



Abstract. *Graphs are indispensable elements of education in terms of expressing qualitative and quantitative data and laws of science. Individuals need to have the skill to use graphs. The ability to use graphs is listed under three groups as interpretation skill, modeling skill, transformation skill. The lack of performing these skills, failing to overcome these challenges may cause students to develop anxieties towards using graphs. Students' existing anxieties towards using graphs may prevent the emerging of these skills, reinforce the emerging of the challenges. Therefore, this study focused on developing a scale for anxiety towards using graphs in chemistry using a draft scale along with its validity and reliability studies. The reliability and validity analysis of the scale concluded with a one dimensional assessment tool of 15 items with a reliability level of 0,903.*

Key words: *affective, anxiety, chemistry education, graphic.*

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DEVELOPING A SCALE OF ANXIETY TOWARDS USING GRAPHS IN CHEMISTRY CLASSES

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Introduction

Human is a biological entity interacting with the cultural stimuli of his birthplace continuously. As a result of their interaction with the cultural and social environment, individuals attain several new cognitive, affective or psychomotor behaviors. This process, named as "socialization" or "acculturation", is mainly a comprehensive learning and teaching process. Learning, which is defined as the permanent changes in behaviors or potential behaviors as a result of experiences (Kızılloluk, 2002), is closely related to knowledge. All actions performed by the human organism are called behaviors; however, all behaviors do not correspond to learning. For example, the temporary behaviors of individuals and the behaviors that occur as a result of an individual's natural growth and maturation are not considered as learning. There are many criteria affecting learning, which are listed under five titles: learner, learning, learnt, teacher and learning environment. Looking at these five features in terms of their affects on learning, it is observed that the last two do not affect learning directly. However, they are quite effective on indirect learning through affecting the other three features. Therefore, factors affecting learning are classified under three titles being related to the learning methodology as well as learner and learning equipment (Senemoğlu, 2005; Bacanlı, 2005):

1. Factors Related to the Learning Methodology:
 - a. Structure of the topic to be learnt,
 - b. Time dedicated to learning,
 - c. Feedback,
 - d. Active participation of the student.
2. Factors Related to the Learning Material:
 - a. Perceptual Differentiability,
 - b. Semantic association,
 - c. Conceptual Classification (Concept Maps – Webs).



3. Factors Related to the Learner:

- a. Motivation,
- b. Past experiences (positive & negative transfer),
- c. Attention,
- d. Readiness for the type,
- e. Maturation,
- f. General state of arousal and anxiety.

General state of arousal and anxiety are considered to be amongst the sub factors affecting learning extensively. The level of arousal is related to the level of an individual's perception of the stimuli. If the individual perceives little stimuli from the environment or is closed to the external stimuli, then s/he has a low level of arousal. If the individual perceives a lot of external stimuli, then s/he is considered to have a high level of arousal. Regardless of its level, arousal affects learning. In order the affective learning to occur, the level of arousal shall be at the medium (Seven and Engin, 2008). The affect of anxiety on learning is similar to the general level of arousal. Anxiety has entered into the Turkish language with the translation of the "anxiety" concept. Among various definitions, anxiety means the occurring of a thought that something bad would happen and it could not be prevented (Antony, and Swinson, 2000). According to Tas (Tas, 2011), it is a state of arousal displayed through physical, emotional and mental changes when an individual is face to face with a stimuli. Beck and Steer (Beck and Steer, 1984) defines anxiety as a general state of worry and unpleasantness about potential future events or uncertainties. According to the American Psychology Association (APA, 2010), anxiety is a feeling that is displayed through physical changes such as increase in the blood pressure.

Anxiety is a feeling of fear and worry. In case anxiety starts to affect and individual's life quality, this could be considered as anxiety disorder (Uçar, 2004). Research on the reasons for anxiety mainly focuses on the state of feeling that experience during an uncertain and uncontrollable situations. It is also individuals considered as a factor reinforcing anxiety when individuals lack some knowledge during knowledge processing process and considers this situation the sign a potential disaster.

