Affective Factors That Influence Chemistry Achievement (Motivation and Anxiety) and the Power of These Factors to Predict Chemistry Achievement-II

Ahmet AKBAŞ*, Adnan KAN**

*Assoc.Prof.Dr., Mersin University, Faculty of Education, Dep. of Secondary Sci and Math. Edu., Mersin
**Assist.Prof.Dr., Mersin University, Faculty of Education, Dept. of Educational Science, Mersin

ABSTRACT

In this research, motivation and anxiety for Chemistry course of 819 high school students attending 10 different high schools located in the city center of Mersin, were investigated. Anxiety and motivation scales constituted and developed for Chemistry course by researchers were used as an instrument to collect the data. To provide evidence reliability and validity of scales, test re-test reliability and Crα, correlation between items and total test scores and factor analysis have been utilized on data. In order to find reach our research problem and sub problems, descriptive statistic, t tests, simple and multiple lineer regression analysis and variance analysis have been performed.

In this study, it was determined that while grade 10 students have the highest motivation for this lesson, grade 9 students possess the highest anxiety level for chemistry lesson, as well. Also, it was found out that the motivation and anxiety for chemistry lesson, on their own, is a significant predictor of chemistry achievement'

Keywords: *Chemistry Achievement, Motivation, Anxiety*

INTRODUCTION

Determining the fact that whether the affective factors have a role in the field of interests, about preferences, in social activities, on success and in failure of students, has been investigated for years. The effects of affective characteristics of students for lessons in school education were proved by the investigation (Bloom, 1979). Since the academic achievement is related directly or indirectly with many factors, the affective factors could be considered as one of the mentioned factors. With consistency, the factors (as motivation and anxiety) will affect many other factors such, as the will and the interests of students in lessons. Thus, it could be thought that students' performances and their academic achievements would be affected. The first aim of this study is to determine the affective

factors in relation to the academic achievement of chemistry lesson and the level of affection. The second one is to seek whether these variables influence the student's levels

Motivation is one of the most important impulsive power sources which gives some guidance to behaviour of students in school and determines behaviour's strength and stability. Motivation is a repulsive power to conduct organism attaining to certain goal and being able to do necessary actions in particular conditions, giving energy and a guide to behaviours causing an affective advance. It is a power gaining state to reach a certain goals (Senemoğlu, 2004). In order to learn, each student has to participate to the teaching-learning process willingly. She/he should also obey the required learning principles and bare responsibility for pertaining to learn. Therefore, providing a necessary motivation and giving priority to motivation for learning are among the major duties of teachers and school. There are differences in principle between motivated and non motivated student behaviours. When an individual motivated, maintenance of being interested and paying attention, willingness to make an effort and coursing of necessary time to gain behaviours, focusing and devoting on the subject, not giving up doing demanded behaviour in difficult circumstances, insisting on bring to an end and resolution are observed. It is considered that bearing all these peculiarities would influence the academic achievement and the anxiety level of an individual.

Anxiety is one of the fundamental sensations of humans. All human beings become little anxious when faced to a perilous situation. The temporary and situation dependent kind of anxiety, created by dangerous situations, is called as situational anxiety (Spielberger, 1966). Situational anxiety is the subjective fear of an individual feels because of being under stress. As signs of individual's tension and discomfort impressions, appearance of sweating, blushing, getting pale and shivering are the physiologically results of a stimulus to autonomous nervous system. Under the high stress the situational anxiety increases and when the stress relieved the situational anxiety declines (Öner & Lecompte, 1983). All of the people get anxious in different levels when they are frightened or worried. When the learning is mentioned, it is considered that being anxious may be helpful for conducting the organism to bear responsibility for learning and to motivate student for the course. However, the anxiety caused by excessive stress has adverse effects on learning and performance of students.

