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EFFECTS OF SOME VARIABLES ON CHEMISTRY ACHIEVEMENTS AND CHEMISTRY-RELATED ATTITUDES OF HIGH SCHOOL STUDENTS

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ABSTRACT: There have been various research studies assessing factors that affect science achievement of students. The family characteristics are the most powerful predictor of school performance. The higher the SES of family is, the higher his or her academic achievement is. In literature there are significant differences between boys and girls regarding their academic achievement. Some other studies indicated that science achievement might differ from one school environment to another. In this research the effects of gender, on chemistry attitudes cumulative secondary school grades and chemistry achi everment effect of father education on chemistry achievement, and effect of school type on chemistry achievement and chemistry attitude were investigated. The sample of this study consists of 205 science students from Ayrancı Super Lycee and Ayrancı Curriculum Laboratory School located in the metropolitan region of Ankara. A questionnaire consisting of Chemistry Attitude Scale and questions about students' family, cumulative school grades, chemistry scores was completed by 103 Ayrancı Super Lycee and 102 Ayrancı Curriculum Laboratory School students. Results of this research indicated that there is a significant gender difference of students' cumulative secondary school grades whereas there is no significant effect of gender on chemistry achievement and chemistry attitudes. On the other hand, school type has a significant effect on chemistry achievement and there is no effect of fathers' education on chemistry achievement.

KEY WORDS : *Chemistry attitudes, chemistry achievement, lycee level, SES (socioeconomical status)*

ÖZET: Son yıllarda öğrenci başarısını etkileyen faktörleri belirleyebilmek amacı ile pekçok araştırma yapılmakta olup, araştırma bulguları, öğrencinin başarısının üyesi bulunduğu ailenin sosyoekonomik düzeyinden yüksek oranda etkilendiğini göstermektedir. Ailenin sosyoekonomik durumu yükseldikçe öğrencinin başarısının da yükseldiği kanıtlanmıştır. Öğrencilerin genel başarılarında erkek ve kız öğrenciler arasında belirgin farklılıklar olduğu, okul özelliklerinin ve öğrencilerin okul özgeçmişlerinin de öğrencilerin başarısını etkileyen faktörler olduğu bulunmuştur. Bu çalışmada, öğrencilerin cinsiyetlerinin, kimya tutumlarına, kimya başarılarına ve ortaokul mezuniyet derecelerine etkisi, baba eğitiminin kimya başarıları üzerine etkisi ve okul türünün kimya başarılarına ve kimya tutumlarına, etkisi araştırılmıştır. Ankara metropolitan kent sınırları içinde yer alan Ayrancı Süper Lisesi ve Ayrancı Müfredat Laboratuvar Okulu öğrencilerinden, 103 Süper Lise ve 102 Müfredat Laboratuvar Okulu olmak üzere toplam 205 fen bölümü öğrencisine kimya tutum anketi ve öğrencilerin ailevi ve kişisel bilgilerinin yeraldığı soru anketi uygulanmıştır. Sonuçlar öğrencilerin kimya başarılarına ve kimya tutumlarına cinsiyetlerinin önemli bir etkisinin olmamasının yanısıra, ortaöğretim başarı puanları üzerinde anlamlı bir etkisinin olduğunu göstermiştir. Okul türünün, öğrencilerin kimya alanındaki tutumlarını ve başarılarını etkileyen bir faktör olduğu ancak baba eğitiminin kimya başarısı üzerinde önemli bir etkisinin olmadığı saptanmıştır.

ANAHTAR SÖZCÜKLER : *Kimya başarısı, kimya tutumu, lise düzeyi, SES (sosyoekonomik düzey)*

1. INTRODUCTION

In many lycees throughout Turkey at least three years of chemistry is required of science students. There have been various research studies assessing factors that affect science achievement. Considering both the affective and cognitive variables that may have an impact on achievement, studies are more focused on science achievement rather than chemistry. Findings of Schibeci [1] indicated that the variables might differ from one school environment to another. Schibeci and Riley [2] investigated the influence of a set of students' background characteristics and perceptions on their science attitudes and achievements and found that there are significant differences between males and females regarding