Despite its association with negative feelings, anxiety, from a different point of view, is a feeling that exists in all individuals, which shall be experienced at a certain level (Hamarta, 2009). **Anxiety at an appropriate level**, help individuals to get motivated, make decisions, proceed and increase performance.

Research on the affects of anxiety in learning concluded that low level of anxiety resulted in low level of productivity, high level of anxiety caused the lowest level of learning while medium level of anxiety lead to high level of productivity (Cuceloğlu, 1997; Gall, 1996;) However, in order learning to occur at the maximum level, the negative effects of anxiety should be minimized. In addition to the personal efforts of students, the environment plays a role in this situation. Students experience anxiety in various lessons due to various reasons during their education years. These anxieties might affect their learning positively or negatively. Students tend to have anxieties through the utilization of graphs in teaching the relations between concepts in Chemistry. Chemistry is a field of science analyzing all substances found in nature. The laws are expressed through a mathematical language in chemistry. Mathematics is a tool frequently made use of in expressing the laws, solving problems and expressing problems. Graphs are quite commonly utilized in chemistry in proceeding these functions. In evaluating the relationship between concepts, in expressing the directions and sizes of these relationships, in organizing and summarizing data, graphs are effectively utilized tools. Graphs make it easier for us to see the relationship amongst the large data sets. They are also useful in displaying the relationships that are difficult to express in numbers. For solving the arithmetical and algebraic problems, graphs are functional tools (Beichner, 1994; Ersoy, 2004; Mc Kenzie and Padilla, 1986; Padilla, Mc Kenzie, and Shaw, 1986). The literature was observed to contain various studies on using, understanding and interpreting graphs.

In the study of Beichner'in (1994), it was determined that students have difficulties in explaining position, speed and momentum vs. time graphs and finding slope and interpreting spaces under the slopes.

In the study of McDermott, Rosenquist and Van Zee, (1987), it was expressed that when students have to draw a graph for given any situation, they usually tend to draw linear graphs and prospect for encountering graphs which are consist of regular, symmetrical and sustainable.



In his study, Kwon, (2002) said that middle school students can learn to communicate with graphs in the context of appropriate Calculator-Based Ranger activities. Three issues about Calculator-Based Ranger activities on graphing abilities were addressed in this study:

- a) the effect of Calculator-Based Ranger activities on graphing abilities;
- b) the extent to which prior knowledge about graphing skills affects graphing ability;
- c) the influence of instructional styles on students' graphing abilities.

Following the use of Calculator-Based Ranger activities, students' graphing abilities were significantly more developed in three components interpreting, modeling, and transforming.

However, no studies were found on the anxiety students experience during using graphs.

Graphs are indispensable elements of education in terms of expressing qualitative and quantitative data and laws of science. Therefore, individuals need to have the skill to use graphs. The ability to use graphs is listed under three groups as interpretation skill, modeling skill, transformation skill.

Interpretation skill is related to the verbal expression of a graphic. Modeling skill is the ability to express an observation through a graphic. Transformation skill is creating another graphic by using a graphic related to the same event (Kwon, 2002). Studies concluded that students face some difficulties in drawing graphs or interpreting the drawn graphs as follows:

- Students generally tend to draw linear graphs. They also expect to see proper, symmetrical and continuous graphs.
- Students tend to draw $y = x$ graphs even though it is not appropriate.
- Origin is the essential part of the graphic according to the students and they always tend to start the graphic from the origin.
- Most students see graphs as a picture of a situation instead of seeing them as abstract presentations displaying relationships.
- Students tend to reverse x and y coordinates and lack the ability to adapt their knowledge into unfamiliar situations.
- Students use the scale of 1s or 10s; therefore, they misread the scale. (Kwon, 2002; Hadjimetriou, and Williams, 2002)

As summarized above, students do not only need to have the three skills in order to interpret, draw and organize graphs but also need to overcome these challenges. The lack of performing these skills or failing to overcome these challenges may cause students to develop anxieties towards using graphs. Similarly, students' existing anxieties towards using graphs may prevent the emerging of these skills or reinforce the emerging of the challenges. Therefore, this study focused on developing a scale for anxiety towards using graphs in chemistry using a draft scale along with its validity and reliability studies.

