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Affective Factors That Influence Chemistry Achievement (Attitude and Self Efficacy) and The Power Of These Factors To Predict Chemistry Achievement-I

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ABSTRACT

In this research, our aim was to determine students' level of attitude and self efficacy towards chemistry and to put forth effects of these variables on chemistry achievement for consideration (in other words, to determine how the chemistry achievement were predicted by these variables). In this point of view the research was conducted with 1000 students studying at the 1st, 2nd and the 3rd grade of 10 high schools which are located in the city center of Mersin. Addressed to research problems, data was analyzed via descriptive, correlation, linear and multiple regression statistical analyses. As a result it is determined that 2nd graders group of high schools has maximum attitude scores and the attitude towards chemistry course, on its own, is a significant predictor of chemistry achievement. it is also determined that 2nd graders group of high schools has maximum self efficacy scores and the self efficacy towards chemistry course, on its own, is a significant predictor of chemistry achievement.

Key Words: *Attitude, Self Efficacy, Chemistry Education, Achievement*

INTRODUCTION

Having an effect of sensorial characteristics on determination of interests, choices, social activities, success or failure of students had been a subject of investigations for years to find out if they have such a role. There are evidences about the effects of affective characteristics related to grades on school learning (Bloom, 1979). It is claimed that the academic success is directly or indirectly related to many factors. Affective characteristics may be considered as one of these factors. In this respect, It could be thought that the affective factors as attitude, self-efficacy, motivation, and anxiety would effect before all other desires and interests of students in classes and then many other factors. In this manner, students' performance would also be affected on account of the academic achievement. Primary aim of this study is to find out what the sensorial factors closely related to academic success of chemistry course are, and the levels of their effects. Secondary aim of this study is to reveal the effect levels of these variables on the students in the Centrum of Mersin province.

Thurstone (1931) defines an attitude as the degree of sensation to an object or an individual. This definition would be comprehended that the attitude is one of the important determinants of human behaviors. Individual attitudes effect their affections, and behaviors in a significant level (Morgan, 1991). In this respect, measuring the attitudes and knowing the level of attitudes of individuals related to objects or circumstances are in demand in many fields (Erkuş, 2003). Attitude is a fact that causes taking aside during the decision process which was gained by learning and giving a guidance to individual behavior (Ülgen, 1995). Affirmative attitude development to a class includes such behaviors as desire to participation in classes, being gratified for responses, approving self-merits, being in favor of acceptance as a person of great merit (Özçelik, 1992). Attitude, with its cognitive, affective, and behavioral dimensions, is a psychological construct that is considered to be a critical predictor of the behavior of an individual (Anderson, 1988).

Existence of a certain interaction and this important and meaningful interaction between attitude and attainment brings up the necessity of consideration of attitude in scheduled school education. Oliver and Simpson (1988) investigated the influence of attitude towards science class, academic ego and motivation on academic success and they revealed that attitude scores had not predicted academic achievement whereas the motivation did. Levin, Sabar & Libman (1991) suggested that attitude scores have significantly predicted the academic success and the attitude had played role to designate this success more in males than females. Hose and Prison (1998) have observed a significant correlation between attitude scores and academic success in their research on the English class of university freshmen students. Baykul (1990) has showed that the 5th graders attitude score is the maximum in the primary school and it decreases by the grades increase. It has also been clearly revealed that attitude scores of mathematics and science courses have significant relations with the scores of subtests of mathematics and science tests in ÖSS (student selection test for university registration). It has also been suggested that becoming negative attitudes towards these courses might be taken as an important factor for the students' achievement in Mathematics and Science which were not improved through the years as it has been expected. Çakır and Şahin (2000), in their research on the 6th grader students, have found out that the science grade in the report cards was the superior commentary variable for academic achievement and in this manner researchers have attained that the academic ego was the superior determinant variable for attitude towards science. This study is leading us to conclude that the attitude has an affect on academic achievement indirectly via other variables.

Individuals record thoughts about themselves and make decision about accomplishment of these thoughts as a result of their activities. All of these decisions improves the vision, relating to how much confident and competent in having success in any course of action. Bandura calls this decision as self-efficacy. Perceived self-efficacy has an important role in behavioral arrangements of the individual. Self-efficacy effects activity preferences, the efforts used for an activity, the duration of patience against a difficulty, and the level of anxiety or confidence (Bandura 1982; Senemoğlu 2004). Self-competence includes decisions which are related to success of an individual in responding to any probable situations. If these are positive decisions, individuals will organize responses against these situations to carry themselves to success. As for being in the state of negative decisions, individuals will have anxiety for failure. In this manner, it may be thought that the self- efficacy would have a significant role in anxiety, in motivation and in academic achievement.

