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Examination of Middle School Students' Learning Motivations and Metacognitive Awareness in the Context of Science Education[1]

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Abstract

In this research, which was carried out with the assumption that science lessons establish a ground for an effective learning environment for motivation and metacognitive awareness, it was aimed to examine the middle school students' motivation towards learning science and their metacognitive awareness in terms of various variables in the focus of science education and to determine the relationship between them. A total of 637 students participated in the study. The 'Science Learning Motivation Scale' was used to determine the students' science learning motivation and the 'Metacognitive Awareness Scale B Form' was used to determine their metacognitive awareness. Mann Whitney U and Kruskal Wallis tests were used to analyze the data. As a result of the analysis, it was determined that students' science learning motivation changed significantly according to gender, experimentation, participation in science projects, using science in daily life, grade level and science course grade point average. In addition, it was concluded that there were significant differences in students' metacognitive awareness according to experimentation, participation in science projects, using science in daily life and science course grade point average. Therewithal, it was determined that there was a moderately positive relationship between the middle school students' science learning motivation and their metacognitive awareness. It is seen that teachers' diversification of learning environments with methods and techniques as well as activities and materials in science lessons, which enable students to develop their science learning motivation and metacognitive awareness, will make important contributions.

INTRODUCTION

The characteristics that individuals should have are changing day by day, and in this direction, various attempts are made at times in order to ensure that the necessary target level is reached in the curriculum. Accordingly, it is seen that updates are made in Turkey in certain periods depending on the changing and developing needs in the curriculum. In 2018, the Ministry of National Education (MEB) created a curriculum that guides the use of metacognitive skills, provides meaningful and permanent learning, is associated with previous learning, and integrated with other disciplines and daily life around values, skills and competencies. Considering the recent studies, it is seen that the approaches towards raising individuals with the targeted qualifications, taking into account the dynamics of the changing and developing age for the science lesson, as in all fields (MEB, 2013, 2017). Regarding the goal of "Educating all students as scientifically literate individuals", which is the vision of the science curriculum; to arouse students' curiosity about scientific and technological developments, to take into account scientific knowledge in order to learn and understand the natural world, to use appropriate scientific process skills in the exploration of nature and to understand its interaction with humans, to find solutions to problems, to develop curiosity, attitude and interest towards events in the environment is intended (MEB, 2013, p2).

In the fundamental philosophy of the science curriculum, it was emphasized that "...the most important power that will direct the individual to learning is the sense of curiosity…" (MEB, 2017). Since the beginning of the twenty-first century, it has been accepted by educators that one of the motivating factors in students' learning is curiosity (Halimoğlu, 2019). From this point of view, it is stated that curiosity motivates students (Edelman, 2007), and it is a prerequisite for learning (Carlin, 1999). At this point, it is emphasized that support such as motivation for learning science is important in order to ensure the continuity of students' curiosity and to educate them as science literate. (Halimoğlu, 2019).

The concept of motivation, which is one of the main factors of learning, has been defined by Schunk, Meece, and Pintrich (2013) as the force that directs the person to the behavior and ensures that the behavior is maintained by determining its severity. Abell and Lederman (2007) expressed motivation as an internal state that enables students to take action, gives direction and maintains their behavior. Explained in similar ways by many researchers (Arslan, 2021; Ertem, 2006; Yıldırım, 2007), the most prominent feature of motivation is that it makes the individual move towards certain goals and act in line with these goals (Demir & Budak, 2016). Therefore, motivation for learning has been one of the subject areas that attracted the attention and interest of educational research due to its positive educational outcomes (Uzun & Keleş, 2012).

Motivation has an important effect on providing meaningful learning, especially in fields such as science, where students have cognitive difficulties (Güvercin, Tekkaya & Sungur, 2010). On the other hand, many concepts in science lessons are difficult to understand by students, and this reduces students' motivation for the lesson. Students should be motivated to learn science concepts better, increase their success in science lessons, and develop scientific process skills (Uzun & Keleş, 2012). Student motivation to learn science is a complex concept influenced by instructional strategies, curriculum, students' individual characteristics, and teachers (Lee & Brophy, 1996). It has been stated by researchers that it is useful and important to determine students' motivation levels for learning science and the variables that affect science learning motivation (Alkan & Bahri, 2017; Buehl; 2003; İnel Ekici, Kaya & Mutlu, 2014; Karakaya, Yılmaz & Avgın, 2018; Molden & Dweck, 2006; Okumuş, 2020; Tuan, Chin & Shieh, 2005; Uzun & Keleş, 2010, 2012; Wood & Kardas, 2002; Yıldırım & Karataş, 2020).

Previously, individuals were considered sufficient only when they had the knowledge, but now they are considered sufficient when they choose the meaningful one among the information, organize this information, and have sufficient knowledge of their deficiencies and competencies (Boran, 2016). For this reason, students are expected to be able to access, organize and use information in a rapidly developing and changing environment (Balcı, 2007). The concept of metacognition, which is explained as being aware of and controlling one's learning (Schraw & Dennison, 1994), comes to the fore at this point.

Flavell used the term metacognition for the first time in his study on metacognitive abilities in children in 1976 and enabled this term to enter the literature. Flavell defined metacognition as “the individual's awareness and control of his or her own cognitive processes” (Flavell, 1976). Swiderek (1996) and Schoenfeld (1987) similarly expressed the concept of metacognition as thinking about one's thoughts. Metacognition emphasizes the awareness of what an individual can do with their own thoughts and knowledge (Özsoy, 2008).

In general, the concept of metacognition means that individuals prepare a plan for realizing their learning task by keeping their learning processes under control, become aware of effective and ineffective methods in their individual learning, choose and use the appropriate method in their new learning, become aware of the positive and negative situations that occur in the learning processes and recall their old knowledge when necessary (Ormrod, 1990). It stands out that metacognition includes cognitive skills aimed at effective learning (Bruning, Schraw & Norby, 2014).

In the concept of metacognition, which appears as a thinking system, the student is an active participant who has an idea about learning by including the external environment in the learning process. At this point, being aware of his or her own cognition is an important factor in ensuring that the student is active. The concept of metacognitive awareness comes to the fore with the individual's awareness of his/her own cognition. According to Özsoy (2008), metacognitive awareness is the individual's knowledge of his/her own cognitive abilities, cognitive strategies and knowing what to do in the problem he/she faces. In this respect, skills such as the individual's ability to decide what needs to be done in a task, to prepare a plan together with the evaluation of this task in his mind, to review this plan from time to time when starting to implement the plan, and to determine and organize the missing parts can be considered as metacognitive awareness (Demir & Özmen, 2011).

It is important to organize learning environments to develop metacognitive awareness in order to raise students who use metacognitive strategies effectively and thus are aware of their own mental activities, can control their learning processes, and take responsibility for learning. The science curriculum (MEB, 2017), which aims to train individuals who question, research, make decisions with logical reasoning, think innovatively and solve problems, offers a suitable ground for students to gain metacognitive skills at this point.

One of the goals of science teaching is to enable students to use the knowledge they have learned in their daily lives. Because the ability of students to associate the information they learn with the events in daily life is an indicator of how well they make sense of the information they learn and how permanent the information is. The ability of students to carry out this process consciously is related to their ability to use their metacognitive skills. In addition, projects are the works that students carry out individually or in groups in order to find a solution to a daily life problem. In this direction, the most basic feature of a project is that the student understands the problem given to him/her, decides on the solution himself/ herself and applies this solution (Kubinova, Novotna & Littler, 1998). Thus, the student uses his/her metacognitive skills. Besides the activities carried out in the traditional classrooms, laboratory experiences also have a special place in increasing the students’ metacognitive awareness during the education process. Experiments carried out in the laboratory enable the discovery of science phenomena, while realizing high-level conceptual learning (Çepni, Kaya & Küçük, 2005) and providing meaningful learning (Telli, Yıldırım, Şensoy & Yalçın, 2004; Yavru & Gürdal, 2013). In laboratory activities; it is known that in addition to experimental processes, high-level scientific process skills such as data processing, hypothesis formation, interpretation of findings and inference are also included (Tan & Temiz, 2003). It is stated that metacognitive skills are an effective factor in the development of high-level scientific process skills (Şahin Kürşad, 2018). It is only possible for students to make sense of what they have discovered through experiments in the laboratory environment by using metacognitive skills. In this context, science teaching provides important opportunities for students to gain and develop metacognitive awareness.