Methodology of Research

General Background of Research

The purpose of the study is to develop an assessment tool in order to determine general high school students' anxieties towards using graphs in chemistry classes and making recommendations for overcoming these anxieties.

Sample of Research

253 students participated in the study. The results, according to their schools, genders, and classes, are shown in Table 1.



Table 1. The Distribution of 235 Students According to Level of School, Gender and Class.

Class Level		Female	Male	Total
Class 1	Private high school	3	7	10
	Anatolian high school *	1	2	3
	Anatolian vocational high school	5	8	13
Total		9	16	26
Class 2	Health vocational high school	6	4	10
	Private high school	5	7	12
	Anatolian high school *	36	28	64
	Anatolian vocational high school	8	7	15
	Industrial vocational high school	5	6	11
Total		60	52	112
Class 3	Health vocational Lisesi	14	3	17
	Private high school	5	4	9
	Anatolian vocational high school *	25	22	47
	Industrial vocational high school	12	12	24
Total		56	41	97

* The sample of Anatolian High School consisted of 4 schools: Dr. Ridvan Binnaz Ege Anatolian High School, Başkent Anatolian High School, Cumhuriyet Anatolian High School, Kurtuluş Anatolian High School.

The socio-economic status of students at private schools are a bit better than the socio-economic status of students at other schools. Giving examples of students from different kinds of schools represents the universe. The students who participated in the study have to take science in primary school, and take physics, chemistry, biology, and mathematics in high school. During their education, when they come across graphics, they have to use their reading, interpreting, translating skills. To give an example, in chemistry lessons (books), the graphics are often used in the units (chapters) of "the state of substance (solid, liquid and gas), speed, balance, acids, bases, and thermodynamics. It was accepted that the sample represents the universe because it was chosen among students who are studying in different types of schools.

Data Analysis

Descriptive statistics were made for each item score and scale scores. For the item analysis, item analysis based on correlations and item analysis technique based on the lower and upper group averages were administered (Murphy and Davidshofer, 1991; Tezbasaran, 1997). For the reliability estimation of the scale, Cronbach α coefficient was used. Additionally, factor analysis was conducted in order to analyze the structure of the scale.

Findings

The anxieties towards using graphs in chemistry classes, as intended to be assessed in this study, express the tendencies towards reacting negatively or positively in relation with the anxiety. In order to write the expressions in the light of the definition above, student opinions were recorded. In line with the items of the anxiety scale, 37 anxiety items were written provided that all these items involved cognitive, affective and behavioral attitudes. The anxiety scale was evaluated by one philologist and



one assessment and evaluation specialist in terms of both grammar and coherence with the item writing principles. Two chemistry field experts, who teach chemistry at the university, were consulted for providing the content validity. The feedback received after the analysis led to the removal of similar items or items that are difficult to understand. Following this stage, a scale of 33 items was obtained, where negative and positive items were almost equal in number. The responses to the anxiety items were graded in 5 points. The responders were asked to evaluate each anxiety item in five categories as strongly disagree, disagree, neither agree nor disagree, agree and strongly agree. The responses were scored between 1 and 5 by scoring the most positive category with 5 and the most negative with 1 (Turgut, 1977). Since the number of items in the scale is 33, the lowest expected score was 33.00 and the highest expected score was 165.00 where the difference is 132.00. While positive items are graded as 5, 4, 3, 2, 1 from completely agree to completely disagree, negative items are graded as 1, 2, 3, 4, 5.

After the draft scale was organized in a way to facilitate responding, the application was made. For the validity and reliability of the data collection tool, draft data collection tool form was administered to students studying at M. Rustu Uzel Vocational High School of Chemistry, Dr. Ridvan-Binnaz Ege Anatolian High School, Ragip Uner Vocational High School of Medicine, Private Ari High School, Baskent Anatolian High School, Yunus Emre Anatolian Vocational High School, Cumhuriyet High School and Kurtuluş Anatolian High School.

Results of Research

The item-scale correlations in the draft scale are calculated through the correlation between each item and scale scores. When the scores of the related item is between the limits of the scale scores, the correlation coefficient tends to be higher than it is in reality (Tezbaşaran 1997). Therefore, the scale scores were calculated by ignoring such items as explained above. The calculations concluded that all items had high correlation values with significant results at the level of $p < 0.05$ ($p =$ level of significance).