In fact, it is known that, self-efficacy plays an important role in success beside to socializing process (Kobolla ve Crawley, 1985). Morgil & Seçken (2004), in their study, have found significant correlation between gender and attitude towards chemistry course

and they also have found that the self-efficacy belief of male teacher candidates was higher than that of female candidates. Betz & Hackett (1981), Jones & Wheatley (1990), And Brophy (1985) also obtained similar evidences in consensus. Aşkar & Dönmez (2006) showed that the self-efficacy belief changed significantly among grades and it increased in higher grades. According to all these obsevations and data from the literature, it could be thought that the academic achievement is related to and affected by sensorial characteristics as attitude and self-efficacy. The effects of psychological factors as attitude and self-efficacy on academic achievement in chemistry course and their predictive efficiency on chemistry achievement are studied via the problem sentence and the sub problems shown below.

Problem Sentence

How do sensory characteristics (attitude and self-efficacy), considered to be related to academic achievement, affect the achievement in Chemistry class?

Sub Problems

1- What are the attitudes levels of high school students towards the chemistry class?
2- Is there a significant difference in attitude scores towards the chemistry course of high school students according to gender?
3- Is there a significant difference in attitude scores towards the chemistry course in high school students according to their grades?
4- How do the attitude scores towards the chemistry course affect the academic success?
5- How is self-efficacy beliefs concerned with chemistry course in high school students?
6- Is there a significant difference in self-efficacy scores towards the chemistry class of high school students according to the gender?
7- Is there a significant difference in self-efficacy scores towards the chemistry class in high school students in accordance with grades?
8- How do the self-efficacy scores towards the chemistry course affect the academic success?
9- How do the self-efficacy scores along with the attitude scores towards the chemistry course affect the academic achievement?
10- What is the correlation between the attitude scores and self-efficacy scores towards the chemistry course in high school students?

METHODOLOGY

a-Study Group

The research was conducted with 819 students studying at the 1st, 2nd and the 3rd grades 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) which are located in the city center of Mersin in different districts.

Instrumentation

Scales for attitude and for self-efficacy were developed for Chemistry course and as an instrument to collect the data. Developed scales are Likert type scales and the responses to consisting items are graded from 1 to 5 points.

b-Developing Instruments To Collect The Data

Before all else, literature has been searched thoroughly and theoretical background built about attitude and self-efficacy and, warnings were taken into consideration, about constituting the studies of developing scales by Tavşancıl (2004), Erkuş (2003),

Tezbaşaran (1996) & Bandura (1982), and 35 items have been developed to measure attitude and self-efficacy. Then these items were examined by specialists, 5 out of 35 items were eliminated, and final pilot scale included 30 items. This pilot scale, enclosing 30 items, is administrated to 1000 students consisted of 1^{st}, 2^{nd} ,3^{rd} graders in high school. Non valid, non reliable, and non completed tests were eliminated then investigation carried out on 819 students. Evidences obtained by analyzing the data for validity and reliability as below.

- to get evidences for reliability, test-retest reliability and Crα (Cronbach Alpha) as reliability analysis
- to get evidences for item validity, item total test correlations
- to get evidences for construct validity, factor analysis.

The obtained reliability and validity of the scales are below:

Attitude scale: Factor analysis has been conducted to reach the meaningful structure about students' attitudes towards chemistry course and to reveal the component/s which are measured by scale items. At the end of the analysis, 8 items (1,5,14,19,20,24,25,28) which do not comply with scale or which are loaded on more than one factor have been eliminated from 30 items of the scale. The rest of 22 items constitute a 3 sub-factorial structure with eigen value over 1.

The first dimension (sub factor) is constituted by 10 items (2, 4, 6, 7, 9, 15, 17, 18, 22, 26) and eigen value of it informs about the significance level and emphasis (power, weight) of each factor, is found as 8.34. This sub dimension alone explains the variance of attitude variable in 37.90 %.

Second dimension is constituted by 7 items (3, 8, 11, 13, 21, 27, 30) with the eigen value of 1.91. This dimension alone explains the variance of attitude variable in 8.68 %.

