Gender differences in high school students' interests in physics

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Contents

Abstract

The aim of this research was to determine the interests of high school students in Physics and variable of how the influential factors on their interests depending on gender. The research sample included 154 (F:78 M:76) high school students. A structured interview form was used as the data collection tool in the study. The research data were analyzed using frequency, chi square and content analysis. According to the results of the analyses, there was no significant difference between the female and male students' personal interests in physics. In addition, it was found that the male students were more aware of the developments in physics more than the

female students. In terms of career planning, the male students were observed to be more interested in physics than the female students. The results of the content analysis revealed outstanding similarities and differences in the views of the male and female students.

Keywords: High school students, Interest in Physics, Gender

Introduction

Recently, there has been an increase in the number of studies examining the interest towards the field of science with regards to the gender variable. This is thought to be due to the male dominant nature of science fields. According to a comprehensive literature review Osborne et al. (2003) conducted, the reason why the number of studies focusing on the gender variable increased is because of the low number of females in the field of sciences and technique and the need for qualified personnel. Studies indicate that there is a male-dominant characteristic in physics, especially an important field in sciences. According to Jones et al. (2000), while male students are interested in subjects such as the atomic bomb, electronic devices and technology, female students are interested in subjects such as healthy diet, animal associations, weather and aids. In a study Walper et al. (2013) conducted, they suggested that male students have a higher personal interest in physics than female students. In this respect it could be said that the low level of interest towards physics may lead to females being unsuccessful in physics, having prejudice for physics and making less professional choices regarding the field of physics. There are many findings in the literature stating that, with regards to the field of physics, females are highly underrepresented in science fields more than male students (Sainz, 2011; Beede, et al., 2011). This is an outstanding figure in our modern world in which women's social roles have become more active.

Interest and Physics

Researches have suggested two concepts regarding interest. These are personal interests and situational interests (Krapp, 2002). "*Personal interest is topic specific, persists over time" (*Schraw &Lehman, 2001; cited in Juuti and others, 2004). Personal interest, which is less spontaneous, focuses in internal mobility and cherishing of the person (Schiefele, 1999). As for situational interest, it is defined as interest occurring due to the effects of the students learning environment. According to Hidi (1990), personal interest, development and changes occur during a long

period, but in situational interest long-term effects can take place as a result of a factor in the learning environment. Schraw and others (2001) underline that situational interest can be increased by the partial effect of teaching the student in the learning environment. By using various methods and techniques in the field of science, students' situational interest levels can be improved.

Students can be more successful in the field of sciences when they have an interest in these fields (Juuti and others, 2004). According to previous studies the interest for physics course is generally less than the interest towards chemistry and biology (Fairbrother, 2000). It is presumed that the preconception and fear that students experience concerning physics is effective in this. It is necessary to determine the factors that cause these beliefs in students and to organize teaching methods and techniques accordingly. In addition, it is possible to state that teachers, who are crucial components of the education environment, can change the views of students towards physics in a positive way, if they are more equipped. It is recognized that eliminating these negative beliefs that are at the extent of affectivity with necessary regulations is an important tool for bringing up successful individuals in the field of physics. This is thought to be more important for females, who are represented rather less in the field of physics. It will contribute in conducting qualified scientific studies when females, who make up fifty percent of the society, participate in the fields of sciences with the same rate as well. Thus, in following the interest levels of females towards physics, the field which they are mostly biased towards, it is crucial for recent studies to determine the present conditions. This way the state of the problem can be defined and solution suggestions regarding the problem can be determined.

Physics Education in Turkey

In Turkey, physics education in secondary schools is carried out through student-based methods and techniques within the frame of constructive learning approaches. Since 2007, teaching practices in physics education have been carried out gradually according to a program based on activities that are linked to real life. With regards to this program, learnersare defined *"as individuals who enjoy learning, who sometimes access information through their skills or other times enhance their skills through their knowledge, who are curious, creative, who criticize and who attribute themselves responsible for their own learning. They accept that physics is one of the main topics of science and technology and that the physics course is a follow-up of science and technology course*"(Arslan and others, 2012). However, although the program is presented as officially being conducted in secondary school institutions, studies have put forward that there are various problems in

implementing it (Ayvacı, 2010; Kapucu, 2010). Studies have indicated that problems occur due to the inconveniences of learning environments and the attitudes of teachers. In addition, it is possible to say that the university entrance exam conducted on students at the end of secondary education in Turkey leads to bias in students towards life-based learning approaches (Baran, 2011). In this study, this problem was taken into consideration when student views regarding physics were collected according to the personal interest dimension and the situational interest dimension.