Rationale of the Research

It requires a high level of science learning motivation and metacognitive awareness for students to acquire the necessary knowledge and skills to understand and explain science concepts and use them in daily life. Considering the importance and difficulty of increasing motivation and metacognitive awareness, it is necessary to investigate the factors that may affect these variables. The content and practices of science courses offer a wide variety of opportunities that can be beneficial for the development of students' motivation to learn science and their metacognitive awareness. In the literature, it is seen that students' science learning motivations and metacognitive awareness are investigated in terms of different variables. However, it has not been considered in terms of doing science experiments, participating in science projects, and using science in daily life. The research, framed by these reasons, was carried out with the assumption that various variables in the focus of science education may have an impact on students' science learning motivation and their metacognitive awareness. Accordingly, middle school students' science learning motivation and metacognitive awareness were compared in terms of various variables in the science education focus, such as doing science experiments, participating in science projects, using science in daily life, and science course grade point average, and the relationship between science learning motivation and metacognitive awareness was examined.

There are a limited number of studies in the literature examining the science learning motivation and metacognitive awareness of middle school students together. In related studies, students' science learning motivations and metacognitive awareness were mostly examined according to demographic variables such as gender, class level and socioeconomic level of the family, but no examination was found in the context of science education. In addition, the few research results reporting that there is a positive and significant relationship between students' science learning motivations and their metacognitive awareness necessitate supporting this result with new studies and contributing to its generalizability. This study was guided by the assumption that the existence of the relationship between the variables examined could be a guiding result in increasing the students' science achievement both qualitatively and quantitatively. For these reasons, it is aimed that the results obtained by examining the relationship between middle school students' science learning motivation and their metacognitive awareness will make a new contribution to the science education literature and offer important suggestions for increasing the quality of science learning.

Purpose of the Research

The aim of this study is to examine the science learning motivations and metacognitive awareness of the students in the 6^{th}, 7^{th} and 8^{th} grades in terms of various variables in the context of science education. Within the scope of this purpose, answers were sought to the questions of whether the science learning motivation and metacognitive awareness in middle school students differ significantly according to the variables of doing science experiments, participating in science projects, using science in daily life, science course grade point average, and gender and grade level. In addition, examining the relationship between science learning motivation and metacognitive awareness is another sub-problem of the research.

METHOD

Study Design

In this study, the descriptive correlational design was used since it was aimed to reveal the existing situation by examining the science learning motivations and metacognitive awareness of middle school students in terms of various variables in the focus of science education, and also to examine the relationship between students' science learning motivation and their metacognitive awareness.

Büyüköztürk et al., (2013) state that quantitative research would be the most appropriate method if a research problem requires the determination of factors affecting a result. According to Karasar (2010), the correlational study is the preferred design to determine the existence of co-variance between two or more variables. Since in the survey studies, how the investigated feature is distributed among the individuals in the sample (Fraenkel & Wallen, 2006), in this study, how the science learning motivation of middle school students and their metacognitive awareness change according to various demographic characteristics was investigated with the descriptive correlational survey design.

Participants

According to the National Education Statistics of 2021, the number of students studying in middle schools in the Adapazarı district of Sakarya province, which is determined as the universe of the research, is 15,778. In the research, following the cluster sampling method, 4 middle schools were selected from 35 middle schools in the Adapazarı district of Sakarya province in the 2020-2021 academic year. A total of 637 students from these schools participated in the study voluntarily. The students in the sample group consisted of 6^{th}, 7^{th} and 8^{th} grade students. Since the high level of contribution of the students participating in the study was aimed, the $6t^{h}$, 7^{th} and 8^{th} grade students in the middle school who were considered to be in the formal operational stage of Jean Piaget's theory of cognitive development were preferred in the research. Individuals over the age of 12 who are in the formal operational stage think more analytically, set up more various hypotheses for problem solutions, and reach more accurate results by making use of logic patterns while testing these hypotheses than the individuals in the concrete operational stage (Piaget, 1976). In line with the objectives of the research, the study was conducted with 6^{th}, 7^{th} and 8^{th} grade students aged 12 and over, on the grounds that the motivation and metacognitive awareness of students in the formal operational stage could be more distinctly identified. Of the students in the study, 366 (57.5%) were female students and 271 (42.5%) were male students.

Data Collection

The 'Science Learning Motivation Scale' was used to determine the motivation of the students involved in the study towards learning science. In addition, the 'Metacognitive Awareness Scale B Form' was used to determine their metacognitive awareness. Besides, a 'Personal Information Form' was used to collect data on demographic characteristics.

The "Science Learning Motivation Scale" developed by Dede and Yaman (2008) is a 5-point Likert type scale (strongly agree, agree, undecided, disagree and strongly disagree) and consists of 23 items. In the original study, the reliability coefficient of the scale was reported as 0.80. In this study, Cronbach's alpha value was found to be 0.84. According to these values, it can be said that the scale is a reliable tool for this study.

The “Metacognitive Awareness Scale B Form” was developed by Sperling, Howard, Miller and Murphy (2002) to measure metacognitive skills in 3^{rd}-9^{th} grade students. The validity, reliability and factor structure of the scale were examined by Karakelle and Saraç (2007) in order to evaluate the usability of the scale in Turkey. This scale is a Likert-type measurement tool prepared for different age groups consisting of A and B forms. The Form B were developed for 6th, 7th, 8th and 9th grade students. The scale includes 18 items and is marked on a five-point Likert-type scale (never, rarely, sometimes, often, always) for each item. In order to determine the reliability of the scale, the Cronbach alpha value for the B form was calculated and found to be 0.80 (Karakelle & Saraç 2007). The internal consistency reliability was calculated for reliability in the original study and it was found to be 0.86 for form B. (Sperling, Howard, Miller & Murphy, 2002). In this study, the Cronbach alpha value for scale reliability was calculated and found to be 0.86. According to these values, it can be said that the Turkish form of the scale is a reliable tool for this study.

With the "Personal Information Form", data were collected on the students' gender, grade level, grade point average in the science course, participation in science projects, experimentation in science lessons, and their ability to use science in daily life.

Data Analysis

The answers of the participants to the data collection form were recorded in the data file created in the SPSS 22.0 program. In order to test whether the data showed a normal distribution, the Kolmogorov-Smirnov test was performed before each analysis and an evaluation was made about the normality of the distribution of the data. According to the results of the preliminary analysis, the data set was analyzed with non-parametric tests and Mann Whitney U and Kruskal Wallis tests were used in the analysis of the data.

The change in the students' science learning motivation and metacognitive awareness according to the variables of gender, experimentation status, participation in science projects and using science in daily life were analyzed with the Mann Whitney U test. Whether students' grade level and science course grade point average cause a difference in their science learning motivation and their metacognitive awareness was analyzed with the Kruskal Wallis test. In order to determine the relationship between students' science learning motivation and their metacognitive awareness, the Spearman Brown Rank Differences Correlation was calculated.

FINDINGS

The sub-problems regarding students' science learning motivation in the study were "Do secondary school students' science learning motivation differ according to the variables of gender, grade level, experimentation status, participation in science projects, using science in daily life and science course grade point average?" The findings obtained as a result of the analyzes are presented below, respectively.

Findings Related to Students' Science Learning Motivation

Table 1 shows the results of the Mann Whitney U Test conducted to determine whether the middle school students' science learning motivations show a statistically significant difference according to their gender, doing experiments, participating in science projects, and using science in daily life.

Table 1. Mann Whitney U test results of middle school students' science learning motivations according to various variables

Personal Information		N	Mean Rank	Sum of Ranks	U	p
Gender	**Female**	366	334.10	122279.5	44067.5	0.016*
	Male	271	298.61	80923.5		

Participating in Science Projects	**Yes** **No**	356 281	337.60 295.44	120184.5 83018.5	43397.5	0.004*
Doing Experiments	**Yes** **No**	417 220	348.76 262.59	145433.5 57769.5	33459.5	0.000*
Using Science in Daily Life	**Yes** **No**	497 140	343.81 230.91	170875.5 32327.5	22457.5	0.000*

*p<0.05

In Table 1, it is seen that middle school students' science learning motivation changes significantly depending on their gender, participation in science projects, doing experiments and using science in daily life (p<0.05). According to the data in Table 1, it is understood that female students' motivation to learn science is higher than male students. Also, students who participate in science projects, students who do experiments in science lessons, and students who can use the information learned in science lessons in daily life have a higher level of science learning motivation.