Third dimension is constituted by 5 items (10, 12, 16, 23, 29) with the eigen value of 1.15. This dimension alone explains the variance of attitude variable in 5.23 %. These 3 sub factors together explain the variance of attitude variable in 52 %. Factor loads, relating to items, differs between 0.50 and 0.79. These results are used as an evidence for the 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 from the whole group. As a result Crα for the entire scale and test-retest reliability was obtained as 0.92. Crα 0.87 and test-retest reliability were found 0.87 and 0.88 for the first and the second sub dimension respectively. Crα 0.78 and test-retest reliability were obtained as 0.81 for the third sub dimension. All these results are used as an evidence for the reliability of the scale.

Item total test correlation coefficients were computed concerning item validity and homogeneity. The item total test correlation values of the scale were obtained between 0.40 and 0.68. These results are used as evidence for acceptability of item validity measuring the same structure.

Self-efficacy scale: Factor analysis was conducted for revealing factors or components measured by scale items and to reach the meaningful construction in Self-efficacy beliefs of students towards chemistry course. At the end of analysis, 10 items (5, 6, 11, 15, 16, 17, 18, 19, 23, 26) which do not comply with scale or loaded on more than one factor have been eliminated from 28 items of the scale. The rest of 22 items constitute a 3 sub-factorial structure with eigen value over 1.

The first sub dimension (sub factor) composed of 6 items (3, 4, 8, 9, 10, 24) and eigen value of it inform about the significance level and emphasis (power) of each factor, is found as 7.30. This sub dimension alone explains the variance of self efficacy variable in 40.57 %.

Second dimension is also constituted by 6 items (1, 12, 13, 20, 21 22) with the eigen value of 1.46. This dimension alone explains the variance of self efficacy variable in 8.12 %.

The third dimension is also constituted by 6 items (2, 7, 14, 25, 27, 28) with the eigen value of 1.07. This dimension alone explains the variance of self efficacy variable in 5.97 %. These 3 sub factors together explain the variance of self efficacy variable in 55 %. Factor loadings for items, differs between 0.51 and 0.80. These results are used as an evidence for satisfying construct validity of the self efficacy scale scores.

Related to 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 by using 100 students chosen randomly among the whole group. As a result Crα was obtained as 0.91 and test-retest reliability 0.91 for entire scale. Crα 0.88 was found and test-retest reliability was found 0.85 for the first dimension. Crα was found 0.82 and test-retest reliability was found 0.84 for the second sub dimension, Crα 0.77 and test-retest reliability was obtained as 0.80 for the third sub dimension. All these results are used as an evidence for satisfying reliability of the scale.

Item total test correlation was computed concerning item validity and homogeneity. The item test correlation values of the scale were obtained between 0.42 and 0.65. These results are used as evidence for acceptability of item validity and measure the same structure.

FINDINGS AND DISCUSSION

It is observed that the distribution of scores obtained from the attitude scale has slight kurtosis and skewness to the left when compared to normal distribution as it is seen in Table 1. This distribution shows there is an accumulation towards higher scores.

Table 1. *Descriptive statistics of Attitude Scale Score*

Mean	75.13	Kurtosis	-0.24
Standard Deviation	17.73	Skewness	-0.32
Variance	314.18	K(Number of Item)	22
Minimum	24	N(Number of Person)	819
Maximum	110		

The mean value of attitude scores of 819 (sophomore, junior and senior classes) 1st, 2nd and 3rd graders of high school students was obtained as 75.13. Considering maximum score of the scale and distribution of data, the mean value (75.13) indicates that the attitude towards chemistry course may said to be closer to positive.

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

Table 2. *T-Test Results of Attitude scores according to Gender* (p>0.01)

Gender	N	Mean	S	sd	t	P
Female	422	74.76	18.18	817	-0.61	0.55*
Male	397	75.71	17.23			

In table 1, the mean of attitude score was obtained as 75.71 for male students and 74.76 for female students, and the difference is not significant ($t_{(817)}$=0.61, p>.01). There are no significant differences between the mean of attitude score according to gender.

The descriptive statistical analysis of attitude scores of students versus grades(class levels) is shown in Table 3.

