
22	While getting ready to study for a chemistry test	1	2	3	4	5

23	When given a homework assignment of many difficult problems which is due the next chemistry class meeting	1	2	3	4	5
24	While solving a difficult problem on a chemistry test	1	2	3	4	5
25	While taking final examination in a chemistry course	1	2	3	4	5
26	When thinking about an upcoming chemistry test one day before	1	2	3	4	5
27	When a chemical Spills	1	2	3	4	5
28	While listening to another student describe an accident in the chemistry lab	1	2	3	4	5
29	when told how to handle the chemicals for the laboratory experiment	1	2	3	4	5
30	While working with acids in the lab	1	2	3	4	5
31	When getting chemicals on my hands during the experiment	1	2	3	4	5
32	While breathing the air in the chemistry laboratory	1	2	3	4	5
33	When working with a chemical whose identity I don't know	1	2	3	4	5
34	When mixing chemical reagents in the laboratory	1	2	3	4	5
35	While heating a chemical in the Bunsen Burner flame	1	2	3	4	5
36	While walking into a chemistry laboratory	1	2	3	4	5

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