Women in the Fields of Science in Turkey

Tepav (2011) stated that women were a minority in scientific areas in Turkey. Reasons for why women in Turkey are not represented at desired rates in scientific fields and especially in the field of sciences are given below:

a. There is a state of gender inequality in the society (Poyraz, 2013).
b. There are socio-cultural features that prevent women from entering the business world (Tepav, 2011).
c. It was stated that female students in the South-East of Turkey encounter problems in completing their education because they get married at an early age. Yakıt and Coşkun (2014) indicated that early marriage is still a problem all around Turkey, especially in South-East and East regions.

Among the students who entered the university entrance exam between years 2000-2014 and ranked as the first 1000 in the numeric field, females were reported to be 18.1% of those who got enrolled in the Science, Technology and Math departments (OSYM, 2015). It is possible to state that this rate is rather low.

Importance of the Research

The aim of this research was to examine students' personal and situational (being informed about developments in Physics, being interested in solving problems in physics, choosing a profession related to physics) interest towards physics with regards to the gender variable by resorting to their views. As it was mentioned before, there are problems with the female participation in science areas in Turkey. In this research, while identifying the problems which existed especially in the research area (south east of Turkey), student views were gathered and the reasons for these problems were reached upon. It is believed that this cause-effect based study will contribute to the related literature. Also, there were few studies in Turkey which resorted to student views when determining students' interests in physics. It is

believed that this study is significant both in terms of solution suggestions and also in terms of filling in the gap in the literature.

The Research Questions

It has been seeked to answer the questions below for this study:

1. Is there any significant relationship between the personal interest of physics and gender?
2. Is there any significant relationship between the situational interest of physics and gender?
3. What are the factors that affect the interest of female and male participant students concerning physics?

Methodology of Research

Research Design

Qualitative research analysis model was used in this study. *"The process of qualitative research is largely inductive, with the inquirer generating meaning from the data collected in the field"* (Creswell, 2003).

Participants

The study sample consists of a total of 154 students, 76 female and 78 male. The participants were students from two high schools during the 2014-2015 academic years. The students were selected based on their accessibility at the time of the study.

Data collection instruments

Structured interview form aimed at determining the interest towards physics was used as the data collection instrument in the study. A pilot study was conducted initially for the data collection instrument in the study. The questions, which were prepared by the researcher concerning the interest towards physics, were directed to the students taking education in various high schools and grades. Open, clear and efficacious questions were determined according to the pilot study findings that were examined by the researcher and another faculty member. In order to determine reliability and validity of the data collection instrument, the draft form was examined by two researchers and presented to field education and Turkish grammar experts for their opinions. Questions which were come to agreement upon remained in the instrument and the other questions were eliminated. Thus, the number of questions in

the data collection instrument was four. With these processes, the validity and reliability of the data collection tool were achieved.

Data Collection and Analysis

Required permissions were obtained from the Provincial Directorate for National Education for both the pilot study and this study. The researcher contacted the officials and classroom teachers working in the schools where the study was conducted. Students were given a one hour class time to answer the interview form. A total of 170 interview forms were completed but 16 which were reported as inappropriate were not included in the study. In this study the data were collected and evaluated with the structured interview technique, one of the qualitative research methods. An interview form with four questions was prepared to determine the interest of participants towards physics and the factors which affected these interests. The data resulting from the statements in the interview forms were analyzed through a content analysis, one of the qualitative research methods, and through a frequency analysis and a chi-square independence test with the SPSS 20 software. The content analysis was conducted both by the researcher and a faculty member. Comparisons between the researchers of different studies were carried out. Reliability of the study was tested after these comparisons. The reliability evaluation method [Reliability=Consensus/(consensus+dissensus)] introduced by Miles and Huberman (1994) was used to test the study's reliability. Reliability of the study was reported to be 90%. Studies with reliability rates over 70% are accepted as reliable (Miles and Huberman, 1994).

Results of Research

Content analysis was conducted on the statements of participants and results of the chi-square analyses based on the gender variable as well as the results of the content analyses regarding the factors that affect students' interests towards physics are given in this section.

Table 1. Participants' personal interest levels on physics course according to the gender

Gender			I have personal interest in Physics			Total	p
			Yes	No	Partly		
	Female		33	37	8	78	.109
			42.3%	58.7%	61.5%	50.6%	
	Male		45	26	5	76	
			57.7%	41.3%	38.5%	49.4%	
Total			78	63	13	154	
			100.0%	100.0%	100.0%	100.0%	

According to Table 1, although the results are not significant, male students have a higher personal interest towards physics than female students X2 (df:2 N:154)=4.434, P>.05.