Table 3. *Descriptive statistics of Attitude Scale Score according to grades*

Class Level (High School)	N	Mean	Standard Deviation
1st class	263	72.40	*19.06*
2nd class	290	77.11	*16.84*
3rd class	266	75.64	*17.01*
Total	*819*	*75.12*	*17.72*

When the Table.3 is examined, the highest mean value is observed in the 2nd graders as 77.11 and the lowest 72.40 is from the 1st graders. Attitude differences between the grades and source of variance are analyzed via ANOVA test and results are shown in Table 4.

Table 4. *The ANOVA Results of the Attitude scores as to the Class Levels (Grades)* (p<0.01)

Variance Source	Square sums	sd	Mean Sq	F	p	Significant Difference
Between Groups	3152.93	2	1576.47	5.068	0.00*	1st and 2nd grade of High School
Within Groups	253529.3	816	311.08			
Total	*256682.3*	*818*				

According to results of ANOVA it is observed that there are significant attitude score differences between grades ($F_{(2\text{-}816)}$=5.068, P<.01). To determine which grade was the source of attitude difference, Scheffe test was applied and the finding showed that 2nd graders' attitude (Mean=77.11) towards Chemistry is more positive than that of 1st graders' attitude (Mean 72.40). According to all findings above, it could be said that 2nd grade students have the most positive attitude towards Chemistry course.

The findings of Regression analysis of the attitude scores in order to determine the effects of attitude on academic success is given in Table 5.

Table 5. *Regression Analysis results Relating to the of Chemistry Achievement as to the Attitude* (p<0.01)

Variable	R	R^2	B	SH_B	β	t	p
Constant	0.323	0.104	39.11	2.66		14.71	*0.00**
Attitude			*0.336*	*0.034*	*0.33*	*9.75*	*0.00**

As table 5 is examined, it could be seen that attitude towards Chemistry course predicts significantly the Chemistry achievement (R= 0.323, R^2= 0.104, F= 95.025,p<.01). There is almost moderate level relationship between Attitude scores towards Chemistry course and achievement scores (R=0.32). 10 % of total variance related to the achievement score of Chemistry course could be explained by the attitudes of students' towards chemistry course. These observations are in consensus of literature that suggest attitudes towards any course has an effect on achievement and the other influential factors on achievement.

Self-efficacy scores obtained from Self-efficacy Scale are almost normally distributed as seen on Table 6. Distribution has slight kurtosis and skewness to the left when compared to standard normal distribution. The mean value of Self- efficacy scores of 819 (sophomore, junior and senior classes) 1st, 2nd and 3rd graders of high school students was obtained as 59.50. Considering maximum score of the scale and distribution of data, the mean value(59.50) indicates that the Self- efficacy towards chemistry course may said to be average but closer to positive.

Table 6. *Descriptive statistics of Self-efficacy Scale*

Mean	*59.50*		Kurtosis	-0.09
Standard Deviation	*13.04*		Skewness	-0.17
Variance	170.06		K (Number of Item)	18
Minimum	18		N(Number of Person)	819
Maximum	90			

Differences according to gender variable in Self-efficacy towards the Chemistry class were tested for independent groups via t-test and result is shown in Table 7.

Table 7. *T-Test Results of Self-efficacy scores according to Gender* ($p<0.01$)

Gender	N	Mean	S	sd	t	P
Female	422	58.40	12.88	817	2.50	0.00*
Male	397	60.67	13.13			

As seen on Table 7, mean of male students' self-efficacy score was 60.40 and females' was 58,40. The results of t-test indicates that there is a significant difference between self-efficacy score means of males and females ($t_{(817)}=2.50$, $p<.01$) regarding the mean self-efficacy score of males. In this manner, our observations are in the consensus of literature.

The findings of the descriptive statistical analysis of self-efficacy scores of students according to class levels is shown in Table 8.

Table 8. *Descriptive statistical data of self-efficacy according to grades*

Class Level (High School)	N	Mean	Standard Deviation
1st class	263	59.01	*13.04*
2nd class	290	61.22	*12.25*
3rd class	266	58.12	*13.69*
Total	*819*	*59.50*	*13.04*

According to results of ANOVA it is observed that there are significant self-efficacy score differences between grades ($F_{(2-816)}=4.25$, $P<.05$). To determine which grade was the source of differences, Scheffe test was applied and result showed that 2nd grades' self-efficacy (Mean=61.22) towards Chemistry is more higher than that of 3rd graders' self-efficacy (Mean=58.12). According to results of ANOVA it is observed that there are significant self-efficacy score differences between grades ($F_{(2-816)}=4.25$, $P<.05$). To determine which grade was the source of differences, Scheffe test was applied and result showed that 2nd grades' self-efficacy (Mean=61.22) towards Chemistry is more higher than that of 3rd graders' self-efficacy (Mean=58.12).

