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An Investigation of Secondary School Students' Anxiety and Motivation Levels towards Science Course in Terms of Some Variables*

Belkız CAYMAZ[1], Abdullah AYDIN[2]

[1]Minsitry of National Education, Kastamonu, Turkey 🆔 0000-0002-3689-040X

[2]Kastamonu University, Department of Mathematics and Science Education, Kastamonu, Turkey 🆔 0000-0003-2805-9314

ARTICLE INFO	ABSTRACT
	This work aims at studying the anxiety and motivation levels of secondary school students towards science course depending on gender, class levels, and their parents' level of education. In addition, it was aimed to examine the relationship between students' anxiety, motivation, and academic achievement towards science course. The study relies on a relational scannig model within the context of the general scannig model. The research sample consist of 629 students who continue their education at public secondary school in Kastamonu Province, Turkey, in the 2019-2020 academic year. Anxiety Scale for Science Course, Motivation Scale for Science Learning, Personal Information Form, and science grade for the end of the first semester were used as data collection tools in the research. The data obtained from the research were analyzed using the SPSS 22 program. As a result of this study, it is found out that the secondary school students' science anxiety levels were incredibly low but, their motivation levels towards science course were high. Also, it was observed that there was a significant relationship between students' science anxiety, science motivation and academic achievement. As to gender, it was determined that there was no significant difference between students' anxiety towards science course, and a significant difference between motivation towards science course. In addition, it was determined that students' anxiety and motivation towards science course differ significantly depending on class levels and their parents' level of education.

1. Introduction

In the teaching-learning process, the development of the students' affective characteristics is as important as the development of their cognitive characteristics (Duit, 1991; Turner & Lindsay, 2003). Existing literature emphasizes that the development of cognitive characteristics is at the forefront of the science learning process while affective characteristics are overlooked (Demirbas & Yagbasan, 2004; Duit, 1991; Turner & Lindsay, 2003). However, the objective of science course is that students acquire both cognitive characteristics such as understanding basic science concepts, scientific skills, problem-solving, and affective characteristics such as attitude, motivation and self-efficacy (Ministry of National Education [MoNE], 2018). Therefore, affective characteristics and cognitive characteristics need to be taken into account for better science education. This study investigates the correlation among the following three variables, i.e., anxiety, motivation, achievement.

One of the affective characteristics that affect the science learning process is anxiety. Anxiety can be defined as the state of unrest felt by the individual in the face of a threatening situation. This situation causes emotional

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and physiological arousals in individuals (Hodgin, 2014). Science anxiety is the fear of science concepts, scientists and science-related activities (Mallow, 2006). The attitude of the family may cause science anxiety, the attitude of the teacher, the activities that are not suitable for the level of the student, the wrong perception of the lesson, the lack of role models, negative experiences, fear of exams and the social environment (Anderson & Clawson, 1992; Kaya & Yildirim, 2014; Mallow, 2006; Ucak & Say, 2019; Udo, Ramsey & Mallow, 2004). According to Wynstra (1991), science anxiety has six components: (1*) danger anxiety* (using toxic or flammable chemicals, conducting an explosive experiment or monitoring) (2) *test anxiety* (such as different types of test questions, laboratory tests) (3) *math and problem-solving anxiety* (graphic and table interpretation, problem-solving (4) *meticulousness anxiety* (taking blood from the finger, performing activities that some people do not like, such as investigating cockroaches) (5) *performance anxiety* (preparing a project and presenting the results to the class, being watched by the teacher when experimenting) (6) *science class anxiety* (It can occur while listening to lessons, taking notes). Mallow (2006) reported that science anxiety could be reflected in various ways, both physically and psychologically. Physically, students can have stomach pain, headache, sweaty palms, rashes, etc. Psychologically, students can display tension and nervousness by chewing nails, playing with hair, tapping foot, becoming distracted, etc. According to Oludipe & Awokoy (2010), anxiety can cause disturbing situations in students such as panic, fear, tension, helplessness, failure, difficulty breathing, loss of concentration. Studies have shown that low-level science anxiety is beneficial for learning, while high-level science anxiety prevents learning (Atwater, Gardner & Wiggins, 1995; Mallow, 2006) and decreases science achievement (Jegede, 2007; Osborne, Simon & Collins, 2003).