There are many researches have been done to determine the effects of the variants mentioned above (anxiety and motivation) on the academic achievement. Oliver and Simpson (1988) have researched the effects of academic self-concept and motivation for science on academic achievement and suggest that the motivation predicts academic success. House (1993) has also suggested that the motivation has a significant effect on achievement. Öner (1990) in his study has showed a significant negative interaction in between average scores of mathematics and general academic achievement with anxiety scores to exams. Albayrak- Kaymak (1987) in her study has revealed that the anxiety to examination was significant predictor of academic success. Yıldırım (2000) researched the effects of loneliness, anxiety for exams and social support on academic success and showed that the academic success was predicted by loneliness and anxiety for exams. It can be concluded from these evidences that the academic achievement is related to some affective characteristics. In this study the effects of affective characteristics towards academic achievement of chemistry course and exertion of these factors on chemistry achievement were studied via the problem sentence and the sub problems shown below.

Main Problem Sentence

How do affective characteristics (motivation and anxiety) influence academic achievement for Chemistry courses?

Sub-problems

1- What is the motivation of high school students for the chemistry course?
2- Is there any significant difference among students' motivation scores according to gender?
3- Is there any significant difference among students' motivation scores according to their class grades?
4- How do the motivation scores for the chemistry course affect the academic success?
5- What is the rank of anxiety to chemistry course in high school students?
6- Is there any significant difference among students' anxiety scores according to the gender?
7- Is there any significant difference among students' anxiety scores according to their class grades?
8- How do the anxiety scores to the chemistry course affect the academic success?
9- How do the motivation and the anxiety scores affect the academic achievement?
10- What is correlation between the motivation scores and anxiety scores?

METHODOLOGY

The research was conducted with 819 students studying at the 1st, 2nd and the 3rd classes of 10 high schools (Tevfik Sırrı Gür, Atatürk, Dumlupınar, Hacı Sabancı, Pozcu, Salim Yılmaz, Toroslar, Pakize Kokulu, Mersin Anadolu and Yusuf Kalkavan Anadolu High Schools) located in the city center of Mersin in different districts.

Scales for anxiety and for motivation which were constituted and developed for Chemistry course by researchers and these scales were used in this research as an instrument to collect the data.

Firstly the researcher revised the scientific literature in order to build a theoretical background about these variables, and then go over their scales. (Spielberger 1966; Öner & Le Compte 1983; Öner 1990; House, 1993; Sundre & Moore 2002). During development of scales by taking suggestion of Tavşancıl (2005), Erkuş (2003), Tezbaşaran (1996) about the constituting scale into consideration 25 items have been written to measure motivation and anxiety. Then these items were examined by experts, and 2 items from motivation scale 6 items from anxiety scale was eliminated and final revised scales consisted of 23 items for motivation and 19 items for anxiety. These final scale were administrated to about 1000 students consisted of high school 1st, 2nd, and 3rd grades. Non completed scale were eliminated then carried out investigation with 819 students. Evidences, obtained from analysis of the data for validity and reliability, are presented below.

• to get evidences for reliability, test-retest reliability and Crα (reliability coefficient) reliability analysis

• to get evidences for item validity, correlation between item and total test score

• to get evidences for construct validity, factor analysis have been performed on data

Motivation scale: Factor analysis has been done to approach the meaningful structure about motivation of students for chemistry course and to reveal the component/s which are measured by scale items. At the end of analysis, 9 items (3,4,6,8,16,18,21,22,23) which were not comply with scale or loaded on more than one item have been eliminated from 23 items of the scale. The rest of 14 items constitute a 4 sub-factorial structure with eigen value over 1. The first dimension (sub factor) is constituted by 3 items (5,7,10) and eigen value of it informs about the significance level and emphases(power, weight) of each factor, is found as 4,47. This sub dimension alone

explains the motivation variable in 31.96 %. Second dimension (sub factor) is constituted by 4 items (13, 14, 19, 20) with the eigen value of 1.71. This dimension (sub factor) alone explains in 12.18 % of variance of the motivation variable.

Third dimension (sub factor) was constituted by 3 items (1,2,9) with the eigen value of 1.38. This dimension (sub factor) alone explains the motivation variable in 9.90 %. Fourth dimension (sub factor) is constituted by 4 items (11, 12, 15, 17) with the eigen value of 1.27. This dimension (sub factor) alone explains the motivation variable in 9.10 %.

