Upper Secondary School Pupils' Attitudes towards Natural Science

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Abstract
Students' attitudes towards natural science constitute an important area in science education as fewer students are interested in natural science and they do not choose corresponding science disciplines in postsecondary education. The current study reports preliminary results of a survey on high school students' interests and attitudes towards science topics according to their genders, grades, and parents' educational levels. This is part of a large project, an evidence-based research project to explore why students choose particular professions in college as well as factors that affect their decisions. Data were collected by means of a questionnaire at eight higher secondary school campuses in Turkey. A total of 422 students participated in the study. Of them, 162 were seniors and 260 were high school graduates. The results of the study revealed that some degree of relationship exists between students' attitudes towards science and corresponding variables: science interests, genders, grades, and parents' educational levels. In conclusion, the current study revealed participants' interests in various science branches and their relationships with factors such as genders, grades, and parents' educational levels and occupations. Students at high school level showed a relatively high interest level in all disciplines of science.
Keywords: Science interests, secondary school students scientific attitudes, science education, natural sciences, science programs.

Introduction

Recent investigations concerning students' attitudes toward science may be divided into three major types: studies that focus on possible factors affecting it; those that investigate various ways to enhance it; and these that explore the relationships among certain factors (gender, grade level, national aspects) and students' interest. Recent studies (Seker and Welch, 2006; Michelsen, 2009; Ozden, 2007; Prokop *et al*., 2007) have identified several issues that commonly affect students' interest in science. Among these, Lindahl and Winberg (2008) discovered different factors including attitudes, motivation, epistemological beliefs, self-efficacy and the impact of different working forms. They proposed that researchers should approach the subject more in terms of humanistic perspectives and focus on scientific literacy rather than on science literacy.

In a different study, Ekici and Hevedanli (2010) analyzed high school students' attitudes towards a biology course with a descriptive survey of 1,306 students. They found various factors affected attitudes; gender, educational institutions, grade levels, and academic achievements. These factors also arose in other studies, especially the gender variable (Dawson, 2000; Jones *et al*., 2000; Barram-Tsabari *et al*., 2006; Keeves & Kotte,

1990; Prokop *et al*., 2007). Statistical meanings and analysis were also discussed in the study such as the fact although boys showed more interest in science in general (Ozden, 2007), girls showed more interest in biology. In a similar study, Trumper (2006) reported the statistical results of factors affecting 635 students' interest in physics in a secondary school in Israel and revealed that strong correlations exist among students' interest in physics, attitudes to science and technology, opinions about science classes, and out-of-school experiences in physics where interests and positive attitudes were highest. In a qualitative study, Lavonen (2009), too, investigated out-of-school leaning environments to enhance students' interest and motivation in science education though industry site visits and suggested that site visits had a positive influence on students' interest and motivation.

Another study (Ozden, 2007) explored problems in science and technology education with 84 elementary science teachers and how they affected creative and critical thinking, curiosity and positive attitudes towards nature. The author found that an insufficient number of science teachers, insufficient in-service training workshops for science teachers, and overcrowded classes were the main issues that needed to be resolved in order to increase students' interests and achievements in natural science classes. Another study (Michelsen, 2009) conducted a mixed method research methodology on secondary students' interests in interdisciplinary domains of mathematics and science with the I-FUN project. He found some interesting results such as the use of modern technology in science classes does not have a significant impact on students' interest and students believe that mathematics and science are important subjects for future career needs in future.

On the other hand, several studies focused mainly on what kinds of factors affected students' interest and how their interest could be enhanced. For example, Solbes and Traver (2003) demonstrated that several aspects of the history and sociology of science in classes can result in a significant improvement in pupils' interest, image, and attitudes in science and science teaching. In that study, 694 high school students were included as participants and the research sample utilized four types of conceptual questionnaires related to science and scientific statements. Moreover, Rosberg and Lindahl (2009) discussed 1,427 students' interest, knowledge, and self-efficacy in science. They discovered that socio-scientific issues significantly influence attitudes towards science.

Recent research studies examined students' interest in science in relation to various factors such as science models, history of mechanics, curriculum, and scientific entrepreneurs. Hong *et al*. (1998) investigated Korean middle school students' interest in biology and discussed the implications for biology education. They analyzed 267 students' responses to 64 items on a three-point Likert scale and categorized topics and activities consisting separately of 11 domains and six domains. They discovered that boys showed more interest in biology topics than girls and students showed a low interest level in biology in general because of the instructional strategy used and the biology curriculum itself. A similar study (Seker & Welsh, 2006) was conducted on utilizing effectiveness of the nature of science (NOS) and history of science (HOS) to enhance students' interest in science.