Another of the affective characteristics affecting the science learning process is motivation. Motivation can be defined as an internal state that stimulates, directs, and maintains targeted behaviour (Glynn, Taasoobshirazi & Brickman, 2009). Science motivation is that students participate actively in science lessons to perform higher (Lee & Brophy, 1996). Glynn, Taasoobshirazi & Brickman (2009) reported that motivation has six components: "intrinsic motivation, extrinsic motivation, self-efficacy, test anxiety, self-regulation and personal attention". According to Mubeen and Reid (2014), motivation depends on external factors such as *support, encouragement, rewards* and internal factors such as *self-confidence, determination, self-awareness*. According to Bonney, Kempler, Zusho, Coppola & Pintrich (2005), there are four main characteristics affecting motivation: *task awareness, interest, self-efficacy, goals of achievement*. Based on these factors in the literature, it can be said that motivation has a multivariable structure. Students with high motivation are more willing to participate in the lesson (Glynn, Taasoobshirazi & Brickman, 2009; Yenice, Saydam & Telli, 2012), make more effort in classroom activities (Wolters & Rosenthal, 2000), ask questions to learn and participate in group works eagerly (Glynn Taasoobshirazi & Brickman, 2009), do not give up until they reach the goal (Mubeen & Reid, 2014). Studies have observed that science motivation has a positive effect on science achievement (Bryan, Glynn & Kittleson, 2011; Nolen, 2003; Yildirim & Karatas, 2018).

1.1. The Importance of the Study

The PISA study means the ability to learn and read, expressing a text loudly, establishing a close relationship with the information in one or more texts given for a specific purpose by another reader. In addition to having specific competence in reading, it is expected that students will read for various purposes and have a high reading motivation (Organisation for Economic Co-operation and Development [OECD], 2019). The higher motivation and the less anxiety of the students towards the science course, the higher their success towards the science course in such international applications. According to PISA 2018, Turkey's average score in science literacy increased to 468, increasing 43 points compared to 2015. It is seen that Turkey has achieved the most remarkable improvement in science literacy compared to the previous period (MoNE, 2019).

It is a fact that the anxiety and motivation levels of secondary school students towards science course affect academic achievement in science courses (Akbas & Kan, 2007). It is essential to determine the anxiety and motivation levels of the students towards science course and the variables that affect them and take the necessary precautions. A review of studies on science anxiety in Turkey investigates the factors affecting students' science anxiety (Avci & Kirbaslar, 2017) and the role of anxiety as a predictor of secondary school students' self-learning skills (Kahyaoglu, Birel & Yetisir, 2019) were found. In addition, the relationship between science anxiety and attitude towards science lesson (Ulucinar-Sagir, 2012), science anxiety and mental risk-taking behaviours (Akca, 2017), anxiety towards science course and academic achievement (Avci & Kirbaslar, 2017), anxiety towards science course and science learning orientations (Yolagiden & Bektas, 2018)

was investigated. Various measurement tools have also been developed to determine students' science anxiety (Kagitci & Kurbanoglu, 2013; Ulucinar-Sagir, 2014; Yildirim, 2015). In some studies, with semi-experimental design, science anxiety levels of students were compared before and after the teaching (Guldal & Dogru, 2018; Yildiz, Simsek & Aras, 2017).

In most studies on science motivation, it was seen that students' science motivations were examined in terms of some variables (Demir, Ozturk & Dokme, 2012; Uzun & Keles, 2010; Yildirim & Karatas, 2018). In some studies, the science motivation scale was developed (Dede & Yaman, 2008) or adapted to Turkish (Yilmaz & Huyuguzel-Cavas, 2007). In addition, the relationship between science motivation and science achievement (Demir, Ozturk & Dokme, 2012; Yildirim & Karatas, 2018), learning styles, attitude towards science lesson and science motivation (Azizoglu & Cetin, 2009; Kahyaoglu & Pesen, 2013), learning strategies and science motivation (Cekim & Aydin, 2018), achievement, self-efficacy and science motivation (Ugras, 2018) was also investigated. The literature review reveals that there are many studies on science anxiety and science motivation in Turkey. However, a study investigating the relationship between science anxiety and science motivation of secondary school students (Muezzin & Ozata, 2019) was found. Muezzin & Ozata (2019) carried out some research in private schools in the Turkish Republic of Northern Cyprus. This work studies the relationship between science anxiety and science motivation of secondary school students. More research should be conducted to gather more reliable information on this topic. In this regard, it's aimed to contribute to the literature. In addition, it is thought that determining the possible factors that may affect students' science anxiety, and motivation will be beneficial for the organization of the learning environment.

1.2. The Aim of the Study

This work aims at studying the students' anxiety and motivation levels towards science course depending on gender, class levels, and their parents' level of education. In addition, it was aimed to examine the relationship between students' anxiety, motivation and achievement towards science course. In the present study, answers were sought to the following research questions:

1. What is the secondary school students' anxiety levels towards science course, and does it differ according to gender, class levels, mother's education levels and father's education levels?

2. What is the secondary school students' motivation levels towards science course, and does it differ according to gender, class levels, mother's education levels and father's education levels?

3. What are the relationships between the anxiety, motivation and academic achievement levels of secondary school students towards science course?