These 4 sub factors together explain the variance of motivation variable in 63.14 %. Load of dimensions, related to items, range from 0.50 to 0.83. These results are used as an evidence for satisfying construct validity of the scale.

For reliability of the scale, for the entire scale and for each of the sub dimensions reliability coefficient Crα was calculated and test-retest reliability was determined with 100 students randomly chosen from the sample. As a result for entire scale Crα as 0,83 and test-retest reliability as 0.92 was obtained. Crα 0.78 and test-retest reliability 0.81 was obtained for the first sub factor and Crα 0.72 and test-retest reliability was obtained as 0.86 for the second sub dimension, Crα 0.77 and test-retest reliability was obtained as 0.88 for the third sub dimension, Crα 0.72 and test-retest reliability was obtained as 0.85 for the 4th sub dimension. All these results are used as an evidence for satisfying construct validity of the scale.

Item test correlation was calculated concerning item validity and homogeneity. The item test correlation values of the scale were obtained between 0.32 and 0.56. These results are used as evidence for acceptability of item reliability and into the measure same structure.

Anxiety scale: Factor analysis was used for revealing factor or component measured by scale items and to reach the meaningful construction in anxiety of students towards chemistry course. At the end of analysis, 10 items (2,4,6,8,9,12,12,14,15,19) which were not comply with scale or loaded on more than one item have been eliminated from 19 items of the scale. The rest of 9 items constitute a 2 sub-factorial structure with eigen value over 1.

The first dimension (sub factor) is constituted by 7 items (1,3,5,7,1016,18) and eigen value of it informs about the significance level and emphases(power, weight) of each factor, is found as 3,13. This sub dimension alone explains the anxiety variable in 34,77 %. Second dimension (sub factor) is constituted by 2 items (11,17) with the eigen value of 1.09. This dimension (sub factor) alone explains in 12.11 % of variance of the anxiety variable. These 2 sub factors together explain the variance of anxiety variable in 46.87 %. Load of dimensions, relating to items, differs between 0.50 and 0.82. These results are used as an evidence for satisfying construct validity of the scale.

Related to reliability of the scale, for the entire scale and for each of the sub dimensions reliability coefficient Crα calculated and test-retest reliability determined by the randomly chosen 100 students among the whole group. As a result for entire scale Crα as 0,77 and test-retest reliability as 0.90 was obtained. Crα 0.76 and test-retest reliability 0.90 was obtained for the first sub factor and Crα 0.50 and test-retest reliability was obtained as 0.72 for the second sub dimension. Since, number of items is one of the parameters of formula of Crα (Magnusson 1967; Gulliksen 1954), It is thought that the source of lower Crα value of second sub factor than first sub factor may be the lesser number of item on second sub factor. All these results are used as an evidence for satisfying construct validity of the scale.

Item test correlation was calculated concerning item validity and homogeneity of the scale. The item test correlation values of the scale were obtained between 0.30 and 0.58.

These results are used as evidence for acceptability of item reliability and into to measure same structure.

FINDINGS AND DISCUSSION

In this study, each of the affective factors is taken in consideration as separate factors and at firstly, descriptive studies were done in affective factor of Mersin downtown schools and descriptive statistical analysis was carried out through these data. Results of the descriptive analysis for motivation scale were shown in Table1.

Table 1. *Descriptive Statistical Data of Motivation Scale*

Mean	*48.36*
Standard Deviation	*9.17*
Variance	84.07
Minimum	20
Maximum	70
Kurtosis	-0.30
Skewness	-0.19
K(Number of Items)	14
N(Number of Person)	819

It is observed that the distribution of scores obtained from the motivation scale in almost normal distribution with slightly kurtosis and skewness to the left when compared to standard normal distribution as seen in the Table 1. The mean value of motivation scores of 819 high school students was obtained as 48,36. Considering mean value and distribution structure of data, accumulation of motivation scores to the higher values indicates that the motivation for chemistry course may said to be middling closer to positive.

Differences according to gender in motivation scores for the Chemistry course were tested for independent groups via t-test and result was shown in Table 2.