A t-test was administered for the significance of the difference between the averages of the upper and lower groups related to the score distribution of the items in the draft scale. Students with the highest scores were grouped as the 27% upper group; and the students with the lowest scores were grouped as the 27% lower group. The difference between the upper and lower group averages of all items excluding Item 10, 17 and 23 were found to be statistically significant. These items were removed from the scale. The t-test results of the scale with the remaining 30 items (Appendix 1) are displayed in Table 2.

Table 2. The T-Test Results of the Lower and Upper Groups of the Scale.

	Lower Group		Upper Group		t ($p < 0.05$)	Item-Scale Correlation
	Average	SD	Average	SD		
ITEM1	2.10	0.89	3.71	1.27	8.26	0.00**
ITEM2	2.28	1.20	3.54	1.16	6.04	0.47**
ITEM3	2.14	1.03	3.75	0.97	9.04	0.61**
ITEM4	2.06	0.88	3.51	1.12	8.10	0.55**
ITEM5	1.84	0.87	3.26	1.23	7.50	0.50**
ITEM6	2.57	1.42	4.09	1.13	6.66	0.41**
ITEM7	2.54	1.23	4.39	0.95	9.46	0.56**
ITEM8	3.42	1.34	4.03	1.09	2.81	0.19**
ITEM9	2.71	1.17	3.26	1.23	2.56	0.16*
ITEM11	2.59	1.10	3.50	1.06	4.70	0.35**
ITEM12	2.59	1.21	3.25	1.24	3.01	0.19**



	Lower Group		Upper Group		t (p<0.05)	Item-Scale Correlation
	Average	SD	Average	SD		
ITEM13	2.40	1.10	3.82	1.20	6.95	0.45**
ITEM14	1.78	0.80	3.39	1.20	8.89	0.52**
ITEM15	2.57	1.30	3.26	1.30	2.98	0.25**
ITEM16	2.78	1.27	3.75	1.18	4.45	0.30**
ITEM18	1.90	0.93	3.90	1.07	11.18	0.64**
ITEM19	1.81	0.73	3.71	1.06	11.83	0.70**
ITEM20	2.57	1.17	3.64	1.17	5.11	0.36**
ITEM21	2.06	1.11	4.10	0.83	11.77	0.67**
ITEM22	1.89	0.85	3.75	1.06	10.86	0.64**
ITEM24	1.65	0.82	3.64	1.37	9.93	0.59**
ITEM25	1.65	0.78	3.45	1.33	9.31	0.54**
ITEM26	2.56	1.06	3.34	1.23	3.82	0.36**
ITEM27	1.57	0.68	3.59	1.23	11.45	0.70**
ITEM28	2.35	1.31	4.20	0.91	9.24	0.57**
ITEM29	2.03	0.92	4.15	0.99	12.51	0.70**
ITEM30	1.60	0.58	3.87	0.95	16.27	0.77**
ITEM31	1.73	0.71	3.60	1.07	11.58	0.67**
ITEM32	2.01	0.93	3.90	1.20	9.92	0.61**
ITEM33	2.21	1.25	3.39	1.13	5.54	0.47**

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

* Correlation is significant at the 0.05 level (2-tailed).

The final version was administered to 235 high school students forming the sampling. After the application, the distribution of the total scores of the scale was analyzed. The results obtained from the scale scores are listed in Table 3.

Table 3. Descriptive Statistic Results of The Scale of Anxiety Towards Using Graphs In Chemistry.

Mean	79.69
Median	80.00
Std. Deviation	16.79
Skewness	0.09
Std. Error of Skewness	0.16
Kurtosis	0.26
Std. Error of Kurtosis	0.31
Range	92.00
Maximum	127.00

The values obtained in these statistical results (especially Skewness and Kurtosis values) show that the distribution of scale scores is quite close to the normal distribution.



The Reliability of the Scale

While the Cronbach α reliability coefficient of the first draft of the scale was 0.88, it was calculated for the final version with 3 items removed as 0.90.