Results of the analysis concerning participant awareness about the developments in the field of physics according to the gender are given in Table 2.

Table 2. Participant student views concerning awareness about the developments in the field of physics according to the gender

Gender			I am aware			Total	p
			Yes	No	Partly		
	Female		4	50	24	78	.005
			30.8%	63.3%	38.7%	50.6%	
	Male		9	29	38	76	
			69.2%	36.7%	61.3%	49.4%	
Total			13	79	62	154	
			100.0%	100.0%	100.0%	100.0%	

According to Table 2, male participants are significantly more aware of the developments in physics than the female participants X2(df:2 N:154) =10.642, P<.05.

Analysis results concerning the role of physics in the students' career planning with regards to the gender variable are given in Table 3.

Table 3. Distribution of the Role of Physics in Career Planning According to the Gender

Gender			I may prefer it		Total	P
			Yes	No		
	female		7	62	69	.000
			20.6%	55.4%	47.3%	
	Male		27	50	77	
			79.4%	44.6%	52.7%	
Total			34	112	146	
			100.0%	100.0%	100.0%	

According to Table 3, with regards to the views of female and male participants about physics concerning their choices of a profession, there is a significant difference in favor of male students X2(df:1 N:154)= 12.650, P<.05.
Analysis results about the level of participants' enjoying problem solving in physics are given in Table 4.

Table 4. Analysis results concerning participants enjoying solving problems in physics with regards to the gender

Gender			I like solving problems in Physics			Total	p
			Yes	No	Partly		
	Female		26	27	17	70	.278
			42.6%	46.6%	60.7%	47.6%	
	Male		35	31	11	77	
			57.4%	53.4%	39.3%	52.4%	
Total			61	58	28	147	
			100.0%	100.0%	100.0%	100.0%	

According to Table 4, male and female students didn't offer different responses significantly about enjoying solving problems in physics X2(df: 2 N:154)=2.562, P>.05.
Content analyses results concerning participants' interests towards physics are given in Table 5 and Table 6.

Table 5. Content analysis results concerning the awareness theme for female students

Category 1: Technologically	f	Category 2: According to daily life	F	Category 3: Explaining events and facts	f
Technologic devices are being developed.	20	Quality of life increases, it makes life easier, contribute to modernization.	20	It responds to questions, helps us to understand life.	15

Table 6. Content analysis results concerning the awareness theme for male students

Category 1: Technologically	f	Category 2: According to daily life	f	Category 3: Explaining events and facts	f
Medicine is enhancing, electronic devices are improving, it used in wars, makes people lazy, household devices are easy to use, computer software are improving.	45	Makes life easy, quality of life increases.	25	Explaining natural disasters, helping understand external events.	19

According to Table 5 and Table 6, it is evident that male students stated that they are technologically more aware of the developments in physics than the female students. Analysis results concerning female students' personal interest levels towards Physics course, interest towards problem solving in Physics and preferring physics in future career planning are given in Table 7.

Table 7. Analysis results concerning female students' interest level towards Physics course, preferring physics in career planning and interest towards problem solving in Physics

Reasons for positive interest	f	Reasons for negative interest	f	Reasons for preferring	f	Reasons for not preferring	f	Reasons for enjoying solving questions	f	Reasons for not enjoying solving questions	f
Teachers teach the course interestingly	3	Our teacher is not qualified	16	I like it	4	I don't like it, it is not interesting	31	I like Mathematics, It is fun	23	I can't solve them	27
Physics explains nature	12	It is complicated, it is difficult	28	I'd like to share my knowledge with other people.	6	I'm unsuccessful, physics is more difficult	15	My self-confidence increases	12	There are boring, difficult and long questions,	10

										it isn't interesting	
It is fun, I like researching	14	It is boring and unnecessary	4								
		I don't like it	11							.	

Analysis results concerning male students' personal interest levels towards Physics course, interest towards problem solving in Physics and preferring physics in future career planning are given in Table 8.