Table 2. *T-Test Results of Motivation Scores According to Gender* (p>0.01)

Gender	N	Mean	S	sd	t	p
Female	422	48.68	9.16	817	1.02	0.31*
Male	*397*	*48.03*	*9.17*			

As seen from Table 2, there was no significant (p>0.01) difference between the mean of motivation score of female students and that of male students ($t_{(817)}$=0.417, p>.01).

The descriptive statistical analysis of motivation scores of students versus class levels is shown in Table 3.

Table 3. *Descriptive Statistical Data of Motivation Scale According to Grades*

Class Level (High School)	N	Mean	Standard Deviation
1st class	263	47.65	*9.14*
2nd class	290	49.87	*9.11*
3rd class	266	47.44	*9.10*
Total	*819*	*48.37*	*9.16*

As seen from Table 3, whilst the highest mean value is observed in the 2nd grade student as 49,87, the lowest one is for the 3rd grade student as 72.40 Students' motivation level for chemistry course differences between the grade variables are analyzed via one-way ANOVA test and results are shown in Table 4.

Table 4. *The ANOVA Results of the Motivation Scores as to the Class Levels* (p>0.01)

Variance Source	Sum of Sq.	sd	Mean Sq	F	p	Significant Difference
Between Groups	1014.59	2	507.29	6.11	0.00*	1st grade-2nd
Within Groups	67759.52	816	83.04			2nd –3rd grade
Total	*68774.11*	*818*				

According to the Table 4, the mean motivation scores of each grades for chemistry course, obtained from motivation scale, are significantly different ($F_{(2-816)}$=6.11, P<.01). To determine which grade was the source of motivation difference, Scheffe test was applied and result showed that 2nd grades' motivation (Mean=49,87) for Chemistry is significantly higher than that of 1st (Mean 47,65) and 3rd grade students' motivation (Mean 47,44). According to these results, the motivation levels of students for chemistry course is changing meaningfully with grades and 2nd grade student group have the highest motivation level for Chemistry course.

The results of Regression analysis of the motivation scores in accordance to determine effects of motivation on academic success is given in Table 5.

Table 5. *Regression Analysis Results Relating to Prediction of the Chemistry Achievement as to the Motivation* (p>0.01)

Variable	R	R^2	B	SH_B	β	t	p
Constant	0.251	0.063	39.97	3.35		11.93	*0.00**
Motivation			*0.504*	*0.06*	*0.251*	*7.40*	*0.00**

As seen from Table 5, motivation for Chemistry course predicts significantly the Chemistry achievement (R= 0.251, R^2= 0.063, F= 54,87,p<.01). Motivation scores towards Chemistry course are weakly related to achievement scores at the level of 0,251. It could be said that the 6 % of total variance related to the successive score of Chemistry course could be explained by the students' motivation for chemistry course.

As seen from Table 6, scores from the anxiety scale for chemistry course is almost normally distributed. Distribution has kurtosis and slight skewness to the right as compared to standard normal distribution.

Table 6. *Descriptive Statistical Data of Anxiety Scale*

Mean	*25.16*
Standard Deviation	*7.10*
Variance	50.42
Minimum	9
Maximum	45
Kurtosis	-0.22
Skewness	0.30
K (Number of Item)	9
N(Number of Person)	819

The mean value of anxiety scores of 819 1st, 2nd and 3rd grade of high school students was obtained as 25,16. Considering mean score and distribution structure of data indicate that the anxiety level for chemistry course is about average. Anxiety level of students for chemistry course may said to be average.

Differences according to gender variable in anxiety for Chemistry course were tested for independent groups via t-test and result is shown in Table 7.

Table 7. *T-Test Results of Anxiety scores according to Gender* (p>0.01)

Gender	N	Mean	S	sd	t	P
Female	422	26,25	7,47	817	4.63	*0.00**
Male	*397*	*23,99*	*6,50*			

As seen from Table 7, mean anxiety score of male students is lower than that of female students and t-test results shows that this difference is significant. In these circumstances it could be clearly proclaimed that anxiety level for chemistry course of female students is higher than that of male students. The descriptive statistical analysis of anxiety scores of students versus class levels is shown in Table 8.