The Validity of the Scale

Although the reliability of the scale is determined with an appropriate method, this operation does not address the questions such as “what do we want to assess with this assessment tool?”, “can our items assess accurately what we want to assess in line with our purpose?” (Gumus, 1977; Sencer and Sencer 1978). Therefore, the assessment tool needs to be analyzed in terms of the degree to which it assesses behavioral features, especially the ones with dominant cognitive and affective attitudes (Ozcelik, 2010). The concrete features that could be measured directly, assessment tools with high values of serving to the aim are to be utilized (Ozcelik, 2010; Sencer and Sencer 1978). As the feature to be assessed gets abstract, it becomes challenging to assess using the scales with lower or limited values of serving the aim. In order the assessments to fit the assessment purposes, assessment tools shall provide assessments that could be the measures of the variable to be assessed (Oncu, 1994).

The Validity of the Criterion

The inner criteria were evaluated to provide the criterion validity and for the final version, the difference between the averages of the lower group (average=64.32; standard deviation =9.70) and upper group (average=107.47; standard deviation=10.53) was found to be statistically significant ($t=24.11$, $p<0.05$).

Evaluation of the Availability of the Data Set for Factor Analysis

In order to determine whether the data are available for the Principal components analysis, Kaiser-Meyer Olkin (KMO) and Barlett Sphericity tests were administered. The KMO coefficient is a statistical method used in determining the availability of the size of the sampling and the data obtained for the analysis to be made. The KMO ratio needs to be higher than 0.5. According to Sharma (Sharma 1996) the values, which are equal to and higher than 0.90, are evaluated to be perfect. The more the rate is close to 1, the more appropriate the data set is for the factor analysis (Kalayci, 2006). The analysis made on the 235 scales with 30 items concluded that the KMO value was 92.3%. Since 92.3 is bigger than 0.50, the data set is found to be appropriate for the factor analysis.

In order to use the parametric method, the assessed feature needs to display a normal distribution in the universe. Barlett Sphericity test is a statistical technique used to check whether the data are obtained from a multi variable normal distribution. If the test concludes with a significant chi-square test statistic, this shows that the data are obtained from a multi variable normal distribution (Kan and Akbas, 2005). The analysis concluded with significant Barlett test results ($\chi^2=1798.15$; $p<0.05$).

Structure of the Scale: Descriptive Factor Analysis

“Factor analysis” was used in gathering the information regarding the structural validity of the assessment tool. Factor analysis is one of the multi variable statistical techniques commonly used in turning multiple variables with close relations into few, meaningful and independent factors (Kleinbaum, Kupper and Miller, 1998). Among the various factor analysis methods, the most common one is the Principal Component Analysis. In factor analysis, it was considered that the items in each factor shall be coherent in terms of meaning and content, the eigenvalues of factors shall be equal to or higher than 1, each item shall have a factor loading of “0.30” or higher and that the difference between the factor loadings of items within their factors and the factor loading values of other factors shall be at least “0.10” or higher (Buyukozturk, 2002).



Obtaining Factors

In order to obtain a meaningful structure regarding students' anxieties towards using graphic in chemistry classes, factor analysis was administered with the aim of revealing structures named as factors or components. The purpose of the factor analysis was to obtain a structure, where there are high degree relationships between variables in a few number of factors (Dunteman, 1989). Following the factor analysis, 15 items (1, 2, 4, 6, 8, 9, 11, 12, 13, 15, 16, 20, 25, 26, 33), which do not fit the structure of the scale, have factor values below 0.30, have less than 0.10 differences between their factor values or give high loadings to more than one factors. When data was examined in Table 4 "Total Variance Explained", it was seen that 15 items which were analyzed were gathered in one factor which has value more than 1 Appendix 2).