2. Methods

2.1. Model of the Study

The study was conducted using a relational screening model. This model is used to determine the presence and degree of covariation between two and more variables (Karasar, 2014). For research, quantitative data were collected with the Personal Information Form (PIF), Anxiety Scale for Science Course (ASSC), Motivation Scale for Learning Science (MSLS) and students' science course grades.

2.2. Participants

Participants of the research consist of 629 secondary school students in Kastamonu Province, Turkey in the 2019-2020 academic year. One of the researchers works at the school where the study was conducted. Therefore, the convenience sampling method was used to give speed and practicality to the research (Yildirim & Simsek, 2006). Demographic features of students such as gender, class levels, mother's and father's education levels are shown in Table 1.

According to Table 1, it is seen that 56.4% of the students are females and 43.6% are males. 23.8% of students are in 5th grade, 23.2% are in 6th grade, 28.5% are in 7th grade, 24.5% are in 8th grade. For the 23.8% of the students, the mothers are primary school graduates. For 30.7%, the mothers are secondary school graduates. The mothers for the 29.1% are high school graduates; 16.4% of the students had mothers with a graduate/postgraduate degree. The fathers are primary school graduates for 11.1%; secondary school

graduates for 23.8%; high school graduates for 39.6%. For the 25.4% of the students, the fathers had graduate/postgraduate degree.

Table 1. *Demographic Features of Students*

Variable	Category	f	%
Gender	Female	355	56.4
	Male	274	43.6
Class level	5th grade	150	23.8
	6th grade	146	23.2
	7th grade	179	28.5
	8th grade	154	24.5
Mother's education level	Primary school graduate	150	23.8
	Secondary school graduate	193	30.7
	High school graduate	183	29.1
	Graduate/postgraduate	103	16.4
Father's education level	Primary school graduate	70	11.1
	Secondary school graduate	150	23.8
	High school graduate	249	39.6
	Graduate/postgraduate	160	25.4

2.3. Data Collection Tools

2.3.1. Personal Information Form (PIF). It includes questions to determine the demographic features of students such as gender, class levels, and their parents' level of education.

2.3.2. Anxiety Scale for Science Course (ASSC). This scale was developed by Kagitci & Kurbanoglu (2013). The scale has a single factor structure and contains 18 items, all of which are positive. The Cronbach Alpha reliability coefficient of the scale was found .89 by Kagitci and Kurbanoglu (2013). In the current study, this value was found as .89. The scale is a five-point Likert scale and includes "never", "rarely", "often", "usually", "always" options. Starting from the "never" category, it was scored as 1-5, respectively. While the lowest score to be obtained from the scale is 18, the highest score is 90. The range of points taken into consideration to determine the anxiety levels of the students are as follows; *very low level* between "18-32.3", *low level* between "32.4-46.7", *medium level* between "46.8-61.1", *high level* between "61.2-75.5", *very high level* between "75.6-90".

2.3.3. Motivation Scale for Learning Science (MSLS). This scale was developed by Tuan, Chin & Shieh (2005) and adapted to Turkish by Yilmaz & Huyuguzel-Cavas (2007). The scale has a six-factor structure and contains 33 items, 25 of which are positive and 8 of which are negative. The Cronbach Alpha reliability coefficient of the scale was found .87 by Yilmaz & Huyuguzel-Cavas (2007). In the current study, this value was found as .91. This scale is a five-point Likert type scale and includes the options "I never disagree", "I disagree", "I am indecisive", "I agree", and "I totally agree". The positive statements in the scale were scored as 1-5, while the negative statements were scored reversely. While the lowest score to be obtained from the scale is 33, the highest score is 165. The range of points taken into consideration to determine the motivation levels of the students are as follows; *very low level* between "33-59.3", *low level* between "59.4-85.7", *medium level* between "85.8-112.1", *high level* between "112.2-138-5", *very high level* between "138.6-165".

2.3.4. Students' Science Course Grades. As a criterion of academic achievement, students' science course grades were taken into consideration. The students' report grades for science course were taken from the school administration end of the first semester. Report grades are classified as low, medium and high. 0-44 points are classified as low; 44-69 points are classified as medium, and 70-100 points are classified as high. The scales were applied face-to-face by the researchers at the school in January-February 2020.

2.4. Analysis of the Data

The SPSS 22 program was used for analysis. Frequency and percentage were used to analyze demographic features, and arithmetic mean was used to determine the students' anxiety and motivation levels. Since the data obtained from the science anxiety and motivation scale showed normal distribution, parametric tests were used to analyze the data. Whether the students' science anxiety and motivation levels differ by gender were analyzed by independent t-test, and whether they differed by class and parents' education levels were analyzed by one-way ANOVA test. When group variances are equal, and the number of groups is high, the

Tukey test can be used (Buyukozturk, 2004; Can, 2013). The correlation coefficient shows the level of the relationship as follows; *the low-level relationship* between ".00-.30", *the medium level relationship* between ".30-.70", the *high-level relationship* between ".70-1.00". The significance of *the p* value was evaluated at the level of .01 in the correlation analysis and at the level of .05 in the other analysis.