Table 8. *Descriptive Statistical Data of Anxiety According to Grades*

Grades	N	Mean	Standard Deviation
1st	263	26.37	*7.60*
2nd	290	25.25	*6,70*
3rd	266	23.85	*6,80*
Total	*819*	*24.81*	*7.10*

When the Table 8 is examined, as can be seen from Table 8, whereas first grade students has the highest mean value (26,37), third grade students possess the lowest one (23,85). All these results show the way to suggest a decrease in anxiety levels with an increase in grade. Anxiety level differences between the grades and source of variance are analyzed via ANOVA test and results are shown in Table 9.

Table 9. *The ANOVA Results of the Anxiety scores as to the Class Levels* (p>0.01)

Source of variance	Sum of Sq.	sd	Mean Sq	F	P	Significant Difference
Between Groups	840.503	2	420,251	8,49	0,00*	1st grades –3rd grades
Within Groups	40408,17	816	49,520			
Total	*41248,68*	*818*				

As seen from Table 9, significant anxiety score differences between grades ($F_{(2-816)}$=8,49, P<.01) was obtained . To determine which grade cause this differences, Scheffe test was applied and result showed that 1st grades' anxiety (Mean=26,37) for Chemistry is higher than that of 3rd grade students' anxiety. According to these evidences, it could be suggested that the level of anxiety for chemistry differed significantly as to grade of classes and 1st grade student have the highest anxiety level for chemistry course.

The Regression analysis of the anxiety scores were carried out to determine effects of anxiety on chemistry achievement and results were given in Table 10.

Table 10. *Regression Analysis results Relating to prediction of the Chemistry Achievement as to the Anxiety* (p<0.05)

Variable	R	R²	B	SH$_B$	β	T	P
Constant	0.39	0.15	89,56	2,19		40,93	*0.00**
Anxiety			*-1,00*	*0,046*	*0,39*	*-11.97*	*0.00**

As can be seen from Table 10, anxiety for Chemistry course predicts significantly the Chemistry achievement (R=0.39, R^2=0.15, F=143.35, p<.01). Anxiety scores for Chemistry course is related to achievement scores at the level of 0,39. It could be said that

the 15% of total variance related to the achievement score of Chemistry course could be explained by the students' anxiety levels for chemistry course.

To interpret how the both self-competence and the attitude towards Chemistry course effect academic achievement The Multiple Regression Analysis was carried out and results are shown in Table 11.

Table 11. *The Multiple Regression Analysis relating to the Interpretation of the achievement in accordance with the Motivation and Anxiety*

Variable	R	R^2	B	SH_B	β	T	p
Costant			70,32	4,24		16,58	0,00
Motivation			0,35	0,07	0,17	5,26	0,00*
Anxiety	0,42	0,18	-0,90	0,09	0,35	-10,65	0,00*
F(2,816)=87,88 p=0,00							

According to Table 11, the motivation and anxiety scores for chemistry lesson are significant predictors of chemistry achievement, and there is a relation at the level of 0,42 amongst the motivation scores, anxiety scores for chemistry lesson and achievement scores. These variables together explain 18 % of chemistry achievement.

To determine the relation between the motivation scores and anxiety scores for chemistry course, Correlation analysis was implemented and the relation is determined significantly negative with the value as -0,23.

CONCLUSIONS AND SUGGESTIONS

In this study, to determine state of students enrolled at high school in terms of the sensorial factors (Motivation and Anxiety), correlation between these factors within different variables and the effects of these affective factors on the Chemistry course achievement were investigated.

For this purpose, the developed scales were implemented to the 819 students of 1st, 2nd and 3rd grade students of high school and statistical analysis were applied to data to answer the sub-problems. The results will be evaluated by analyzing each of the sensorial variables separately.

Concerning the motivation variable, results and reached conclusions are summarized below:
(a) Motivation scores of students at high school for chemistry lesson is distributed with the skewness to the left;
(b) there is no difference between genders in the motivation for chemistry lesson;
(c) 2nd grade students of high school have the most positive motivation for chemistry lesson and there is a significant difference between 1st and 3rd grade students regarding the motivation for chemistry lesson;
(d) the motivation for chemistry lesson, on its own, is a significant predictor of chemistry achievement and it explains 6 % of the variance of chemistry achievement. Correlation between successive scores and scores of students taken from the motivation scale for chemistry course is on the level of 0,25.