Table 4. The Factor Numbers Depending on the Eigenvalue Statistics And The Explained Variance.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.48	43.22	43.22	6.48	43.22	43.22
2	0.99	6.58	49.80			
3	0.96	6.42	56.23			
4	0.86	5.73	61.95			
5	0.78	5.17	67.13			
6	0.71	4.75	71.88			
7	0.64	4.29	76.17			
8	0.60	4.02	80.19			
9	0.53	3.52	83.71			
10	0.50	3.31	87.03			
11	0.43	2.89	89.92			
12	0.42	2.82	92.74			
13	0.40	2.63	95.38			
14	0.37	2.47	97.84			
15	0.32	2.16	100.00			

Explained variance by this single factor related to the scale is 43.22%. According to this, it is seen that the single factor which is appeared as significant factor explains the majority of total variance in the items. The number of significant factor is seen in the linear graph which is drawn according to value criteria.



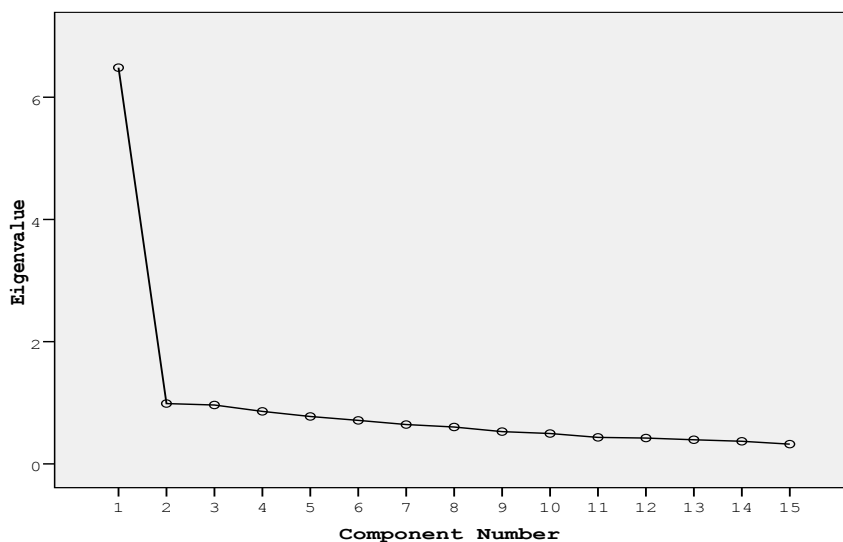


Figure 1: Line Chart of Factor Analysis (Scree Plot).

A decrease which has high momentum is observed after first factor in Figure 1. This display that scale has a general factor. The graph is horizontal in the next factors and significant tendency of decrease is not observed. So the contribution of second and next factors to variance is close to each other. The calculated coefficient alpha for anxiety scale towards usage of graph in chemistry education is 0.903. Also, calculated item total correlations for item reliability and distinctivity of 15 anxiety statements in the scale were given in Table 5. According to this, it is seen that calculated correlations change between 0.44 and 0.75.

Table 5. The factor analyze results.

Item	Common Factor Variance (Communalities)	Factor Loading Value (Component Matrix)	Item Total Correlation
ö3	0.37	0.61	0.54
ö5	0.31	0.51	0.44
ö7	0.32	0.53	0.46
ö14	0.33	0.55	0.48
ö18	0.46	0.68	0.61
ö19	0.52	0.72	0.66
ö21	0.50	0.71	0.65
ö22	0.44	0.66	0.60
ö24	0.39	0.63	0.56
ö27	0.52	0.72	0.66
ö28	0.36	0.60	0.54
ö29	0.55	0.74	0.75
ö30	0.65	0.80	0.75
ö31	0.47	0.68	0.62
ö32	0.42	0.65	0.58

Explained Variance Total: % 43.22



The analyse results of anxiety scale towards usage of graph in chemistry lessons were displayed that the scale has general factor and it is a one factor scale. Because first factor loading values and separately explained variance by it are high.

Conclusions

Anxiety is a state of feeling experienced by all individuals at different levels in our everyday lives. Most of the time, anxiety is an undesirable state of feeling for individuals. Determination of the situations that create anxiety in students during the learning process plays a n important role in overcoming undesirable problems or turning them into positive situations. In the light of this aim, a scale of anxiety towards using graphs in chemistry classes was developed. The findings concluded that the scale was qualified to determine the anxieties of students towards using graphs.