3. Results

In this section, the findings from the scales are arranged and interpreted based on each research question.

An independent t-test was applied to determine whether the students' anxiety levels differ according to the gender, and the results are shown in Table 2.

Table 2. *T-Test Results Analysing Students' Anxiety Scores in Terms of Gender*

Gender	N	$\overline{x}$	SS	SD	t	*p*
Female	355	29.96	10.79	627	-.68	.492*
Male	274	30.57	11.33			

*p>.05

As seen in Table 2, there was no significant difference between the students' anxiety scores in terms of gender [t(627)= - .68; *p*> .05]. A review of Table 2 suggests that the secondary school students' mean anxiety scores towards science course are 30.26. This finding indicates that the students have low level according to the ASSC.

Table 3 presents analysis results identifying whether students' anxiety scores differ depending on class and parents' education levels.

Table 3. *Descriptive Statistics Results Students' Anxiety Scores in Terms of Class Levels and Parents' Education Levels*

Variable	Category	N	$\overline{x}$	SS
Class level	5th grade	150	30.04	12.26
	6th grade	146	28.96	9.68
	7th grade	179	28.96	8.52
	8th grade	154	33.09	12.94
Mother's education level	Primary	150	33.47	13.12
	Secondary	193	29.69	9.47
	High	183	28.76	10.47
	Graduate/postgraduate	103	29.12	10.57
Father's education level	Primary	70	32.61	11.90
	Secondary	150	31.34	11.44
	High	249	29.91	11.10
	Graduate/postgraduate	160	28.64	9.87

According to Table 3, science anxiety scores for the 5th graders are 30.04, the 6th graders are 28.96, the 7th graders are 28.96 and the 8th graders are 33.09. Therefore, the highest anxiety scores belong to the 8th graders, while the lowest scores belong to the 6th and the 7th graders.

According to Table 3, the mean scores of science anxiety of the students whose mothers are primary school graduate is 33.47, secondary school graduate is 29.69, high school graduate is 28.76, and graduate/postgraduate is 29.12. The mean scores of science anxiety of the students whose fathers are primary school graduate is 32.61, secondary school graduate is 31.34, high school graduate is 29.91, and graduate/postgraduate is 28.64.

Accordingly, the highest mother's education level belongs to primary school graduate, while the lowest score belongs to high school graduate. Similarly, the highest father's education level belongs to primary school graduate, while the lowest score belongs to graduate/postgraduate.

Table 4 shows analysis results identifying whether students' anxiety scores differ depending on class levels, mother's and father's education levels. One-way ANOVA was applied to determine whether there is a significant difference between the mean scores of science anxiety and the analysis results in Table 4.

According to Table 4, there was a significant difference between students' science anxiety mean scores in terms of class levels ($F_{(3-625)}$=4.990; *p*< .05), the education levels of mother ($F_{(3-625)}$=6.036; *p*< .05), the education levels of father ($F_{(3-625)}$=2.799; *p*< .05).

Table 4. *One-way ANOVA Results Analysing Students' Anxiety Scores in Terms of Their Class Levels and Parents' Educational Levels*

Variable	Source of variance	Squares sum	SD	Squares average	F	*p*
Class level	*Inter group*	1787.156	3	595.719	4.990	.002*
	In group	74618.956	625	119.390		
	Total	**76406.112**	**628**			
Mother's education level	*Inter group*	2151.499	3	717.166	6.036	.000*
	In group	74254.612	625	118.807		
	Total	**76406.111**	**628**			
Father's education level	*Inter group*	1012.802	3	337.601	2.799	.039*
	In group	75393.309	625	120.629		
	Total	**76406.111**	**628**			

*p<.05

Tukey test was carried out to determine which group the difference originated from and the results are shown in Table 5.

Table 5. *Tukey Test Results Analysing Students' Anxiety Scores in Terms of Their Class Levels and Parents' Educational Levels*