All these evidences produce information about the academic achievement has been directly predicted by the motivation in contrary to literature that suggests the indirect prediction of motivation.

As for the anxiety variable, obtained results and reached conclusions are:

a) Anxiety scores of students in high school for chemistry lesson is designated a distribution with kurtosis and slight skewness to the right when compared to standard normal distribution.

b) Considering gender with regard to anxiety for chemistry course, there is difference in favor of female students.

c) The highest level of anxiety group is 1st grade students and there is significant difference between levels of anxiety for chemistry course of 1st and 3rd grade students.

d) The anxiety for chemistry lesson, on its own, is a significant predictor of chemistry achievement and it explains 15 % of the variance of chemistry achievement. Correlation between successive scores and scores of students taken from the anxiety scale for chemistry course is at the level of 0,39.

These evidences describe the prediction of academic achievement by anxiety in the consensus of literature. However, it is also indicated that across motivation with anxiety is a significant predictor of academic achievement. These study revealed that inventions as the motivation and anxiety are significant predictors of academic achievement in agreement with studies carried out by Oliver and Simpson's (1988), House's (1993), Öner's (1990), Albayrak- Kaymak's (1987), Yıldırım's (2000). They also reported that both motivation and anxiety are meaningful predictors of academic achievement as a result of their research.

Therefore, it could be suggested that the sensorial factors as motivation and anxiety have an important effects on academic achievement, and also are important components of educational and instructional processes.

REFERENCES

Albayrak-Kaymak, D. (1987). Sınav Kaygısı Envanterinin Türkçe Formunun Oluşturulması ve Güvenirliği. *Türk Psikoloji Dergisi*. 6 (21): 55-62

Bloom, B., S. (1979). (Çev. D. A. Özçelik). **İnsan Nitelikleri ve Öğrenme**. Milli Eğitim Basımevi. Ankara.

Erkuş, A. (2003). **Psikometri Üzerine Yazılar**. Türk Psikologlar Derneği Yayınları. No: 24, Ankara.

Gulliksen, H. (1950). **Theory of Mental Tests.** New York: John Wiley & Sons Inc.

House, J. D. (1993). Cognitive-Motivational Predictors of Science Achievement. *International Journal of Instructional Media.* 20 (2): 155-163

Magnusson, D. (1967). **Test Theory**. Massachusetts: Addison-Wesley Pub. Co.

Oliver, J. S. & Simpson, R. D. (1988). Influences of Attitude Toward Science, Achievement Motivation and Science Self Concept on Achievement in Science: *A Longitudinal Study Science Education* 72 (2): 143-155

Öner, N. (1990). **Sınav Kaygısı Envanteri El Kitabı**. Yöre Yayınları. İstanbul.

Öner, N. & Le Compte A. (1983). **Durumluluk – Sürekli Kaygı Envanteri El Kitabı**. Boğaziçi Üniversitesi Yayınları, No:333, İstanbul.

Senemoğlu N. (2004). **Gelişim, Öğrenme ve Öğretim. Kuramdan Uygulamaya**. Gazi Kitapevi. Ankara.

Spielberger, C., D. (1966). **Theory and Research in Anxiety**. Academic Press. New York.

Sundre D., L. & Moore D., L. (2002). The Student Opinion Scale: A Measure of Examinee Motivation. *Assessment Update*, 14 (1), 8-9

Tavşancıl E. (2005). **Tutumların Ölçülmesi.** Nobel Yayınevi. Ankara.

Tezbaşaran, A., A. (1996). **Likert Tipi Ölçek Geliştirme Kılavuzu**. Ankara: Türk Psikoloji Derneği Yayınları.

Yıldırım, İ. (2000). Akademik Başarının Yordayıcısı Olarak Yalnızlık, Sınav Kaygısı ve Sosyal Destek. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, 18, 167 – 176