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their verbal, numerical and visual spatial ability levels. Throughout the elementary and secondary educational periods, girls' school performance level is greater than the boys' school performance. However, Fiengold [3] found that, as beginning with the end of senior high school and continuing educational years boys tend to outperform girls. Furthermore girls are more successful in verbal abilities than boys whereas boys are more successful than girls in numerical abilities. The family characteristic that is the most powerful predictor of school performance is socioeconomical status (SES). The higher the SES of the student's family is, the higher his/her academic achievement is. This relation has been documented in countless studies and seems to hold no matter what measure of status is used and it holds with a variety of achievement aspiration variables, including grades, achievement test scores, retention at grade level, course failures, college plans and total amount of formal schooling. The overall impression of several studies is that the higher SES parents want their children to understand the world around them and come to grips with it through their own efforts, although control of their environment will require getting along with others; while the lower SES parents are concerned with mainly avoiding trouble by means of meeting the demands of those in authority. In this research it was aimed to investigate the effect of SES on chemistry achievement specifically.

The general purpose of this research is to investigate the factors that affect chemistry achievement and chemistry attitudes of 11th grade students, by investigating some student related variables such as gender, school type, and father education. For this purpose the relations between chemistry achievement and gender; chemistry attitudes and gender; cumulative secondary school grade and gender; chemistry achievement and father education; chemistry achievement and school type; chemistry attitudes and school type were examined.

2. METHOD

2.1 Hypotheses:

The following null hypotheses were tested in this study.

H◦1: There is no significant relation between chemistry achievement and gender.

H◦2: There is no relation between cumulative secondary school grades and gender.

H◦3: There is no significant relation between chemistry attitudes and gender.

H◦4: There is no significant relation between chemistry achievement and school type.

H◦5: There is no significant relation between chemistry attitudes and school type.

H◦6: There is no significant relation between chemistry achievement and father education.

2.2 Instruments:

A two-part questionnaire was used in the study. In the first part, students answered questions about their gender, father education, cumulative secondary school grades, Chemistry I grades and Chemistry II grades. The second part of the questionnaire consisted of a 23 likert type item, Chemistry Attitude Scale [4]. This scale was designated in such a way as to include attitudinal statements sampling out aspects of the chemistry-related opinions and feelings of the lycee students.

2.3 Procedure:

All 11th grade students attending Ayrancı Curriculum Laboratory School and Ayrancı Super Lycee were included in the investigation during the academic year 1998-1999 fall semester. The sample made up of 205 science students of ages 16-17 and there was not any ethnic breakdown. Ayrancı Curriculum Laboratory School students were mostly Ayrancı Secondary School graduates

whereas Ayrancı Super Lycee student were from different secondary schools. Even though they were in different programs they were taught chemistry topics in science courses at secondary schools and they took chemistry courses at high school level. Different instructors taught these courses and examinations were not common for all of them. Instructional methods, content of the courses, textbooks were almost similar. Their own chemistry teachers administered the questionnaire and Chemistry Attitude Scale during class hours. The dimensions of the items in Chemistry Attitude Scale were investigated by factor analysis and a t-test independent sample was used for hypothesis testing. The hypotheses were tested at a significance level of 0.05, the analysis were carried out by using SPSS/PC. In the first step of analysis, 23 items of the chemistry attitude scale were analysed in terms of dimensionality of the item content by the principle component analysis. The dimensions derived were scored separetely and used in the t-test analysis.

3. RESULTS

Items in Chemistry Attitude Scale were designed in such a way as to measure attitudes towards chemistry in different dimensions. The students in the sample perceive the chemistry attitudes in 4 orthogonal dimensions and they were clustered in such a way that the first dimension is enjoyment, the second dimension is laboratory work, the third dimension is negative feelings and anxiety, and the fourth dimension is perception of success. As may be seen in Table 1, the most of the items were loaded in first dimension rather than second third and fourth dimensions. For instance 'I am afraid of chemistry courses' is loaded in enjoyment subdimension. In the light of this finding it may be claimed that negative feelings and anxiety dimensions also represented in enjoyment Therefore, items were categorised in two parts specifically: Feelings related with chemistry (attitude factor 1) and Laboratory work (attitude factor 2) and these two factors were considered in statistical analysis.