Variable	Category		The difference between the mean scores	SS	*p*
Class level	5th grade	6th grade	1.080	1.27	.830
		7th grade	1.085	1.20	.806
		8th grade	-3.044	1.25	.043*
	6th grade	5th grade	-1.080	1.27	.830
		7th grade	.004	1.21	1.00
		8th grade	-4.125	1.26	.006*
	7th grade	5th grade	-1.085	1.20	.806
		6th grade	-.004	1.21	1.00
		8th grade	-4.130	1.20	.003*
	8th grade	5th grade	3.044	1.25	.043*
		6th grade	4.125	1.26	.006*
		7th grade	4.130	1.20	.003*
Mother's education level	Primary	Secondary	3.779	1.18	.008*
		High	4.708	1.20	.001*
		Graduate/postgraduate	4.347	1.39	.010*
	Secondary	Primary	-3.779	1.18	.008*
		High	.929	1.12	.842
		Graduate/postgraduate	.568	1.33	.974
	High	Primary	-4.708	1.20	.001*
		Secondary	-.929	1.12	.842
		Graduate/postgraduate	-.361	1.34	.993
	Graduate/postgraduate	Primary	-4.347	1.39	.010*
		Secondary	-.568	1.33	.974
		High	.361	1.34	.993
Father's education level	Primary	Secondary	1.267	1.58	.856
		High	2.702	1.48	.265
		Graduate/postgraduate	3.970	1.57	.047*
	Secondary	Primary	-1.267	1.58	.856
		High	1.435	1.13	.586
		Graduate/postgraduate	2.702	1.24	.134
	High	Primary	-2.702	1.48	.265
		Secondary	-1.435	1.13	.586
		Graduate/postgraduate	1.267	1.11	.665
	Graduate/postgraduate	Primary	-3.970	1.57	.047*
		Secondary	-2.702	1.24	.134
		High	-1.267	1.11	.665

*p<.05

As seen in Table 5, there was no significant difference between anxiety scores of 5th, 6th and 7th grades. However, there was a significant difference between 5th and 8th grades, 6th and 8th grades, and 7th and 8th grades.

The science anxiety mean scores of the 8th grades were significantly higher than the other class levels. There was no significant difference between anxiety scores of students whose mothers have a secondary school, high school or graduate/postgraduate degree. However, the anxiety means scores of the students whose mother graduated from primary school were significantly higher than the students whose mother graduated from other education levels. There was no significant difference between the anxiety scores of students whose fathers have a secondary school, high school or graduate/postgraduate degree. There was only a difference between the students whose fathers have primary school degrees and those whose fathers have graduate/postgraduate degrees. The anxiety means scores of the students whose fathers are primary school graduate was significantly higher.

An independent t-test was applied to determine whether the students' motivation levels differ according to gender, and the results are shown in Table 6.

Table 6. *T-Test Results Analysing Students' Motivation Scores in Terms of Gender*

Gender	N	x̄	SS	SD	t	*p*
Female	355	128.94	17.94	627	4.004	.000*
Male	274	122.71	21.03			

*p<.05

As seen in Table 6, there was a significant gender-based difference between the students' motivation scores [t(627)= 4.004; *p*< .05], in favour of the female students. A review of Table 6 reveals students' mean motivation scores towards science course is 125.82. This result shows that students have a high level according to the MSLS.

Table 7 presents analysis results identifying whether students' motivation scores differ depending on class levels, parents' education levels.

Table 7. *Descriptive Statistics Results Students' Motivation Scores in Terms of Class Levels, Parents' Education Levels*

Variable	Category	N	x̄	SS
Class level	5th grade	150	127.56	20.44
	6th grade	146	128.08	19.75
	7th grade	179	127.76	15.23
	8th grade	154	121.40	22.26
Mother's education level	Primary	150	122.24	20.12
	Secondary	193	125.26	18.21
	High	183	126.69	19.75
	Graduate/postgraduate	103	133.02	19.38
Father's education level	Primary	70	121.27	19.13
	Secondary	150	123.04	19.93
	High school graduate	249	125.83	18.86
	Graduate/postgraduate	160	132.00	19.33

According to Table 7, motivation scores for the 5th graders are 127.56, the 6th graders are 128.08, the 7th graders are 127.76 and the 8th graders are 121.40. Therefore, the highest science motivation scores belong to the 6th graders, while the lowest scores belong to the 8th graders.

As seen in the Table 7, the mean scores of science motivation of the students whose mothers are primary school graduate is 122.24, secondary school graduate is 125.26, high school graduate is 126.69 and graduate/postgraduate is 133.02. The mean scores of science motivation of the students whose fathers are primary school graduate is 121.27, secondary school graduate is 123.04, high school graduate is 125.83 and graduate/postgraduate is 132.00.

Accordingly, the highest mother's education level belongs to graduate/postgraduate, while the lowest score belongs to primary school graduate. Similarly, the highest father's education level belongs to graduate/postgraduate, while the lowest score belongs to primary school graduate.

Table 8 presents analysis results identifying whether students' motivation scores differ depending on class levels, mother's education levels and father's education levels. One-way ANOVA was applied to determine whether there is a significant difference between the mean scores of science motivation and the results of the analysis are shown in the Table 8.