The results of the Kruskal Wallis test conducted to determine whether the science learning motivations of middle school students differ according to their grade level and science course grade point average are presented in Table 2.

When the Kruskal Wallis test results in Table 2 are examined, it is seen that there is a statistically significant difference between the students' science learning motivations according to the grade level (χ^2=0.848; p<0.05). According to the results of the Mann Whitney U test applied to determine the source of this difference, it was determined that the statistically significant difference was between 6th and 7th grades, 6th and 8th grades and 7th and 8th grades (p<0.05). The mean rank of the 6th grade students (379.85) is higher than the other students. In addition, the mean rank of 7th grade students (317.97) is higher than that of 8th grade students. According to these findings, it can be said that as the grade level increases, the motivation to learn science decreases.

Table 2. Kruskal Wallis test results of middle school students' science learning motivations according to various variables

Personal Information		**N**	**Mean Rank**	**df**	**χ^2**	**p**	**Meaningful Difference**
Grade Level	**Grade 6** **Grade 7** **Grade 8**	182 159 296	379.85 317.97 282.14	2	0.848	0.000*	Grades 6-7 Grades 6-8 Grades 7-8
Science Course Grade Point Average	**(1) 0-44** **(2) 45-54** **(3) 55-69** **(4) 70-84** **(5) 85-100**	14 27 71 189 336	232.04 244.89 277.30 319.77 336.96	4	14.367	0.006*	1-5 2-5 3-5

*p<0.05

In Table 2, it is seen that the science learning motivation of the students changes statistically significantly according to the science course grade point average (χ^2= 14.367; p<0.05). According to the results of the Mann Whitney U test applied to find the source of this difference, it was determined that the difference was between students with a grade point average of 85 and above and students with a score below 70 (p<0.05). Students with a grade point average of 85 and above have a higher rank (336.96) than other students. According to these findings, it is seen that science course grade point average affects science learning motivation in favor of students whose average is 85 and above.

Findings Related to Students' Metacognitive Awareness

In the research, the sub-problems related to the students' metacognitive awareness were "Does the metacognitive awareness of middle school students differ according to the variables of gender, grade level, experimentation status, participation in science projects, using science in daily life and science course grade point average?" The findings obtained as a result of the analyzes are presented below, respectively.

Table 3 shows the results of the Mann Whitney U test conducted to determine whether the metacognitive awareness of middle school students differs according to gender, doing experiments, participating in science projects, and using science in daily life.

Table 3. Mann Whitney U test results of middle school students' metacognitive awareness according to various variables

Personal Information		**N**	**Mean Rank**	**Sum of Ranks**	**U**	**p**
Gender	**Female**	366	330.45	120945.0	45402.0	0.068
	Male	271	303.54	82258.0		
Participating in Science Projects	**Yes**	356	341.71	121649.0	41933.0	0.000*
	No	281	290.23	81554.0		
Doing Experiments	**Yes**	417	344.66	143724.5	35168.5	0.000*
	No	220	270.36	59478.5		
Using Science in Daily Life	**Yes**	497	345.99	171956.5	21376.5	0.000*
	No	140	223.19	31246.5		

*p<0.05

According to the values seen in Table 3, it is understood that there is no statistically significant difference between the metacognitive awareness of female and male students ($p>0.05$). According to this result, it can be stated that gender is not an effective variable on middle school students' metacognitive awareness.

It is seen that the metacognitive awareness of middle school students changes significantly depending on their participation in science projects, doing experiments and using science in daily life ($p<0.05$). In line with the data in Table 3, it is understood that the metacognitive awareness of the students who participated in the science projects, the students who made experiments in science lessons, and the students who could use the information learned in the science lesson in daily life was higher.

The results of the Kruskal Wallis test conducted to determine whether the metacognitive awareness of middle school students differs according to grade level and science course grade point average are presented in Table 4.

Table 4. Kruskal Wallis test results of middle school students' metacognitive awareness according to various variables

Personal Information		**N**	**Mean Rank**	**df**	**χ^2**	**p**	**Meaningful Difference**
Grade Level	**Grade 6**	182	340.65	2	3.800	0.150	
	Grade 7	159	316.44				
	Grade 8	296	307.06				

	(1) 0-44	14	128.64				1-4
Science	**(2) 45-54**	27	216.26				1-5
Course	**(3) 55-69**	71	245.28	4	43.382	0.000*	2-4
Grade Point	**(4) 70-84**	189	323.68				2-5
Average	**(5) 85-100**	336	348.13				3-4
							3-5

*p<0.05

According to the results in Table 4, it is seen that there is no statistically significant difference between the metacognitive awareness of the 6th, 7th and 8th grade students (χ^2=3.800; *p*>0.05). Accordingly, metacognitive awareness in the middle school students does not change according to grade level.

When the Kruskal Wallis test results in Table 4 are examined, it is seen that there is a statistically significant difference between the students' metacognitive awareness levels according to the science course grade point average (χ^2=43.382; *p*<0.05). According to the results of the Mann Whitney U test applied to find the source of this difference, it was determined that the statistically significant difference was between the students with a grade point average of 70 points and above and those with a score below 70 points (*p*<0.05). Students with a grade point average of 70 and above have a higher grade point average (323.68; 348.13) than other students. According to these findings, it is seen that science course grade point average affects metacognitive awareness in favor of students whose average is 70 and above.

Findings Related to the Relationship between Students' Science Learning Motivation and their Metacognitive Awareness

The other sub-problem of the research is "Is there a significant relationship between middle school students' science learning motivation and their metacognitive awareness?" The results of the Spearman Brown Correlation analysis conducted to determine the relationship between students' science learning motivation and their metacognitive awareness are presented in Table 5.

Table 5 shows that there is a statistically significant relationship between students' science learning motivation and their metacognitive awareness (*r*=0.615, *p*<0.05). It is understood that this relationship is moderate and positive. Accordingly, it can be stated that secondary school students' motivation to learn science and their metacognitive awareness tend to change in the same direction.

Table 5. Correlation results between students' science learning motivation and their metacognitive awareness

Variables	**N**	**r**	**p**
Science Learning Motivation	637	0.615	0.000*
Metacognitive Awareness			

*p<0.05

CONCLUSION, DISCUSSION AND SUGGESTIONS

In the study, science learning motivations and metacognitive awareness levels of middle school students were examined in terms of various variables in the context of science education, and it was concluded that activities and practices related to science education were effective on students' science learning motivation and metacognitive awareness levels.

An important result of this research, which was carried out with the assumption that various science practices and activities would provide a suitable environment for the development of science learning motivation and metacognitive awareness; middle school students participating in the science project have a higher level of science learning motivation and metacognitive awareness. According to this result, it can be claimed that the processes of preparing, executing and finalizing science projects positively affect their metacognitive awareness as they require using high-level thinking skills. In addition, it can be stated that participating in science projects increases students' interest in science, thus increasing their science learning motivation. From this result, it can be concluded that participation in science projects helps to increase students' science learning motivation and metacognitive awareness. When the literature is examined, no research has been found that examines science learning motivation and metacognitive awareness with this variable, and it is thought that this result reached in the study will make an important contribution to the relevant knowledge by supporting it with other studies.

The analysis conducted to answer the question "Do experiments, which are an important element of science education, lead to a positive change in secondary school students' science learning motivation and metacognitive awareness?" showed that doing experiments in science lessons positively affects students' science learning motivation and makes a significant difference in their metacognitive awareness. Experimenting involves the processes of changing and controlling variables, and this requires various skills for scientific processes. A student conducting an experiment can set up a suitable mechanism using many necessary materials, obtain data by changing and controlling the variables, record and evaluate these data, interpret the data, and report what has been done by concluding. Thus, he/she actually uses his/her metacognitive skills and as a result, his/her metacognitive awareness is high. According to this result that is in parallel with the study of Karataş and Yıldırım (2018), it is understood that doing experiments in science lessons has a positive effect on science learning motivation. For this result that emerged in the study, it can be thought that the students who made science-related experiments learned meaningfully by better understanding the relationships between science concepts and events, and thus they were more willing to learn science, and all these outcomes might have increased their motivation for learning science.