Table 8. Analysis results concerning male students' interest level towards Physics course, preferring physics in career planning and interest towards problem solving in Physics

Reasons for positive interest	**F**	**Reasons for negative interest**	**f**	**Reasons for preferring**	**f**	**Reasons for not preferring**	**f**	**Reasons for enjoying solving questions**	**f**	**Reasons for not enjoying solving questions**	**F**
It's as same as daily life, It explores the mystery of the universe.	23	Boring, unnecessary	15	Lively and fun	5	I'm interested in other fields	16	I like numbers	18	I don't know how to solve them	13
		Complicated, too many formulas	12	I'm interested in engineering	11	I'm not successful in it	8	it's fun	16	questions are too long, too many formulas	10
it's fun	5	I don't like it	12	I'm interested in it.	9	I don't like it.	10	Enhances my self-confidence	7	I'm not interested	10
it's numeric	10			I like researching	6						
questions in the university entrance exam	5										

According to Table 7 and Table 8, both female and male students stated that they have positive personal interests in physics because it's a part of daily life and it explained nature. While female students stated that they are interested in the course due to their teacher, male students stated that they are interested in physics because it is a numeric course and that it is a subject at the university entrance exam. Both

groups expressed that are not interested in physics because they found it boring, unnecessary and complicated. Female students expressed their teacher as the cause for their disinterest towards physics, male students underlined that they were not curious about the course. While some of the male participants stated that they found fields of physics lively and fun, that they were interested in engineering and that they would prefer it because they like doing research, some of the female students underlined the positive feeling of conveying information to other people. In addition, with regards to not preferring the fields of physics, some of the female participants expressed that they don't like physics and the course is too difficult and some of the male participants stated that they are interested in other fields. According to the views concerning solving problems in physics, male and female participants expressed similar views.

Discussion

In the study, there was an insignificant difference, in favor of the male students, concerning the personal interest levels of female and male students. According to this finding, when the findings in the literature (Rajakorpi, 2000; cited in Uitto, Juuti, Lavonen and Meisalo, 2006) related to significant differences between the interest levels towards physics that are in favor of male students are considered, that the female students' personal interest level towards physics is insignificantly different from male students' interest levels indicates that women's' position in the field of physics may increase. According to the content analysis results, some of female students suggested their teacher as the cause for their disinterest more than the male students. Based on this finding, it is possible to suggest that physics course teachers are crucial factors affecting personal interest levels of female students. It is believed that based on the experience of teachers, they can conduct effective classroom activities in order to enable female students' classroom participation. Zhu (2007) indicated that female and male students may have different learning styles; *"Girls preferred to learn physics in a conversational style and collaborative activity, and work with concrete objects. Boys, on the contrary, liked to learn through argument and individual activity, and tended to use more abstract thinking"*. Parallel to this idea, Wilson (1996) indicated that classrooms arelearning environments *"where teachers and learners interact with each other and use variety of tools and information resources with each other and use variety of tools and information resources in their pursuit of learning activities"*(cited in Adeyemo, 2011).However, the literature review suggests that there are significant differences between female

and male students' interest in physics. Although females have recently experienced a better development in physics than the past (Synder, Tan and Hofmann, 2004) studies indicate that female students are less interested in physics than male students. For instance, Tsabari and Yarden's (2010) literature review suggests that male students are more interested in the physics course than female students. According to their study, Cobern and Loving (2002) stated that male students were interested in the Physics course more than the female students. Researchers have tried to explain this based on cultural factors. Similarly, according to a study conducted by Adams et al. (2006), females have less personal interest towards physics than male students.

In this study, male students were detected to be significantly more aware of the developments in the field of physics than female students. According to the content analysis results concerning this finding, unlike female students male students were more interested in technological developments. This finding is not surprising when the passive social role of females and the general social structure in which they tend to more sociable fields are considered. This finding may have occurred due to the fact that males are generally more interested in technology than females. Previous studies support this finding. Cunningham et al. (2015) stated that female students are significantly less interested in technology than male students. Similarly Charles and Bradley (2005) asserted that females are rather less represented in information and communication technologies. Based on the content analysis results, when male students' views concerning their technologic interest are considered, it is evident that these views are centered on the fact that developments in physics affect the developments in technologic devices and computer software, contribute to the developments in medicine and are used in war environments. According to several studies, women have fallen behind men in computer technologies (Sanders, 2006) and the harsh language of technology may be negatively affecting women's' interest (Cole et. al., 1994; Linn, 1999). Similarly Appianing and Eck (2015) stated that when compared to male students, female students attack less importance to developments in computer technologies.