Another study (Haussler & Hoffmann, 1999) presented three interlinked studies: developing the curricular framework for physics education, assessing student interests in science, and developing a curriculum that measures its cognitive and emotional effects on students. Buang *et al*. (2009) employed a case study that studied the significance of scientific entrepreneurs for science education and how this affected students' interest in science. They came up with models to increase students' interests. Wells *et al*. (2007) also utilized science models to exert a positive influence on students' approaches towards scientific concepts with their project called `Raytheon`. In a separate paper, Klug *et al*. (2003) used an authentic research model to encourage student interest in science, mathematics, and technology with 5th grade students investigating camera images taken by Mars exploration projects. Another research paper (Fensman, 2006) offered some possible solutions to the problem of students' lack of interest towards science by, for example, revising the curriculum to present science as a story involving persons, situations, and actions; emphasizing real-world situations; engaging students with more open problems for investigations.

Current study, in quite a different way, focuses on various factors including students' interests in different science branches and parents' educational levels as well as their occupations. Our research was guided by two descriptive and inferential research questions:

1- Which specific topics in science interest higher secondary school students the most?
2- How are certain fundamental factors (students' grades, genders, and their parents' educational levels) related to their attitudes towards science?

We considered that there would be no significant difference between students in different grades in their attitudes toward science. On the other hand, we expected that significant relationships would exist between students' attitudes towards science and their interests. In addition, their parents' educational levels played an important role in the levels of science interest and attitudes.

Methodology

The current study was designed as a quantitative survey investigation with a numeric description of related variables (students' interests, students' attitudes towards science, genders, grades, and parents' educational levels). We used the results of the study sample to generalize and draw conclusions about the study-population. The study was conducted in eight middle-sized various sized (enrollment range 600-800), public, co educational, liberal art colleges and three midsize high schools. The body of participants represents a typical study group for our research purposes and for generalization findings restricted to certain constraints such as their socioeconomic status and particular parental features.

During the fall semester of 2010, 700 high school students were asked to complete questionnaire forms and of them, 422 did so. During data collection, research participants included high school seniors and high school graduates planning to go to college. Of these, 104 (24 %) were female and 318 (76%) were male. Ninty-five percent of the students were between the ages of 16 and 19. Research participants were selected through random sampling whereby each individual has an equal probability of being selected from the population, ensuring that the sample will be representative of the population (Keppel, 1991).

Data were collected by means of a questionnaire with 23 items. After reviewing several data collection instruments such that the Children's Environmental Attitudes & Social Knowledge Scale (CHEAKS), Children's Science Curiosity Scale (CSCS), Draw a Scientist Test (DAST), Epistemological Beliefs Assessment for Physics Science (EBAPS), Modified Attitudes Towards Science Inventory (mATSI), Programme for International Student Assessment (PISA), Relevance of Science Education Students Questionnaire (ROSE), Science Opinion Survey (SOS), and Science Attitudes Inventory (SAI), we chose two of them to use as data collection tools because they best fitted our research purposes. The questionnaire items were a mixture of two previous diagnostics instruments (Modified Attitudes towards Science Inventory and the Children's Science Curiosity Scale). Two research purposes were investigated through items in the data collection questionnaire; these can be summarized as how students' interest in science are affected by their attitudes and how certain important factors such as their grades, gender, and parents' educational levels are related to their science attitudes and interests.

The items of the questionnaire were Likert-like items based on a scale from "strongly disagree" to "strongly agree." Other questions were asked for factual information, such as grades, genders, ages, and parents' educational levels. All information used in this analysis was derived from questionnaire data. The items in the questionnaire were developed and tested at two other institutions before their use in our study. (Harty and Beall, 1984). The simultaneous and convergent validity (Harty and Beall, 1984) of these measures was established through factor analysis, and was found to be at an adequate level. The reliability of the factors was also established through the coefficient alpha. The constructs were represented by 23 measures-multiple items combined on the basis of factor analysis to make indices and 23 measures were single item indicators. The SPSS statistics package program was used to analyze the data collected.