According to another result reached in the study, it was determined that the science learning motivation and metacognitive awareness of middle school students who stated that they used science in daily life were higher. The fact that students can use the information they learned in their lessons in daily life can be accepted as an indicator of generalization skills, and the information becomes meaningful and useful only in this case. From this point of view, it can be said that students' seeing that what they have learned about science subjects finds its way in daily life and being able to use their knowledge in real life environments affects their motivation positively. Transferring knowledge to daily life requires using higher-order thinking skills while realizing the learning objectives consisting of the steps of remembering, understanding, applying, analyzing, evaluating and creating in the gradual classification of the cognitive domain according to Bloom's Revised Taxonomy, and actually develops metacognitive awareness. There is also a need for other studies examining students' metacognitive awareness levels and their science learning motivation according to the variable of using science in daily life, so that the role of science education in developing students' high-level cognitive skills can be revealed more effectively.

Another conclusion reached in the study is that the science learning motivations and metacognitive awareness of middle school students vary according to the science course grade point average. It has been determined that science course grade point average affects science learning motivation in favor of students with an average of 85 and above, and metacognitive awareness in favor of students with an average of 70 and above. Accordingly, it can be stated that students who are more successful in science courses have higher science learning motivation and metacognitive awareness levels. When the literature is examined, it is seen that metacognitive awareness is examined according to the academic achievement of students by Bağçeci, Döş and Sarıca (2011), Emrahoğlu and Öztürk (2010), Turan and Demirel (2010). According to the results of these studies, it was observed that the increase in the level of academic achievement also increased the metacognitive awareness. In addition, it has been revealed by the results of the relevant research that metacognitive awareness is a positive predictor of academic achievement. In the study conducted by Karatay (2010) with 6th, 7th and 8th grade students, it was concluded that students with high metacognitive awareness levels are more successful academically. It is understood that the results of the relevant research support the conclusion reached in this study, and it is an expected result that the metacognitive awareness of the students, who show high achievement, is high as a result of being aware of their own learning. It has been determined that this result is also in parallel with the results of other studies (Çetin & Kırbulut, 2006; Glynn, Taasoobshirazi & Brickman, 2009, Karakaya et al., 2018; Yenice, Saydam & Telli, 2012). It is understood that the results of the relevant research support this result reached in the study, and the high motivation of students with high achievement is again an expected result. Since success is an intrinsic motivation source, a high grade point average affects motivation positively by its nature.

When the effect of gender on the variables discussed in this study is examined, it has been concluded that gender is an effective variable in students' science learning motivation, but it was not effective on their metacognitive awareness. It was determined that female students had higher motivation to learn science and this result was in parallel with the results of studies (Akpınar, Batdı & Dönder, 2013; Atay, 2014; Britner & Pajares, 2001; Ekici, 2010; Güvercin et al., 2010; Halimoğlu, 2019; İnel-Ekici et al., 2014; Karataş & Yıldırım, 2018; Khamis, Dukmak & Elhoweris, 2008; Martin, 2004; Okumuş, 2020; Okuyucu & Okumuş, 2019; Uzun & Keleş, 2010; Yaman & Dede, 2007) that concluded that female students' motivation towards science was higher than male students. On the other hand, Aydın (2007), Azizoğlu and Çetin (2009), Çavaş (2011), Çetin and Kırbulut (2006), and Yenice et al. (2012) presented in their studies that gender did not affect the motivation for learning science. In addition to the results of the research showing that there is no statistically significant difference between the metacognitive awareness of female and male students (Kandal & Baş, 2021; Özsoy & Günindi, 2011; Şahin & Küçüksüleymanoğlu, 2015), it is seen that there are research results reporting that metacognitive awareness is in favor of females (Akçam, 2012; Aktağ, Şemşek & Tuzcuoğlu, 2017; Alcı & Altun, 2007; Bağçeci et al., 2011; Gül, Özay Köse & Sadi Yılmaz, 2015; Kaya & Fırat, 2011; Oğuz & Kutlu Kalender, 2018; Öztürk & Serin, 2020; Saban & Saban, 2008) and that metacognitive awareness is higher in male students (Demir & Kaya 2015; Gürefe, 2015). It can be claimed that these inconsistent results in the research are due to the differentiation of the sample groups of the related studies due to various reasons such as age, education level, previous learning experiences. Since gender is a variable that is directly affected by social, cultural and geographical features, it is a common situation to see variability in the results obtained depending on the purpose and scope of the research.

As a result of the analysis to test the research hypothesis that 'the science learning motivation in middle school students varies according to the grade level', it was seen that the research hypothesis was supported. Accordingly, it was concluded that the students in the early classes of middle school had a higher motivation to learn science. It was determined that as the grade level increased, the science learning motivation decreased. Students are excited and eager to learn in the first grades of secondary school, but as the grade level increases, the subjects become more complex, and distraction is experienced due to the physiological changes required by the adolescence period, and as a result, it becomes difficult for students to be motivated to learn. In addition to these changes, it can be thought that the learning environments created for the examination system (High School Entrance Exam - LGS) carried out in our country for the transition to a higher education level after middle school also have negative effects on motivation towards learning. An examination system-oriented teaching leads to moving away from the gains of the curriculum and, on the other hand, to adopting a learning approach based on rote learning (Şahin, 2009; Erden, 2020). In addition, in order not to be left out of the exam-oriented system, students enter an intensive study process with private lessons, additional lessons and homework. As a natural consequence of all these, students experience a reluctance to learn and a loss of motivation. At the same time, it can be said that LGS causes stress and test anxiety in 8th grade students, and therefore the pressure it creates has a decreasing effect on their motivation levels for learning. This result show parallelism with the studies of Akpınar et al. (2013), Pigeon et al. (2010), İnel Ekici et al. (2014), Tseng et al. (2009), Uzun and Keleş (2010), Yaman and Dede (2007), Yenice et al. (2012). However, it is seen that there is a study that contradicts this result. According to Azizoğlu and Çetin's (2009) study, students' science learning motivation is not affected by grade level. This may be due to the difference between the sample group and the measurement tools used.

When metacognitive awareness was examined according to grade level, it was found that there was no statistically significant difference between the metacognitive awareness of middle school students studying in the 6th, 7th and 8th grades. It is understood that this result is similar to some related research results (Karslı, 2015; Kaya & Fırat, 2011; Özsoy, Çakıroğlu, Kuruyer & Özsoy, 2010; Öztürk & Serin, 2020), but it also differs from research results (Baysal, Ayvaz, Çekirdekçi & Malbeleği, 2013; Oğuz & Kutlu Kalender, 2018; Özsoy & Günindi, 2011; Öztürk, 2017) indicating that metacognitive awareness increases according to grade level. It can be thought that these differences may have arisen from the fact that the age levels of the selected sample in the studies were different from each other, sometimes by working with pre-service teachers sometimes with certain grade levels, and by considering different dimensions of metacognitive awareness with different data collection tools used for the researched problem. Although the increase in the level of metacognitive awareness seems to be one of the possible outcomes as the grade level increases, the lack of a significant difference in cognitive development between the ages of the students in the sample group (12-14) was also reflected in the grade level, and there was no significant difference between the levels of metacognitive awareness.

When the relationship between students' science learning motivation and their metacognitive awareness was examined, it was concluded that there was a statistically significant, moderate and positive relationship. According to this result, it can be said that the metacognitive awareness of students with high motivation to learn science is also high. This result is in parallel with the studies of Okumuş (2020) and Atay (2014). In her study, Okumuş (2020) concluded that metacognitive learning skills play a role in middle school students' science learning motivation. Atay (2014), concluded that there is a positive and significant relationship between middle school students' science learning motivation and their metacognitive awareness. In addition, Kahraman and Sungur (2011) concluded that students who believe that they will learn the science lesson and be successful use metacognitive strategies better. A student with high metacognitive awareness has an increased belief in fulfilling a task and achieving academic success. For this reason, it can be said that it is an expected situation for students with high metacognitive awareness to increase their science learning motivation. The necessity of motivation for the use of metacognitive skills is an indication that as the science learning motivation increases, metacognitive awareness will also increase.