Table 8. *One-Way ANOVA Results Analysing Students' Motivation Scores in Terms of Their Class Levels ad Parents' Educational Levels*

Variable	Source of Variance	Squares Sum	SD	Squares Average	F	*p*
Class level	*Inter group*	4776.953	3	1592.318	4.216	.006*
	In group	236035.158	625	377.656		
	Total	**240812.111**	**628**			
Mother's education level	*Inter group*	7366.986	3	2455.662	6.575	.000*
	In group	233445.126	625	373.512		
	Total	**240812.112**	**628**			
Father's education level	*Inter group*	8606.021	3	2868.674	7.721	.000*
	In group	232206.090	625	371.530		
	Total	**240812.111**	**628**			

*p<.05

As seen in Table 8, there was a significant difference between students' science motivation mean scores in terms of class levels ($F_{(3-625)}=4.216$; $p<.05$), the education levels of mother ($F_{(3-625)}=6.575$; $p<.05$), the education levels of father ($F_{(3-625)}=7.721$; $p<.05$). Tukey test was carried out to determine which group the difference originated from and the results are given in Table 9.

Table 9. *Tukey Test Results Analysing Students' Motivation Scores in Terms of Their Class Levels and Parents' Educational Levels*

Variable	Category		The difference between the mean scores	SS	*p*
Class level	5th grade	6th grade	-.522	2.25	.996
		7th grade	-.205	2.15	1.000
		8th grade	6.157	2.22	.030*
	6th grade	5th grade	.522	2.25	.996
		7th grade	.316	2.16	.999
		8th grade	6.679	2.24	.016*
	7th grade	5th grade	.205	2.15	1.000
		6th grade	-.316	2.16	.999
		8th grade	6.362	2.13	.016*
	8th grade	5th grade	-6.157	2.22	.030*
		6th grade	-6.679	2.24	.016*
		7th grade	-6.362	2.13	.016*
Mother's education level	Primary	Secondary	-3.029	2.10	.475
		High	-4.453	2.12	.157
		Graduate/postgraduate	-10.789	2.47	.000*
	Secondary	Primary	3.029	2.10	.475
		High	-1.424	1.99	.891
		Graduate/postgraduate	-7.759	2.35	.006*
	High	Primary	4.453	2.12	.157
		Secondary	1.424	1.99	.891
		Graduate/postgraduate	-6.335	2.38	.040*
	Graduate/postgraduate	Primary	10.789	2.47	.000*
		Secondary	7.759	2.35	.006*
		High	6.335	2.38	.040*
Father's education level	Primary	Secondary	-1.775	2.79	.920
		High	-4.567	2.60	.298
		Graduate/postgraduate	-10.728	2.76	.001*
	Secondary	Primary	1.775	2.79	.920
		High	-2.792	1.99	.499
		Graduate/postgraduate	-8.953	2.19	.000*
	High	Primary school graduate	4.567	2.60	.298
		Secondary school graduate	2.792	1.99	.499
		Graduate/postgraduate	-6.160	1.95	.009*
	Graduate/postgraduate	Primary	10.728	2.76	.001*

Secondary	8.953	2.19	.000*
High	6.160	1.95	.009*

p<.05

As seen in Table 9, there was no significant difference between science motivation scores of the 5th, the 6th and the 7th grades. However, there was a significant difference between the 5th and the 8th grades, the 6th and 8th grades, and the 7th and the 8th grades. The science motivation mean scores of the 8th grades were significantly lower than the other class levels. There was no significant difference between science motivation mean scores of students whose mothers are primary school, secondary school or high school graduates. However, science motivation mean scores of the students whose mothers have graduate/postgraduate degree was significantly higher than the mean scores of the students with mothers from other education levels. There was no significant difference between the science motivation scores of students whose fathers are primary school, secondary school, or high school graduates. Science motivation mean scores of the students whose fathers have graduate/postgraduate degree was significantly higher than the mean scores of the students with fathers from other education levels.

Pearson correlation coefficient (*r*) was calculated to determine the relationship between students' science anxiety, science motivation and science achievement and the results are given in Table 10.

Table 10. *The Relationship Between Students' Science Anxiety, Motivation, and Academic Achievement*

	r	*p*
Science anxiety ↔ Science academic achievement	-.301	.000*
Science motivation ↔ Science academic achievement	.445	.000*
Science anxiety ↔ Science motivation	-.599	.000*

*p<.01, N = 629

According to Table 10, there was a moderate negative but significant relationship between science anxiety and science achievement (r= - .301, *p*< .01). However, there was a moderate positive but significant relationship between science motivation and science achievement (r= .445, *p*< .01). In addition, there was a moderate negative but significant relationship between science anxiety and science motivation (r= - .599, *p*< .01).

4. Conclusion and Discussion

In this study, science anxiety and motivation levels of secondary school students were compared in terms of some demographic variables (i.e., gender, class levels, and their parents' level of education) and the relationship between students' science anxiety, motivation and achievement was examined. Mean scores from the science anxiety scale was 30.26; the science anxiety level of students was very low. On the other hand, mean score from the science motivation scale was 125.82; the science motivation level of students was high. In addition, difference between the science anxiety and motivation scores according to gender, class levels, the parents' level of education were examined.