Results

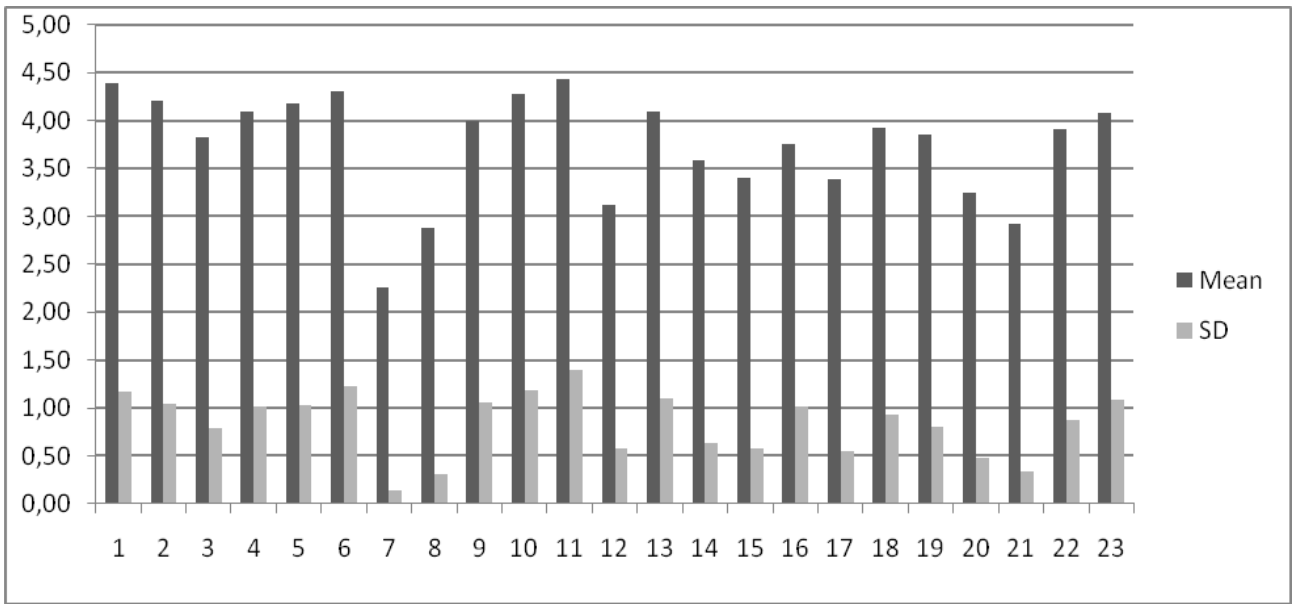
The questionnaire used for data collection can be divided into four groups according to sub-disciplinary preferences such as physics, chemistry, and biology as well as general science interest. The table below illustrates these interest areas.

Table 1. Inter-disciplinary domains in the questionnaire

Category	Questions	Number of questions	Percentages
General science	1-2-3-4-5-6-12-23	8	34.78 %
Chemistry	17-18-19-20-21-22	6	26.08 %
Biology	7-8-9-10-11	5	21.75 %
Physics	13-14-15-16	4	17.39 %
Total	23	23	

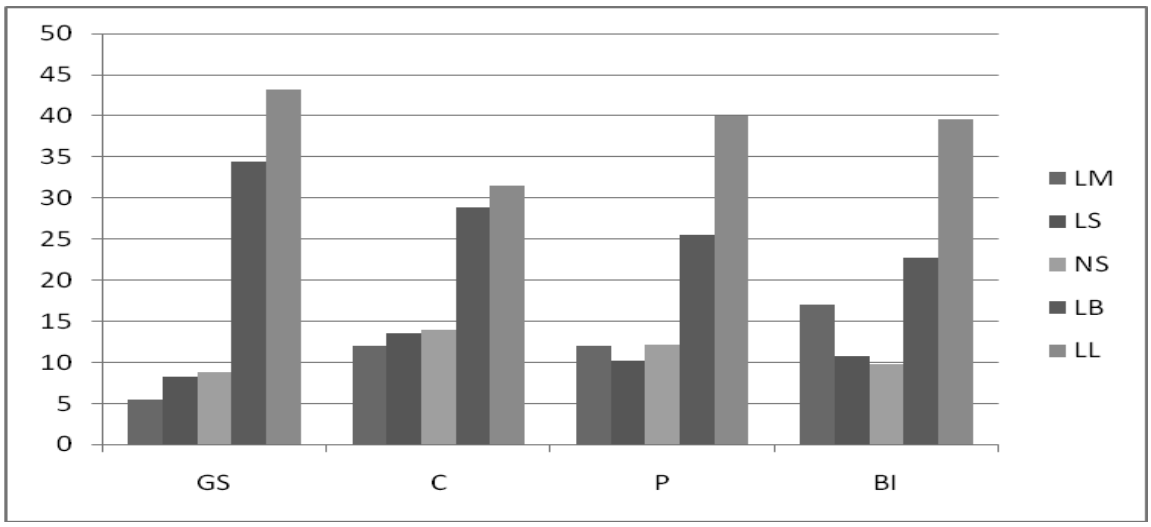
The total mean score and standard scores of items in the questionnaire are presented in Figure 1. The questionnaire was constructed as `5` being "like the most' and `1` being "like the least" for interest in each topic. The value of `interest` for general science and biology (items 1, 6, 11) appeared to be the most popular component in the questionnaire with a score of 4 and higher.