All these results show that the practices carried out within the scope of science education leads to a positive change in science learning motivation and metacognitive awareness. Based on these results, it can be inferred that diversifying and applying activities and studies that can be used in science lessons; providing science learning environments enriched with different methods and techniques, materials and technologies; participating of middle school students in studies focused on science education will increase students' science learning motivation and metacognitive awareness, and thus enable more qualified learning. In addition, it is underlined that the effective use of science laboratories in science lessons, students' participation in science projects and their active participation in all processes from the preparation of the projects to the conclusion, and the design of science learning environments in a way that allows the transfer of knowledge to daily life will make important contributions to an effective science education.

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Evaluation of 8th-Grade Students' Approaches to Solving New-generation Science Questions Based on Variable Determination from Scientific Process Skills[1]

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Abstract

This study aims to investigate students' approaches to solving questions that examine dependent-independent and control variables from scientific process skills in the new-generation questions related to the science lesson. The research was designed as a holistic single case study, one of the qualitative research methods. The research was carried out with 20 students studying in a public school. A total of 25 questions aiming to determine the identifying variables in the High School Entrance Exams between 2018-2020 were selected and applied as a test. These questions were divided into four categories. These categories are requiring concrete thinking, requiring abstract thinking, conducting an experiment, and inferring from the experimental design. A detailed description of the case was made by interviewing the students. The interviews were conducted with six students. In order to understand the students' strategies for reading new-generation questions, a reading strategies meta-awareness inventory was applied. When the findings were evaluated, it was understood that the students took two approaches as the first encounter with the questions asked to them and when solving the questions, and they benefited from strategies based on deep and surface sub-themes in these approaches. It was understood that students' reading strategies meta-awareness and sub dimensions (global reading, problem-solving, supporting reading strategies) were above the medium level. However, when the inventory items were evaluated, it was noticed that they gave low scores to the items containing the phrases; write summaries to reflect on key ideas, take notes while reading, summarizing, and using typographical aids to identify key information, which are associated with the deep approach.

INTRODUCTION

In recent years, in the education system in Turkey, instead of questions that aim at students' knowing and remembering, the emphasis has been on questions that put forward students' research and reasoning skills. In the 2023 Education Vision of the Ministry of National Education, it is planned to reorganize the exams within the scope of their purpose, content, and structure depending on question types and the benefits they will provide. In addition, it is aimed to test reasoning, critical thinking, interpretation, prediction and similar thinking skills (MEB 2018). In this context, it is seen that "skill-based" questions, which are expressed as "new-generation", have been included in the content of the High School Entrance Exam (LGS) since 2018. In accordance with these questions, it is aimed to measure students' high-level skills such as reading comprehension, interpretation, deduction, problem-solving, analysis, critical thinking, and scientific process skills (Erden, 2020; Sanca, Artun, Bakırcı and Okur, 2021). Scientific process skills (SPS) are used to obtain scientific knowledge and include thinking skills that scientists use during their studies, such as observing, measuring, classifying, saving data, establishing hypotheses, using data and creating a model, changing and controlling variables, and conducting an experiment (MEB, 2013; 2017; 2018). SPS are the thinking skills used from the moment the problem situation first arises to the solution (Çepni & Çil, 2013). The skills related to identifying a problem, identifying variables, establishing hypotheses, saving data, and interpreting data are mutually supportive skills (Kocakülah, Turan & Kocakülah, 2020). Identifying and controlling the variables from these skills clearly is essential for planning, implementation and interpretation (Kılıç & Sağlam 2009). Identifying the variables means understanding all the factors that affect the research process (Aslan, Ertaş-Kılıç & Kılıç 2016). In the studies conducted at the primary and secondary school level, it is understood that the students do not acquire the skills related to determining the variables, changing and controlling the variables enough, and it is not easy to gain them (Çakar 2008; Çam & Yalman,2020; Durmaz & Mutlu 2012; Keser & Başak 2013; Ocak & Tümer 2014; Temiz, 2020; Tosun, 2019).

The interaction between the student and the learning task expected from the student is defined as the approaches to learning. Learning emerges as a form of processing information influenced by various factors that reveal the way of perceiving, interacting with, and reacting to the environment (Biggs, 1987; Entwistle, 1986; Entwistle, 2005, Entwistle & Ramsden, 1982; Marton & Säljö, 2005). Biggs (1999) states that each student, concerning the attitude they show and the path they choose, applies different approaches to learning toward the task presented to them. Some students strive to learn and understand, while others are only interested in passing the course. How students approaches to learning is related to the strategies, and the surface approaches is defined as not trying to make sense of what they have learned, relying on rote learning, not establishing a relationship between what has been learned, lack of a specific purpose or target, following their lessons due to fear of failure, and displaying a negative attitude towards the lessons. In addition, a deep approach is defined as trying to relate what has been learned to the facts and events in their life, producing new ideas and reasoning, and aiming for meaningful learning (Biggs, 1987; Entwistle, 1986; Entwistle & Ramsden, 1982; Marton & Säljö, 2005). In this context, asking students to solve the questions posed to them can be considered a demanding task, as well as the expectation of students to perform learning. Therefore, it is crucial to understand how they solve the questions presented as a task and whether an approach is developed towards the questions.

Since many questions about scientific process skills in LGS exams require designing experiments and abstract thinking, it is considered essential to make an arrangement that overlaps students' learning environments and skills (Çepni & Çil, 2013). Başar's (2021) study of evaluating 2018 science curriculum outcomes in terms of SPS showed that the curriculum had very few outcomes related to experimental skills such as "designing experiments" and "changing and controlling variables". In addition, that study revealed four outcomes for the skill of "identifying the variables”, but not any outcomes for the skill of "designing an experiment" at the 8^{th}-grade level. The use of new-generation questions in some exams, such as LGS, has affected their in-class practices. In his study, Erden (2020) explains the difficulties that affect the ability to solve and understand new-generation (skill-based) questions by students, such as having difficulty in solving the questions in time, having difficulty in how to approach the questions, the fact that these questions are not included in the lessons since they are time-consuming in school lessons, and that teachers cannot provide guidance to students regarding the solution of these problems. This study is essential in guiding teachers and education programmers in understanding their students' approaches to solving the questions, identifying variables in new-generation science questions, and designing learning activities considering their approaches to solving the questions in the classroom or laboratory environments. This study aims to explain the students' approaches to solving the questions about identifying variables from scientific process skills in the new-generation questions about the science lesson. For this purpose, answers to the following questions were sought.

How do the 8th-grade students solve the questions about identifying the variables in the new-generation science questions in LGS?

What are the 8th-grade students' approaches to solving the questions about identifying the variables in the new-generation science questions in LGS?

What is the metacognitive awareness of reading strategies of 8th-grade science students?

METHOD

Study Design

The research was designed as a holistic single case study, one of the qualitative research methods. In this design, it is aimed to understand a real-life phenomenon in depth. Explaining the phenomenon means establishing a conjectured set of causal relationships about it, or how or why something happened (Yin, 2009). In this study, secondary school students whose approaches to solving the questions were explained were considered as the unit of analysis.

Study Group

The research was carried out with 20 students (12 girls and 8 boys) studying in a public school located in the center of Bursa in Turkey. While determining the research sample, the convenience sampling method was followed (Creswell, 2016; Miles and Huberman, 2015). Accordingly, 20 volunteer students from the first researcher’s school were included in the research.

Data Collection Tools

New-generation identifying variables test (NIT): In the research, a "new-generation identify variable multiple-choice test was prepared to determine students' success in solving new-generation identifying variables questions. For this purpose, firstly, document analysis was performed. The document analysis was carried out in order to select the questions to be asked to the students about identifying the variable in the new-generation science questions. In this context, LGS science questions published between 2018-2020 constituted the source of the documents. Content analysis was conducted to determine the questions to be selected in this scope. While selecting the questions, two researchers evaluated the questions separately, then the independently-selected questions were compared, and the question themes were determined together by the researchers. The questions that did not reach agreement according to the themes were eliminated, and the final version of the questions was formed. Four categories were determined according to the way of questioning the variables.