There was no significant difference between students' science anxiety in terms of gender. Looking at the literature, it was seen that there was no significant difference between female and male students' science anxiety in studies examining the effect of gender on science anxiety (Avci & Kirbaslar, 2017; Kahyaoglu, Birel & Yetisir, 2019; Udo, Ramsey & Mallow, 2004; Ulucinar-Sagir, 2012). Studies show that science anxiety varies based on gender, and female students are more anxious (Akgun, Gonen & Aydin, 2007; Anderson & Clawson, 1992; Mallow, 2006). However, these studies were conducted with students at different levels, not secondary school students, or students' exam anxiety was examined. Current study was carried out with secondary school students, examining their science anxiety. The science motivation of students was also examined in terms of gender variable. It was determined that there was a statistically significant difference between the science motivation of female and male students, and the science motivation of female students was higher than male students. Students with high motivation focus more easily on the subject and learn it sooner because they are more interested in the lesson. These students continue to struggle when they faced with difficulties, and they are determined to succeed (Pintrich & Schunk, 2002). In this context, the higher motivation of female students compared to male students might be effective in increasing their interest and active participation in the lesson. This situation can both increase their academic achievement in science and lead them to science-related professions in career planning. In the studies conducted by Chow & Yong (2013), Demir, Ozturk & Dokme (2012), Fortus & Vedder-Weiss (2014), Guvercin, Tekkaya & Sungur (2010), Inel-Ekici, Kaya & Mutlu

(2014), Sevinc, Ozmen & Yigit (2011), it was concluded that gender is an influential variable on science motivation and female students have higher science motivation. A possible explanation could be that female students carry the science course to their daily lives more and work more regularly than male students. Contrary to these results, studies conclude that gender is not effective on science motivation (Azizoglu & Cetin, 2009; Glynn, Taasoobshirazi & Brickman, 2009; Yenice, Saydam & Telli, 2012). A possible explanation could be the different study samples or measurement tools. In addition, when the findings of these studies were examined, it was found that the female students' motivations were higher than male students, although they weren't statistically significant.

The scores obtained from the science anxiety and motivation scale were also examined in terms of class levels, it was observed that there was no significant difference between the 5th, the 6th and the 7th grade students' anxiety levels, and there was a significant difference between the 8th grade and other class levels students' science anxiety levels. The science anxiety mean scores of the 8th grades were significantly higher than the other class levels. Similarly, while there was no significant difference between science motivation of the 5th, the 6th and the 7th grades, there was a significant difference between the 8th grades and other class levels. The 8th grades' science motivation mean scores were significantly lower compared to other grades. In other words, it can be said that 8th grades have higher science anxiety and less science motivation than other class levels. Science lesson is intertwined with daily life. This stimulates students' feelings of curiosity, research and discovery and increases their desire to true. However, 8th grade students work hard for a national examination called the High School Entrance Exam (HSEE). Preparing for this examination at an intense may have caused the 8th grades to suppress these feelings and experience anxiety. In addition to exam-oriented study, increasing difficulty levels of science subjects and encountering more abstract concepts can also be shown to increase anxiety and decrease motivation. While science subjects are taught in the 5th grade through activities or experiments, upper classes (especially in 8th grades) are taught with attention to testing and fundamental principles related to testing. This attitude of the teacher at different class levels may be another reason for the change in the anxiety and motivation levels of the students. Smart (2014) investigated the effect of teacher behaviours on the science motivation of secondary school students. Findings indicated that teachers' behaviours influence students' motivation to learn science. For instance, it was stated that teachers interact more with their students in younger age groups and use different methods and techniques to attract their attention. But they did not exhibit similar behaviours in older age groups, were more controlling, and the student-teacher interaction decreased (Smart, 2014). It was seen that as the class levels increased, students' science anxiety increased (Anderson & Clawson, 1992; Avci & Kirbaslar, 2017; Ulucinar-Sagir, 2012) and science motivation decreased (Atay, 2014; Fortus & Vedder-Weiss, 2014; Yenice, Saydam & Telli, 2012; Yildirim & Karatas, 2018). The teacher should create a supportive learning environment in the science teaching process and consider students' individual differences such as interests, skills, and learning strategies. Organizing the learning environment in this way might reduce students' anxiety and increase their motivation towards learning science.