Figure 1. Science attitudes levels for the participants



The percentages of domain components are illustrated in Figure 2. Although the mean score of biology topics showed it was the most popular branch in Figure 1, general science and physics items were found to have the highest percentage among all disciplines. General science and physics were included two items in the questionnaire.

Figure 2. Students' attitudes percentages of the disciplines



The abbreviations for the domains are: GS for general science; P for physics; C for chemistry; BI for biology. Likert scales from `likes most` to `likes least` are abbreviated as `LM` to `LL` respectively.

Grade Difference

The mean scores of topic components for all respondents by domains and the highest scoring items are presented in Table 2. Although 10th graders have the highest interest levels in disciplinary aspects, there is no significant difference among all grades. Ninth graders are mostly interested in general science concepts and 10th, 11th, 12th graders are more interested in chemistry, physics, and biology respectively.

Table 2. Mean scores of science interest in discipline by grade

Grade	Most preferred discipline	Overall Mean
9	GS	3.04 ± 0.91
10	C	3.15 ± 1.02
11	P	2.98 ± 0.89
12	BI	3.09 ± 0.97

Gender difference

Male participants had slightly higher `topic` interest levels than females. Although males were mostly interested in general science and physics, females were found be more interested in biology and general science. Results indicate that gender difference is not a major factor for differentiating interests in general science topics.

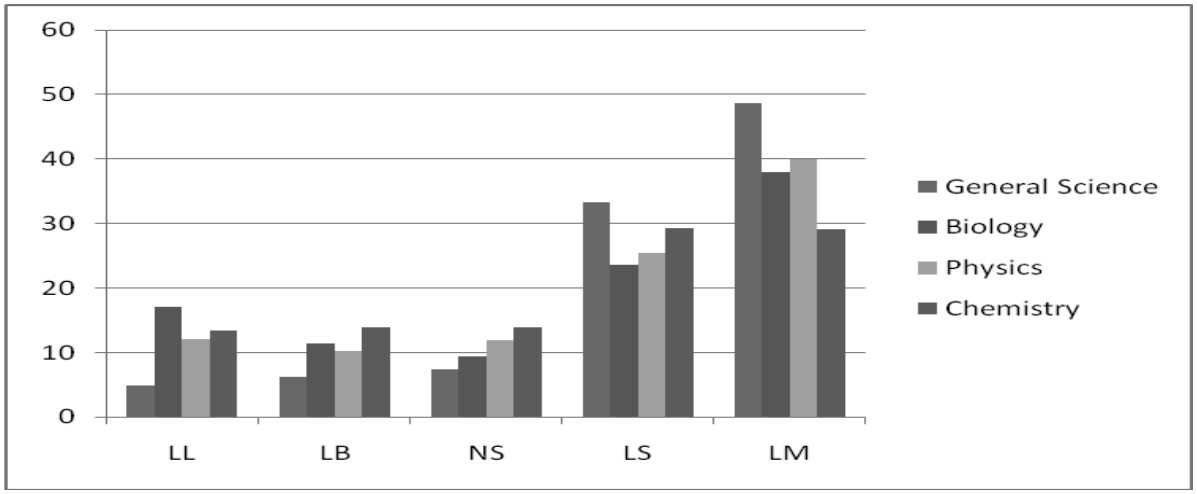
Table 3. Mean scores of science interest in discipline by grade