According to the way of thinking in the question, the ones with written dependent independent variables are divided as "requiring concrete thinking", and the ones that the student should find the variables are "requiring abstract thinking". According to the experimental design in the question, the ones aiming to establish an experimental design from the variables are divided as; "Conducting an experiment", and the questions that the students deducted and reach a conclusion from the variables in the designed experiment are "inferring from the experimental design".

The questions evaluated according to these categories were rearranged as combined categories since there were questions that contained two ways of thinking together. The questions selected according to the combined categories are presented in Table 1.

Table 1. Categories of questions measuring the ability to identify variables

		YEARS	
CATEGORIES	**2018**	**2019**	**2020**
Requiring concrete thinking - conducting an experiment	Q17	Q3, Q10, Q14, Q18	Q11, Q13
Requiring abstract thinking - conducting an experiment	Q3, Q5	-	-
Requiring concrete thinking- inferring from the experimental design	Q4, Q6, Q8, Q18	Q13, Q11	Q2, Q14, Q15, Q16, Q17
Requiring abstract thinking- inferring from the experimental design	Q11	Q9, Q12, Q20	Q4

Based on these categories, 8 questions in 2020, 9 questions in 2019, and 8 questions in 2018, and a total of 25 questions were selected. Sample questions about requiring concrete thinking- inferring from the experimental design, and requiring abstract thinking- conducting an experiment are presented in Figure 1.

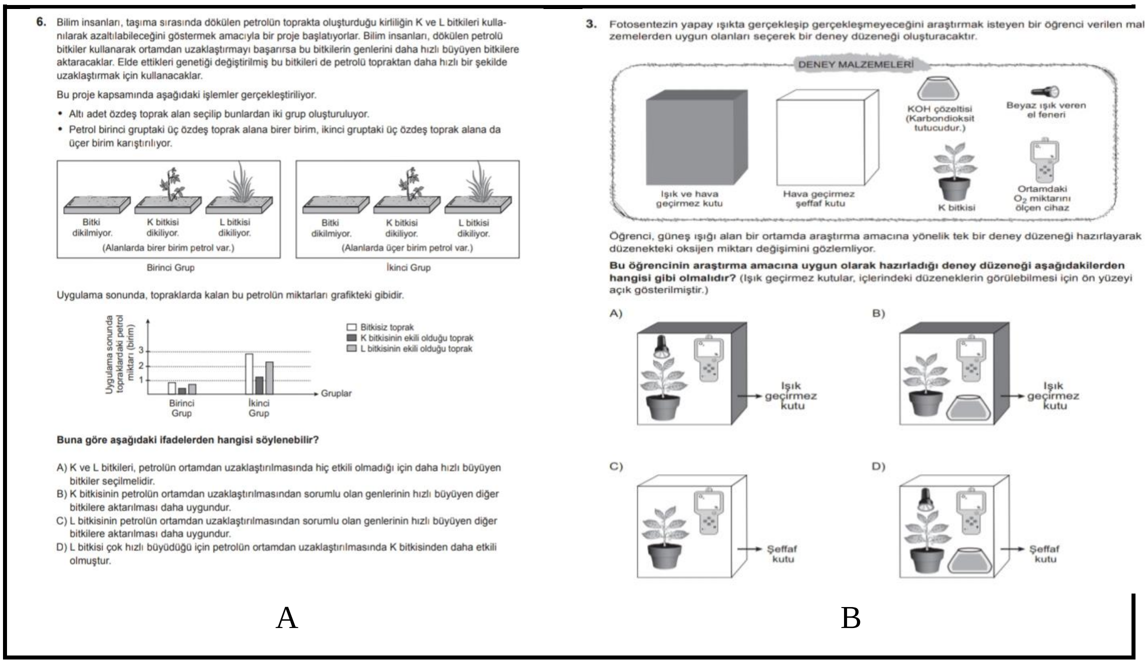

Figure 1. Categories of questions measure the ability to identify variables.

Note: Samples of question categories: Figure A, the sample of requiring concrete thinking- inferring from the experimental design category, 2018; Figure B, the sample of requiring abstract thinking - conducting an experiment category, 2019.

Inventory: The Metacognitive Awareness of Reading Strategies Inventory (MARSI), developed by Mokhari and Reichard (2002) and adapted into Turkish by Öztürk (2012), was applied in order to understand the students' strategies for reading new-generation science questions." The Metacognitive Awareness of Reading Strategies Inventory" consists of 30 questions of 5-point Likert type (p=0.93). The inventory has three sub-dimensions that can be applied to 6^{th} to 12^{th}-grade students. The first sub-dimension, "Global Reading Strategy", consisted of 13 items (p=0.85), the second sub-dimension ", Problem Solving Strategy", consisted of 8 items (p=0.76), and the third sub-dimension ", Supporting Reading Strategies", consisted of 9 items (p=0.81). The highest scores that can be obtained from the test are 150 for general metacognitive awareness of reading strategies, 65 for global reading strategy, 40 for problem-solving strategy, and 45 for supporting reading strategies.

Interview questions: Interview questions were applied using the Google Docs due to the pandemic. In the interview questions, questions such as "When you first encountered new-generation questions in science class, what did you think about the questions?" "Write your positive or negative thoughts about the effect of new-generation science questions on learning in science questions." were asked. The three questions that students answered most incorrectly were added to the interview form, and depending on whether or not identifying the variables while answering these questions, "Did you determine the variables (dependent-independent-control) variables in the above question, explain why? If your answer is yes, how did you go about determining the variables while answering this question?" were questioned. The interview was conducted with 6 (3 girls, 3 boys) students.

Data Collection Process and Data Analysis

In the first stage of the study, NIT was applied to measure students' success in new-generation science questions. In the second stage, the MARSI was applied. Finally, semi-structured interviews were conducted with six volunteer students in order to describe the research situation in detail.

The descriptive approach and thematic analysis were used in the analysis of the data. In the analysis of the NIC test, the response frequencies of the questions and question categories are described. Thematic analysis was used in the analysis of the interview data. All the answers were analyzed together to reveal the interviewed students' general approaches to solving the questions. The students' success in solving the most incorrect questions asked during the interview was not considered, and their correct or incorrect answers were not taken into account. All the answers of the students were evaluated together. The interview questions formed the source of the themes. The common features in the phrases of the students were separated into codes created together by the researchers under these themes, and their frequencies were determined. The data were supported by direct quotations from the students. In addition, the fact that the first researcher spent more time with the students provided more detailed and reliable data from the participants. The students' names were coded as S1, S2, …, S18 in the forms in which the written opinions of the students were stated.

FINDINGS

At the first stage of the research, the answers given to 25 science questions in LGS, which were selected as a result of document analysis, were evaluated. The frequencies of the answers given by the students to the determined question categories are shown in Table 2.

Table 2. NIT correct answer frequencies by question categories

Year	2018		2019		2010	
	Questions	Frequency	Questions	Frequency	Questions	Frequency
RCT/CE	Q17	16	Q3	15	Q11	17
			Q10	17	Q13	19
			Q14	13		
			Q18	18		
RAT/CE	Q3	19				
	Q5	15				
RCT/IET	Q4	16	Q13	16	Q2	15
	Q6	13	Q11	18	Q14	10
	Q8	16			Q15	16
	Q18	13			Q16	18
					Q17	13
RAT/IET	Q11	17	Q9	13	Q4	18
			Q12	15		
			Q20	18		

RCT: Requiring Concrete Thinking, RAT: Requiring Abstract Thinking
CE: Conducting an experiment IED: Inferring from the experimental design

When the NIT was applied to the 20 students, it was found that the frequency of correctly solving the questions was in the range of 10-19. It is understood that the frequency of answering the questions correctly is above the average ($\bar{x}$f=10). The average correct answer frequency of the questions in the category of requiring concrete thinking-conducting an experiment was 13-19. The average correct answer frequency of the questions in the category of requiring concrete thinking- inferring from the experimental design was 10-18, the average correct answer frequency of the questions in the category of requiring abstract thinking-conducting an experiment was 15-19, and the average answer frequency of the questions in the category of requiring abstract thinking-inferring from the experimental design was 13-18, and so all the frequencies were found to be close to each other. Students' frequencies of answering questions show that the questions were successfully answered above average by them. As a result of the students' tests in 2018, the 18th question in the category of requiring concrete thinking- inferring from the experimental design was the most wrongly answered question (N=13). The most frequently wrongly answered question in 2019 was the 14th question, which required abstract thinking- inferring from the experimental design category (N=13). In 2020, the 14th question, which required abstract thinking-inferring from the experimental design category, was the most wrongly answered question.