There were significant differences between students' science anxiety in terms of parents' education levels. Significant differences were also determined in terms of science motivation. Science anxiety of students whose mothers and fathers are primary school graduates, and science motivation of students whose mothers and fathers have graduate/postgraduate degrees were found to be significantly higher. According to the results of the study, it can be said that the education levels of the mother and father is a variable that affects the students' science anxiety and motivation. This may be due to the fact that parents with higher education levels behave more consciously about the education of children and support them correctly in science learning. It is a well-known fact that the rearing style of parents greatly affects the child's emotional development. Parents' being too authoritarian or tolerant can be detrimental to the child's development. On the other hand, parents with a democratic attitude can direct their children according to their abilities. It has been observed that children of families with a democratic attitude are self-confident, able to cooperate more easily with others, and motivated by achievement (Senemoglu, 2005), and children of families with authoritarian attitude are more anxious (Akgun, Gonen & Aydin, 2007). In the literature, studies support the conclusion that parents' level of education has a significant effect on students' science anxiety and motivation (Atay, 2014; Inel-Ekici, Kaya & Mutlu, 2014). However, some studies disagree (Uzun & Keles, 2010; Yildirim & Karatas, 2018). In these studies, it was observed that students with parents from high education degrees had higher science motivation, but this result was not statistically significant.

There was a moderate negative but significant relationship between science anxiety and science academic achievement, and a moderate positive but significant relationship between science motivation and science academic achievement. In this context, science academic achievement will decrease as science anxiety increases, or scientific academic achievement will increase as science anxiety decreases. It can also be said that science academic achievement will increase as science motivation increases, or science academic achievement will decrease as science motivation decreases. In addition, there was a moderate negative but significant relationship between science anxiety and science motivation. The fact that students' science anxiety was low and science motivation was high, confirms this result. Students with high levels of anxiety can see various factors as a threat to themselves. This can lead to a decrease in their motivation and, consequently, academic achievement. In contrast, as students' science motivation increases, they will be expected to increase their science academic achievement as they become more willing to learn. In terms of achieving science learning goals, determining students' science anxiety and science motivations is critical. In this study, the results obtained on the relationship between science anxiety, science motivation, and academic achievement are in line with similar studies in the literature. For instance, in a study conducted by Avci & Kirbaslar (2017), a moderate, negative relationship was found between science anxiety and the academic achievement of secondary school students. In the meta-analysis study conducted by Alkan & Bayri (2017), a positive relationship was found between science motivation and science academic achievement. Similar results were obtained in the studies conducted by Tuan, Chin & Shieh (2005), Yildirim & Karatas (2018). Muezzin & Ozata (2019) found a moderate and negative relationship between secondary school students' science anxiety and science motivation.

There have been studies investigating the relationship between science anxiety and academic achievement or science motivation and academic achievement in the literature. A study was found that examined the relationship between science anxiety and science motivation (Muezzin & Ozata, 2019). In general, existing studies have investigated the relationship between anxiety, motivation, and academic achievement in mathematics education. In this context, in this study, the relationship between science anxiety, motivation and academic achievement in science education was investigated and it was determined that there was a relationship. In line with the results in the study, the following suggestions can be made:

- This study found that secondary school students' science anxiety levels were very low, and science motivation levels were high. However, when the scores obtained from the anxiety and motivation scales were analyzed one by one, it was seen that there were students with high science anxiety and low science motivation. In future research, interviews can be held with students with high science anxiety/low science motivation. With the study to be carried out qualitatively, the sources of this situation can be explored in depth.

- As a result of the research, it was determined that the 8th-grade students had higher science anxiety/low science motivation than other classes. A similar situation was found for students whose parents were primary school graduates. Variables such as class levels, parental education levels cannot be interfered with. However, positive feedback can be obtained by providing correct guidance. In this context, teachers and school administrators have important duties. The science teacher and the counsellor can cooperate and reduce the science anxiety and HSEE anxiety of the 8th-grade students and increase their science motivation. School administrators can give occasional informative seminars to families on how to behave and support their children. One-by-one interviews can be held with high anxiety students and their families.

- There was a significant relationship between science anxiety, motivation, and academic achievement. For improved academic achievement, it is important to organize the science learning environment so that anxiety can be reduced, and motivation can be increased. The science teacher should consider the characteristics of students and include teaching methods and techniques that will appeal to every student in their lessons.

- This study examined whether various variables make a significant difference in students' science anxiety and motivation. The relationship between these variables and science academic achievement and the extent to which they predict science academic achievement can be investigated.

- This research is limited to students in a public secondary school and the data collection tools used in the study. It is recommended to conduct similar studies with different data collection tools and different samples.

- In the science curriculum, the areas of knowledge and skillsdesired to be acquired by students are defined. However, affective characteristics such as anxiety and motivation are not directly included. It is a well-known fact that affective characteristics are highly influential in science learning. For this reason, affective characteristics should also be included in the science curriculum.

- In the changing and developing world, student needs and expectations are also changing. Science teachers must have the professional competence to meet these needs and expectations. In this context, the personal development of science teachers should be supported by professional training.

5. References

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