Table 1

Items from the Chemistry Attitude Scale and Factors

Factor 1

* I like chemistry very much.
* If I were asked to teach one high school science course, I would choose chemistry
* Chemistry is a profession I would choose to work in.
* Chemistry is more interesting than other branches of science.
* I am happier in my chemistry courses than I am in other courses.
* I would like to learn more about chemistry.
* A carrier in chemistry would be enjoyable.
* My mind tends to wander in chemistry class.
* I am more scared of chemistry courses than other courses.
* 'Chemistry' is a word that bothers me.
* I enjoy working in chemistry.
* I do not regret spending time in chemistry.
* I fell depressed when I work in chemistry.
* I am afraid of chemistry courses.
* Chemistry is a difficult subject for me to learn.
* I do not understand why people are afraid of chemistry.
* I prefer doing other things than working in chemistry laboratory.

Factor 2

* I enjoy starting a new experiment in the chemistry laboratory.
* Laboratory work is the most boring part of the learning chemistry.
* I enjoy doing experiments in the chemistry.
* I do not believe that content of chemistry courses is applicable to daily life.

Factor 3

* I feel anxious when attending chemistry classes.
* Clemistry makes our daily life easier.

Factor 4

* I have doubts about being successful in the chemistry field.
* If I take course about science it would not be chemistry.

The relation between gender and cumulative secondary school grade; gender and chemistry achievement; school type and chemistry achievements; gender and chemistry attitudes; father education and chemistry achievement were examined by t-test and results were tabulated in Table 2.

Table 2
Results of t-test

Gender effect on	
Chemistry I achievement	Not significant
Cumulative secondary school grades	Significant
Attitude factor 1(Feelings)	Not significant
Attitude factor 2(Lab work)	Not significant
School type effect on	
Chemistry I achievement	Significant
Chemistry II achievement	Significant
Attitude factor 1(Feelings)	Significant
Father education effect on	
Chemistry I achievement	Not significant

There is no significant effect of gender on Chemistry I achievement, attitude factor 1 (Feelings) and attitude factor 2 (Lab work), however there is a significant effect on cumulative secondary school grades. School type has a significant effect on Chemistry I, Chemistry II and attitude factor 1(Feelings). Finally there is no significant effect of father education on Chemistry I achievement.

4. CONCLUSION AND DISCUSSION

This research is designed to investigate the dimensions of attitudes towards chemistry and how some student related variables such as gender, school type, father education affecting chemistry achievement and chemistry related attitudes of 11^{th} grade students.

The present study indicated that few variables examined were influential in determining the chemistry achievement and chemistry related attitudes of students.

The items clustered in the Chemistry Attitude Scale indicate that high school students perceive chemistry-related attitudes and opinions in four dimensions such as enjoyment, laboratory work, negative feelings and anxiety, and perception of success. As may be seen in Table 1, third and fourth dimensions are contraindicative and those items were also loaded in first dimension in some of the cases. Therefore, items were categorised in two parts specifically: Feelings related with chemistry (attitude factor 1) and Laboratory work (attitude factor 2). The results of the t-test analyses are tabulated in Table 2. Gender predicts the cumulative grade of secondary school but does not predict the chemistry achievement and chemistry attitudes which seems contradiction with literature saying males' ability and feelings related with science is more positive than that of females'. However, in this research all of the participants both males and females were science students of either super lycee or curriculum laboratory school, their anxiety makes them study hard and spend more time in getting satisfactory grades in both chemistry courses. Therefore, their preferences and feelings related with chemistry did not show any significant discrepancies regarding gender difference.

There is a significant relationship between school types and feelings related chemistry and chemistry achievement. Super lycee students' mean of Chemistry II grades is higher than that of curriculum laboratory school students, however curriculum laboratory school students have higher mean of Chemistry I grades than curriculum laboratory school students. This was probably due to chemistry background of students, the topics

covered in Chemistry I and Chemistry II courses or variety of facilities and instructional methods provided for both school students. This indicates that school type is influential on students' achievements and their feelings on chemistry. Finally, father education can not predict the chemistry achievement of students. This is probably due to uniformity of father education level at the schools under consideration because both of the schools were located in a district where high socioeconomic class families were living.

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