When the findings obtained from the interviews of the students were evaluated, the themes of “The strategy of first encountering a question" and “The strategy of solving a question” were constituted. These themes are divided into two sub-learning approaches as deep and surface. Related categories and codes are shown in Table 3.

Table 3. Themes of students’ responses

Theme	Subtheme	Category	Code	F	Theme
The strategy of the first encountering a question	Surface approaches	Emotional reaction	Feeling fear	1	S5
			Feeling anxious	3	S1, S3, S6
		Not questioning	Finding it difficult	3	S2, S3, S6
			Finding it time-consuming	1	S2
			Finding it confused	2	S3, S4
	Deep approaches	Cognitive understanding	Searching logic	1	S4
			Seeking meaning	2	S1, S4

		Meaningful-interpretation of visuals	Understanding the visual message	2	S3, S5
The strategy of solving a question	Surface approaches	Copying	Repeating similar question-solving	2	S3, S4
			Incomprehensible repetition	1	S4
		Rote learning	Using codes	1	S4
	Deep approaches	Comprehension of knowledge	Listening to lesson and note-taking	3	S2, S3, S5
		Association	Using comparison	3	S1, S3, S6
			Making logical connection	3	S3, S5,S6
		Inquiring knowledge	Fnding instructive information	3	S1, S3, S4
			Finding experimental and testable information	2	S1, S4

According to Table 3, it is understood that students' approaches to solving the questions of determining new-generation science variables have two themes: "the strategy of the first encountering a question" and "the strategy of solving a question". Moreover, it is noticed that when students first encounter a new-generation science question, they display emotional reaction and non-questioning processes as the surface approaches and cognitive understanding, and meaningful interpretation of visuals processes as the deep approaches. Some of the responses given by the students are presented below.

"I was scared the first time I saw it…" (S5) (emotional reactions)

"When I first saw it, I was anxious because the questions were long and I had never encountered it before, I thought it was challenging, difficult and complicated.". (S3) (emotional reactions, not questioning)

"I thought it was a logic based on meaning because it was long and it would be confusing" (S4) (not questioning)

"I thought that it would be difficult and I could not do it" (S6) (not questioning)

"My negative thinking is that it takes a lot of time" (S2) (not questioning)

"Since science questions were supported with more visuals, they were better understood..." (S3) (Meaningful-interpretation of visuals)

It is understood that when students use the strategy of solving a question, they tend to prefer the surface approaches such as repeating similar questions-solving, incomprehensible repetition called copying, and coding called rote-learning. In addition, they prefer the deep approaches such as listening to the lesson and note-taking in the lesson, using comparison, making logical connections and inquiring about knowledge in order to solve the questions. Some of the responses given by the students are presented below.

"Our teacher repeated and distributed new-generation questions to reinforce them. I kept it in my mind by coding". (S5) (Rote-learning)

"I studied using logic. (S6) (Comprehension of knowledge)

"*First, I listened carefully to the lectures, then I took notes and pasted them on my desk so that I could look at them when I was solving the questions, and as I solved more questions, I reinforced them..." (S3) (Comprehension of knowledge)*

"We can learn things in paragraphs that we do not know. Experimental questions also make it easier to understand." (S1) (Association, inquiring knowledge)

"Since science is a lesson that requires logic based on experimentation and thinking, new-generation questions are according to the content of the lesson and provide learning through experimentation" (S5) (Association, inquiring knowledge).

According to students' responses, we might say that they can prefer the surface or the deep approaches or both depending on the questions. MARSI, which was applied to understand the students' strategies for reading new-generation questions, was answered by 18 students. When the averages of the answers given by the students to the MARSI were evaluated, their general average was found to be $\bar{x}$=103. The averages of the sub-dimension of the inventory were calculated as global reading strategy $\bar{x}$=43.44, problem-solving strategy $\bar{x}$=34.11, and supporting reading strategies $\bar{x}$=25.11. It was understood that the scores of the students were above the average, and the highest score average was in the problem-solving dimension. When the response frequencies of the statements they gave the lowest score in the inventory were examined in order to be able to interpret them with the students' approacheses to solving the questions, from the global reading strategy sub-dimension items; the 2nd item "I take notes while reading to help me understand what I'm reading." ($\bar{x}$f=47.8), the 22nd item "I use typographical aids like boldface type and italics to identify key information." ($\bar{x}$f=34.4), sub-dimension of supporting reading strategies; the 5th item "When text becomes difficult, I read aloud to help me understand what I'm reading." ($\bar{x}$f=57.8), the 6th item; "I write summaries to reflect on key ideas in the text." ($\bar{x}$f=50.0), the 9th item "I discuss my reading with others to check my understanding" ($\bar{x}$f=55.6), the 15th item "I use reference materials such as dictionaries to help me to understand what I'm reading." ($\bar{x}$f=51.1) were lower than the other items. The highest items are; In the problem-solving strategy sub-dimension items, item 16 "When text becomes difficult, I begin to pay close attention to what I'm reading." ($\bar{x}$f=86.7), item 27 "When text becomes difficult, I reread to increase my understanding." ($\bar{x}$f=81.1) item 30 "I try to guess the meaning of unknown words or phrases." ($\bar{x}$f=82.2), and item 25 in the global reading strategy subscale, "I check my understanding when I come across conflicting information." ($\bar{x}$f=84.4).

DISCUSSION AND CONCLUSION

When the research findings were evaluated, it was determined that students' correct answer frequencies of the new-generation science question categories were close to each other, and the average was above the response frequency. When their approaches to solving these questions were evaluated, it was understood that they had two strategic approaches to solving the identifying variables questions "The strategy of first encountering a question" and "The strategy of solving a question", containing deep and surface sub-approaches. When students' approaches to solving new-generation questions were evaluated in terms of MARSI, it was noticed that the general averages and sub-dimensions of their answers (global reading strategy, problem-solving strategy and supporting reading strategy) were above the average. However, the statements that scored lowest were noticed in the global reading strategy and supporting reading strategies sub-dimensions.

It is understood that in the first encounter with the questions, the students might approach to solving a question with emotions such as fear, and anxiety, which include emotional reactions and lead to the surface approaches. Öztürk (2012) explained the problem-solving strategy in MARSI as the strategy used when having difficulty reading a text. According to the research findings, it is noticed that the students gave the highest scores in the problem-solving sub-dimensions in their answers to MARSI. Entwistle (1986:14) stated that when students focus on meeting a task that is expected of them, they reveal a sense of fear and failure concerning external motivation, which are surface approaches. Marton and Saljö (2005) stated that extrinsic motivation was related to the tasks expected from the student and led to a surface approaches.

Therefore, a sense of failure might arise in students expected to succeed only because of external motivation. For this reason, it should be ensured that students' preliminary ideas about why they solve the questions are improved, and they are aware of the strategies to approaches to solving the question. In addition, according to the research findings, it was understood that students might show emotional reactions such as confusion and time-consuming before questioning with understanding in their first encounter with the questions. However, Güneş (2016) emphasized that questioning is the basis of mental skills, affects and activates complex mental processes of the individual, and is essential for developing high-level learning and comprehension skills. For this reason, it is essential for students to realize by questioning their deep approaches, such as searching for logic, trying to make sense of the information, evaluating the knowledge of the question, which they represent in their first encounter with the questions, and it is thought that it might contribute to the reinforcement of their mental skills such as the determination of the variables that a question aims to measure.

It was understood that the students tend to choose the surface approaches such as repeating similar question-solving and incomprehensible repetition as the strategy of solving a question. In addition, students' comments that form the idea that they are trying to memorize, such as using codes are noticed. According to the results of the Ilkorucu-Gocmencelebi, Ozkan & Bayram (2010), the 6^{th},7^{th}, and 8^{th}-grade students who prefer a deep approach to learning science tend to solve more multiple-choice questions. However, they believe that it should not be thought that the students' success in multiple-choice questions depends on their preference for a deep learning approaches. In addition, the students were asked whether they enjoyed doing the tests, and it was found that they preferred a deep learning approaches to a surface learning approaches in the subjects in which they are interested. Thus, students might prefer the deep approaches but succeed with the surface approaches while solving questions. For this reason, the purpose of solving questions should not be only success-oriented; students should be encouraged to solve questions with deep approaches and should be aimed at meaningful comprehension instead of incomprehensible repetition. Arıkan and Kırıntı (2020) state that one of the criticized points of the education system in our country is the LGS. They mentioned that the high level of the demands in the institutions preferred to move to a higher education institution, and the wishes of families to ensure their children receive a better education created a competitive environment. It is thought that these external processes would affect the students' strategies to answer and solve the questions.