Table 9. *The ANOVA Results of the self-efficacy scores as to the Class Levels* ($p<0.05$)

Variance Source	Sum of Sq.	sd	Mean Sq	F	p	Significant Difference
Between Groups	1434.94	2	717.47	4.25	0.015	2nd and 3rd grade of High School
Within Groups	137673.8	816	168.72			
Total	*139108.7*	*818*				

According to all results above, it could be said that 2nd grade students have the highest self-efficacy beliefs towards Chemistry course.

The Regression analysis of the self- competence scores was carried out to determine the effects of self- efficacy on academic achievement and results are given in Table 10.

Table 10. *Regression Analysis results Relating to the of Chemistry Achievement as to the self-efficacy* (p<0.05)

Variable	R	R^2	B	SH_B	β	t	p
Constant	0.29	0.084	39.92	2.88		13.86	*0.00**
Attitude			*0.41*	*0.047*	*0.29*	*8.68*	*0.00**

When Table 10. is examined, it could be seen that self-efficacy towards Chemistry course predicts significantly the Chemistry achievement (R= 0.29, R^2= 0.084, F= 75.35, p<.01). There is quite low relationship Self-efficacy scores towards Chemistry course and achievement scores (R=0.29). 8.4 % of total variance related to the achievement scores of Chemistry course could be explained by the self-efficacy beliefs of students' towards chemistry course.

To interpret how the both self-efficacy and the attitude towards Chemistry course affect 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 Attitude and the self-efficacy* (F(2,816)=54.90, p=0.00)

Variable	R	R^2	B	SH_B	β	t	p
Constant			33.54	3.05		11.01	*0.00*
Attitude			*0.24*	*0.04*	*0.23*	*5.64*	*0.00**
Self-efficacy	0,35	0.12	*0.21*	*0.06*	*0.15*	*3.65*	*0.00**

According to Table.11, the attitude towards chemistry course and self-efficacy scores are significant predictors of chemistry achievement, and there is nearly medium relationship (R=0,35) between the attitude towards chemistry course, self-efficacy and achievement scores. All of these variables together explain 12 % of the variance of chemistry achievement.

To determine the relation between the attitude scores lesson and self- efficacy scores towards chemistry, Correlation analysis was made and the relation is computed as 0,61 which is an evidence to support the literature.

CONCLUSIONS AND RECOMMENDATIONS

In this study, in order to determine state of students training at high school in terms of the affective factors (attitude, self-efficacy), correlation between these factors within different variables and the effects of these 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 graders 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 psychological variables. Concerning the attitude variable, it was found out that (a) students at high school tend to have a positive attitude towards chemistry lesson; that (b) there is no attitude difference according to gender towards chemistry course; that (c) 2nd graders at high school are the ones who have the most positive attitude toward chemistry course and there is a significant difference between 1st and 2nd graders regarding the attitude toward chemistry course; and

that (d) the attitude towards chemistry course, on its own, is a significant predictor of achievement in chemistry and it explains 10,4 % of the variance of chemistry achievement.

Concerning the self-efficacy variable (a) students at high school have an almost average level self-efficacy towards chemistry course but accumulated in high scores; that (b) there is significant difference between female students self-efficacy and the male students self-efficacy towards chemistry course in favor of male students and that (d) the self-efficacy towards chemistry lesson on its own is a significant predictor of chemistry achievement and it explains 8 % of the variance of chemistry achievement.

The study revealed that inventions as the attitude and self-efficacy beliefs, are significant predictors of academic achievement in agreement with Levin, Sabar & Libman's (1991), House & Prison's (1998), and Baykul's (1990); a significant difference in self-efficacy scores between gender are in favor of males in consensus with Betz & Hackett (1981), Jones & Wheatley (1990), Brophy (1985), Morgil & Seçken (2004); presence of a significant relationship between the attitude scores and self-efficacy scores is in agreement with Morgil & Seçken (2004); and the indication of significant differences of self-efficacy scores according to grades supports Aşkar (2006) who has the same opinion in the literature.

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