Gender	Most preferred topics	Mean
Male	GS and P	3.02 ± 0.90
Female	BI and GS	3.09 ± 0.97

Disciplinary Preference

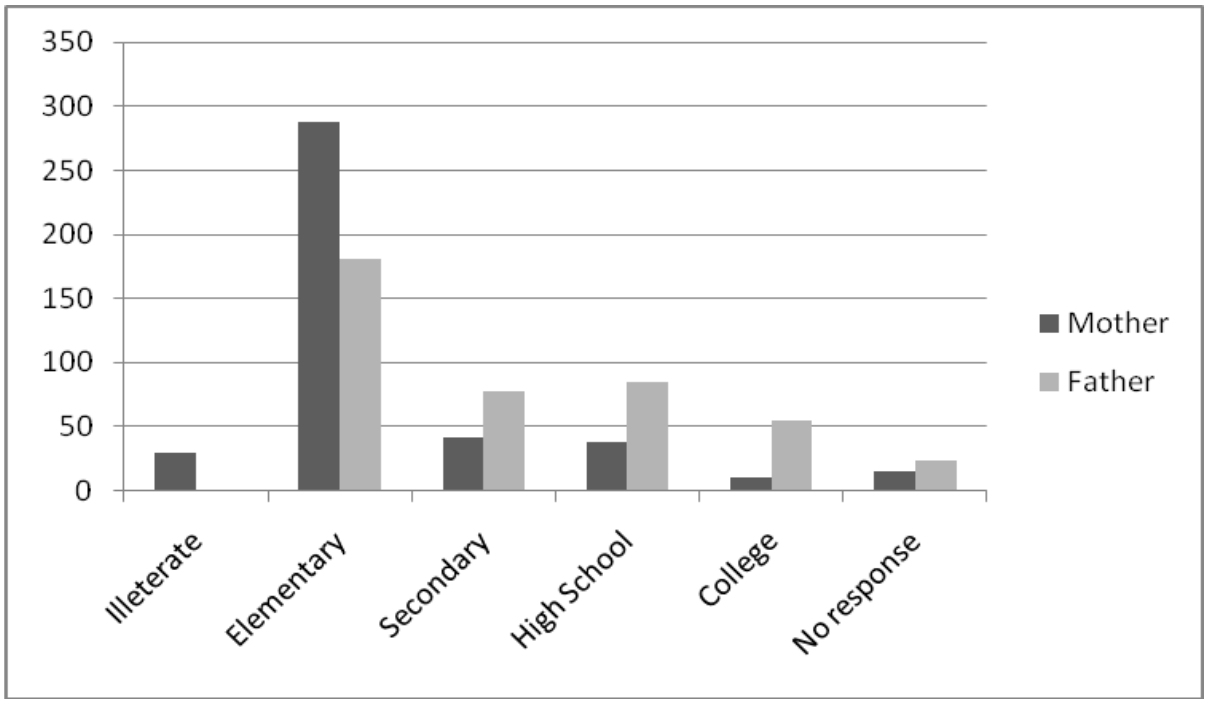
To fulfill one of the research purposes of this study, Figure 3 was constructed to illustrate participants' most preferred domains and their percentages. The most preferred to the least preferred percentages are abbreviated by LL to LM respectively. From the figure we can see that students like general science concepts the most (Figure 3) at approximately 49 % and chemistry the least at around 29 %. Surprisingly, biology was found as the most disliked branch of science. It was also found to be the 3rd preferred science at 39%.