The reliability and validity analysis of the scale concluded with a one dimensional assessment tool of 15 items with a reliability level of 0.903. Most of the items in anxiety scale prepared towards graph usage are items towards determination of anxieties of graph interpreting skills of students. There are not many activities towards graph modelling and converting in the Turkish Education System. There are mostly activities towards usage of graph interpreting of students. There are too few activities towards graph modelling. So sentences consisted of anxieties towards interpreting are placed in forming anxieties sentences. Anxiety sentences towards modelling and converting were removed from scale. Because their factor loading values were low or one item formed high factor loading value in more than one factors after factor analyse.

It is expected that this scale would set an essential data collection tool for both educators and students. Additionally, it would be beneficial to apply the scale on different sampling to retest its reliability and validity.

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Appendix 1: Draft Form for Scale of Anxiety Towards Using Graphs In Chemistry Classes.

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
1. It makes me anxious to solve chemistry problems involving graphs.					
2. It makes me scared when there are graphs in a question related to chemistry.					
3. I have difficulty in interpreting the lines on a graphic.					
4. When interpreting a graphic, I feel anxious that I may fail to interpret what the axis correspond to.					
5. I could not interpret the increases or decreases in the curves included in the graphs.					
6. The question asking how to express any information on the graphic does not make me anxious.					
7. I wish there was a way to achieve in chemistry without interpreting questions with graphs.					
8. My self-confidence increases hen I can express any information on the graphic.					
9. The thought that I can explain a graphical question through another graphical question does not make me anxious.					
11. When I interpret a graphics I feel that my knowledge becomes related to different fields.					
12. In interpreting the graphs questions I feel that my knowledge is transferred to different fields.					
13. I do not like those chemical topics that require the use of graphics for explanation					
14. Before an important test, during a test or when studying for a test I think that some of my friends have less difficulties than I do.					
15. The view that other graphics can be drawn using another graphics does not make me anxious.					
16. Interpreting questions with graphs is a distinguishing feature for an individual.					
18. I think that graphical questions are a way to make sense the theoretical knowledge.					
19. I feel anxious before the exams that questions with graphs may come up.					
20. I have difficulty in understanding chemistry topics, where graphs are widely used.					
21. Chemistry topics with too many graphs do not attract me.					
22. My anxiety towards failing to interpret questions with graphs affect my achievement in exams.					
24. I can't sleep because of the thought that I will have to respond to questions with graphs.					
25. I am anxious about the fact that I could not express any event I have observed.					
26. When I cannot account for the graph questions I feel myself not so smart as I think.					
27. When solving a chemistry problem with graphs or interpreting it, I feel like I am making mistakes.					
28. When I face a question with graphs I experience a failure right at the beginning.					
29. If I manage to interpret questions with graphs, my self-esteem will improve.					
30. I cannot be sure of my decisions in interpreting graphic questions.					
31. When talking about graphic questions, I think of difficult questions to explain.					
32. I have difficulty in understanding when my teachers interpret graphs.					
33. I understand when my teachers or peers are interpreting graphs, but I fail when I try to interpret myself.					



Appendix 2: Scale of Anxiety Towards Using Graphs In Chemistry Classes.

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
3. I have difficulty in interpreting the lines on a graphic.					
5. I could not interpret the increases or decreases in the curves included in the graphs.					
7. I wish there was a way to achieve in chemistry without interpreting questions with graphs.					
14. Before an important test, during a test or when studying for a test I think that some of my friends have less difficulties than I do.					
18. I think that graphical questions are a way to make sense the theoretical knowledge.					
19. I feel anxious before the exams that questions with graphs may come up.					
21. Chemistry topics with too many graphs do not attract me.					
22. My anxiety towards failing to interpret questions with graphs affect my achievement in exams.					
24. I can't sleep because of the thought that I will have to respond to questions with graphs.					
27. When solving a chemistry problem with graphs or interpreting it, I feel like I am making mistakes.					
28. When I face a question with graphs I experience a failure right at the beginning.					
29. If I manage to interpret questions with graphs, my self-esteem will improve.					
30. I cannot be sure of my decisions in interpreting graphic questions.					
31. When talking about graphic questions, I think of difficult questions to explain.					
32. I have difficulty in understanding when my teachers interpret graphs.					

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