According to the results of the analyses conducted in this study, male students are significantly more willing to prefer a future career related to physics compared to female students. When content analysis results concerning this finding are considered, unlike male students, factors including the negative perception towards physics, the lack of a leader model the lack of capacity of female students are prominent. Male students stated that they found the fields of physics active, that they liked doing research and that they may chose a profession related to physics

especially in engineering. Female students stated that they want to be teachers in the fields of physics. According to the study findings, while female and male students have similar personal interest levels concerning physics, it is quite striking that there is a significant difference in favor of male students with regards to preferring fields of physics in career choosing. At this point, female participation in physics can be increased by taking into consideration the factors they underlined (especially the teacher factor) and their negative perceptions concerning physics especially in high school years, a crucial stage in career planning, can be changed. The widespread women roles in social fields in developing countries may cause female students to perceive fields of science as masculine. However, Hill et al. (2010) stated that success and interest levels of females in science and mathematics are shaped by their environment. Similarly Jammula (2015) underlined that, based on an interview with a female student, the female student had cast herself a mother role and that this role would limit her skills in physics. In this context, developed countries should be taken as a role and Physics courses should be taught so as to attract female students' attentions, give them courage and to help them perceive themselves as the center of the learning process. Fencl and Scheel (2005) indicated that using of student centered learning methods, the social persuasion and vicarious learning categories had the most important associations correlated with both classroom environment and the sources of self-efficacy(Cited in Trujillo and Tanner, 2014). According to other studies, there is a considerable amount of similar results. For instance, JCQ (2013) detected that male students prefer physics more than female students in choosing a profession. Akbayır (2002) underlined that the department of Physics was preferred mostly by male students. Priyadarshini (2014) stated that only 30% of the researchers in the fields of science worldwide are female. Osborne et al. (2003) underlined that factors such as teacher and family have crucial effects in female students' professional choices concerning physics. Silim and Crosse's (2014) study indicating that male students are represented in the field of engineering more than female students supports this finding. In a study focusing on the reasons for this, researchers emphasized factors such as female students' perceptions about the fields of science and engineering, having difficulty in understanding subjects and influences of the families. Similarly, International Federation of University (2015) detected that only 12% of the fields of engineering consists of females. Dweck (2003) stated that female students had a belief that they are not as good as male students in the fields of science and mathematics. Similarly, Dar-Nimrod & Heine (2006) stated that between female and male students there is a significant difference in favor of male students with regards to being competent in physics.

One other finding of the study suggests that both female and male students enjoy solving problems at similar rates. According to these findings of the study, female and male students have similar attitudes towards physics with regards to solving problems in physics. According to the content analysis results, it was observed that the participant emphasized similar codes. Problem solving is one of the crucial components of physics class (Benckert, 2000). Problem solving skills, which are at the upper stages in cognitive learning, provide considerable amount of information concerning to what extent learning takes place. Thus, it is possible to assert that success and the problem solving skill are parallel. Both female and male students who participated in the study stated that they like problem solving because it increases their self-confidence and feeling of success. The reasons that participants stated as not liking problem solving were failure, lack of motivation and lack of self-confidence. According to a study conducted by Brad (2011), it is evident that female and male students have similar perceptions concerning problem solving. On the other hand, other studies suggest that male students generally have more positive attitudes towards problem solving in the Physics course. For instance, when Aktamış et al. (2012) examined high school students' attitudes towards problem solving in physics, they detected that male students have more positive attitudes than female students. The finding about enjoying problem solving in physics in this study is significant based on the fact that it, at least to some extent, can change the male-dominant view.

Conclusions

When the findings of this study are considered generally, it is observed that, unlike the results in the literature, while female and male participants studying in high school have similar interests towards physics and problem in physics, female students are not aware of the developments in physics and also do not prefer physics as a career as much as male students. This issue should be dwelt upon. Based on the findings of this study, it could be said that the lower participation of female in physics is not because of their abilities, but their interests. Moreover, it can be concluded that female students have a potential for physics just as male students do but environmental conditions cause them to generate negative perceptions concerning the fields of science. However, it is possible to assert that the country in which the study was conducted is a developing country and that there are social roles attributed to women. It is possible to say that, although not at a desired rate, this issue is at a better condition in developed countries. Thus, it is possible to state that there is

a positive correlation between development and women being active in scientific fields. From this point of view, it can be concluded that it is crucial for a country's development that women are represented at a satisfactory rate in fields that determine a society's future, such as science.

Suggestions

The following suggestions were put forward depending on the findings obtained in the study:

1. Effective, student-oriented classroom activities should be carried out so as to enable high school students, especially female students, to be more active in fields of physics.
2. Physics teachers should be competent both pedagogically and professionally to increase female students' interest in physics and to give them courage concerning these fields.
3. Due to the socio-cultural characteristics of the research area, negative perceptions and self-efficacy levels of female students concerning physics should be examined, and they should be provided with psychological guidance when necessary.

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