Figure 3. Percentages of general science interests



Parents' Educational Levels

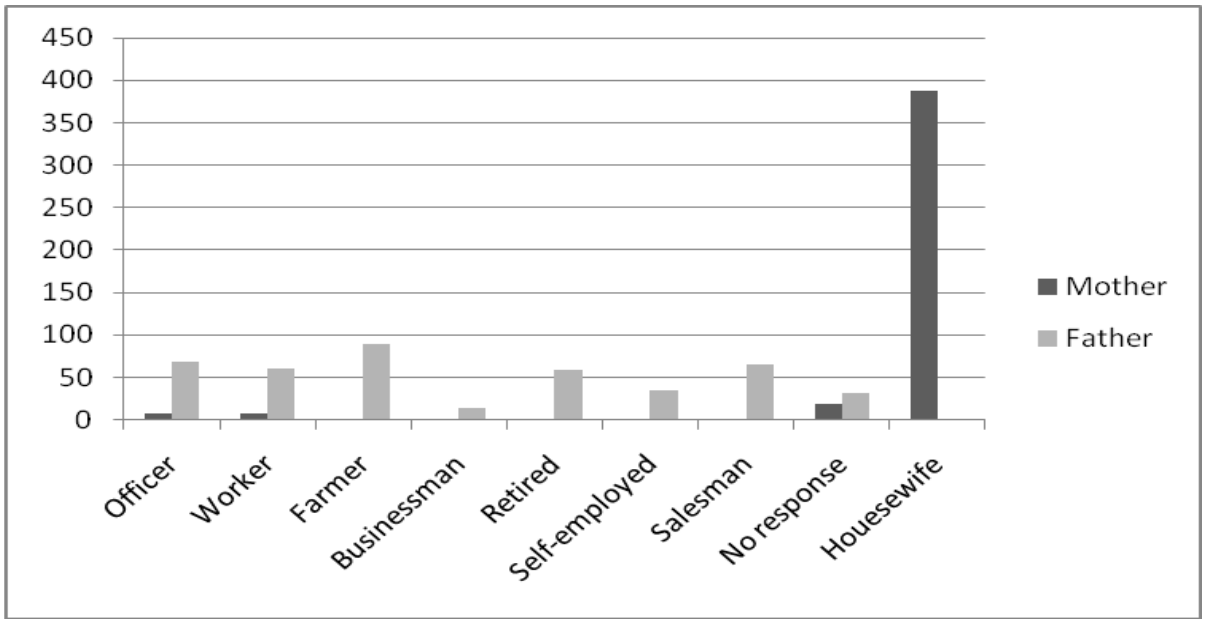
Figure 4. Participants' parents' educational levels



Above figure illustrates the educational levels of the students' parents. Most of the students' parents (n = 290 for mothers and n= 196 for fathers) graduated from elemetary school. This is a typical finding because most of the families went to school prior to the 1980s and they did not have the opportunity to go to high school and college. However, none of the parents went to college and this was an interesting finding especially for the mothers. Around 76 of the students' fathers had the opportunity to go to the college. Their areas of college study were not indicated on the questionnaire.

The figure below presents the parents' occupations. It mostly correlates with Figure 4. For example, students' mothers with no education or only an elementary school diploma usually did not look for work and became housewives. Approximately, 20% of fathers (n = 80) work as officers in government institutions. The city where the data were collected is very industrialized therefore most of the fathers became workers, salesman, tradesman.

Figure 5. Participants' parents' occupations



Correlation

The correlation of science disciplines was also calculated. The correlation among the subjects in the topic components is the most significant. General science is significantly correlated with general science, physics, and chemistry while the general science and physics correlation has the highest value. In addition, the correlation between chemistry and physics was significant ($r > 0.05$, $p < 0.01$).

Discussion and Conclusion

In general, students at high school level showed a relatively high interest level in all disciplines of science. Nonetheless, two items, general science and biology, received the minimum interest rates in data analysis (Figure 1). It was also found that students were most interested in general science concepts with a popularity rating of around 50% (Figure 3). This might indicate that students like science when they are first introduced with general science concepts. A possible explanation for this could be related to how they are introduced and what techniques teachers utilize for them.

Considering parents' educational levels (Figure 4), the socio-economic status of participating students may be considered as middle class and low-income families. For this particular country, and possibly for developing countries, this result could be characteristic because only since 2003 have students been to attend to high school. The Ministry of National Education revised the country's education system and currently mandatory completion of an eight-year educational system (elementary and secondary) is in effect. Secondly, many families used to live in rural areas where there were only a limited number of high schools and this prevented children from attending high school. Also, children used to help their parents and do domestic tasks

such as taking care of farm animals and planting in the fields. In addition, living in a city that has recently become very industrialized may affect parents' career choices for their children.

In conclusion, the current study revealed participants' interests in various science branches and their relationships with factors such as genders, grades, and parents' educational levels and occupations. Our findings were both similar and different to previous studies. For example, unlike earlier studies (Ogden, 2007) female students were found to be more interested in general science and biology than male students. In order to develop more consistent results further studies need to be conducted.

In future, we plan to report the second part of this study, which was carried out among college students, and to compare its outcomes with our current findings including college students' interests in science, study of disciplines, parents' occupations, and their effect on choosing courses at college.

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