The answers given by the students to MARSI were examined, the sub-dimension of global reading strategies items; "I take notes while reading to help me understand what I'm reading", "I use typographical aids like boldface type and italics to identify key information.", and the sub-dimension of supporting reading strategies items; "When text becomes difficult, I read aloud to help me understand what I'm reading", "I write summaries to reflect on key ideas in the text", "I use reference materials such as dictionaries to help me to understand what I'm reading" were found lower than the others. It is noticed that these phrases were especially related to the effort to understand. Remarkably, these items have been related to the deep approaches, which aims to comprehension of knowledge and the association in the students approaches to the solving questions. Marton & Säljö (2005) found in their study that students who are under the effect of external motivation, that is, what is demanded, tend to memorize, which is related to the surface approaches. In their studies, it was found that the students adopted the surface approaches by not paying attention to what a text given to them was about, and remained indifferent to the text read. Öztürk (2012) states that in the students' process of reading and constructing meaning, comprehending knowledge increases when they know and apply reading strategies. Therefore, if the items that students give low scores have assumed to be related to the deep approaches, it could be said that improving students' comprehension of these statements might also be effective in using the deep approaches in solving questions. Öztürk (2012) emphasizes the difference between knowing information and using information and states that the essential thing is to use information effectively. In this respect, students could focus on memorizing the questions instead of constructing meaningful relationships due to tasks such as exam success expected of them. Therefore, even if students seem to concentrate on comprehending facts and details while solving questions, their failure to remember them will not be a surprising result.

As a result, it is understood that the students did not only use the strategy of solving a question when solving the questions about the identifying variables in new-generation science questions evaluated within the scope of this study but also showed an approach as the strategy of first encountering the question. These strategies, which appeared in students' approaches to solving the identifying variables questions, can be seen as information processors or interpreters used to select, memorize, and recall the information encountered by the student. In these strategies that emerge in students, they may prefer the deep approaches that they would get efficiency from a question or the surface approach that they might not remember later. While the deep approaches are an effort to focus and understand the question, the surface approaches might appear as feeling emotional reactions such as anxiety and fear about the question, not remembering the information, and not questioning. For these reasons, when behaviour such as taking notes, using comparisons and making logical connections for the deep approaches has been considered instinctive strategies for solving questions, teachers can be expected to direct their students to these strategies while identifying variable questions. This research was limited to six students' approaches to solving questions based on identifying variables. With questions based on different scientific thinking processes, the scope can be expanded, and students' approaches to solving the questions in these thinking processes can be investigated. In this study, the approaches to solving the questions was tried to be comprehended in a general framework with a holistic evaluation because the correct answer frequencies given to the question categories were close to each other. It can be recommended to repeat it in larger groups and investigate whether there is a difference in approaches to solving the question of the students according to the question categories.

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Relations of In-service Science Teachers' Career Motivation with Demographic Variables[1]

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Abstract

Teachers' career motivation is an important factor affecting the education process. In this study, the relations between science teachers' career motivations and demographic variables (gender, school location and professional experience) were examined. A total of 136 science teachers working at state middle schools in Muğla Province participated in the study. FIT-Choice Scale was used as data collection tool. Data were collected in the Spring 2019 semester. In data analysis, descriptive statistics, independent sample t-test and one-way ANOVA tests were used. The results of the analysis showed that the career motivation of science teachers was at moderate level. In terms of gender, differences were found in the sub-dimensions of expertise, difficulty, social impact, and fallback career. In addition, analysis showed that there was a difference in the sub-dimensions of difficulty, social status, social pressure, enhance social equality, social contribution, determining the future of students and previous experiences in terms of school location. In terms of professional experience, in only the sub-dimension of job security, a statistically significant difference was found. The results of the study suggest that teachers should receive more financial and moral support from their environment.

INTRODUCTION

Schools are a social structure that includes students, teachers and parents. Among these, teachers greatly influence students' intellectual and personal development so that teachers play crucial roles to achieve the educational outcomes (Eryılmaz, 2013). Sometime they act as role models for their students and other times guide knowledge they want to acquire. In the Science Education Curriculum published by the Ministry of Turkish National Education ([MEB], 2018), it is stated that every education system rises on the shoulders of teachers and cannot exceed the quality of a teacher. Considering the importance of teachers on the educational outcomes, teachers are the cornerstone of the education system.

Teachers are expected to foster students with 21st century life skills, prepare them for the professional life, and be a role model to be a good citizen (Ertürk, 2016). Like other countries, Turkish national education system aims to raise individuals with 21st century life skills and innovative thinking (MEB, 2018). These expectations require teachers who are willing and highly motivated in schools with a good working atmosphere. Here, the importance of teachers' motivation emerges. Motivation is the driving force for the behavior of the individual has made it one of the most important factors in highlighting the effectiveness of the learning-teaching process (Akbaba, 2006).

Teachers' professional competencies, perceptions and motivations of are some important inputs for students' achievement and for educational outcomes within the education system. In this context, it is necessary to increase the career motivation of the teacher for a qualified education (MEB, 2018). To do this, in the 2023 Education Vision it was stated that school environments with a self-renewing development vision that motivate students and teachers, make them feel valuable and happy will be enhanced. In addition, the three-year concrete targets of the Ministry of Turkish National Education include that the professional satisfaction of teachers will be increased. The efficient operation of the science program, whose aim is to develop scientific process, life, and engineering skills, to prepare students according to the requirements of the 21st century, to create career awareness, to train individuals who produce entrepreneurs and to ensure their development, can only be possible with willing and highly motivated science teachers in schools with a suitable working atmosphere.

Motivation refers to the internal and external driving force that provides energy for individuals to fulfill their duty and succeed to meet expectations and needs (Duy, 2017). Many theories have been developed to investigate the motivations of teachers and students in teaching-learning process. One important motivation theory is the expectation-value theory. JW Atkinson, one of the pioneers of this theory, has worked on the expectation-value theory for both academic and career motivation and stated that the probability of perceived success is equal to motivation multiplied by the motivational value of success (Duy, 2017). In other words, the motivation of a person to achieve a task depends on the probability of achieving that task and how valuable he/she sees this task (Duy, 2017). Watt and Richardson (2007) adapted the expectancy-value theory to investigate teachers' career motivations and the factors affecting teacher selection, called the FIT- Choice framework. In this framework, there are two upper dimension of career motivation as perception and motivation. Perception includes salary, difficulty, social status, expertise, social dissuasion and satisfaction with choice. Motivation includes time for family, working with children, enhance social equity, intrinsic career value, job transferability, job security, shape future of students/adolescents, prior teaching experiences, social influences, make social contribution, fallback career and ability.

FIT- Choice has been used in many educational studies. Kılınç, Watt and Richardson (2012), for instance, studied 1577 pre-service teachers' career motivation and concluded that the make social contribution had the highest mean among the motivation sub-dimension (M=6.16) whereas the fallback career (M=3.07) has the lowest mean. In another study, Bruinsma and Canrinus (2014) examined teacher candidates' career motivation. They reported that difficulty (M =5.93) and expertise (M =5.57) sub-dimensions had the highest mean score while social impact (x M=2.14) and time with family (M =2.81) sub-dimension were the lowest.

Watt, Richardson, Klusman, Kunter, Beyer, Trautwein and Baumert (2012) investigated teacher career motivation with a cross-cultural study. The sample of the study consists of 2290 teacher candidates studying in Australia, USA, Germany and Norway. According to the results of the analysis, many differences were found between the career motivations of teacher candidates in different countries. Accordingly, while the US teacher candidates had the highest average score in the sub-dimensions of teaching ability and social contribution, it was seen that the average scores in Australia, Germany and Norway were low. In the sub-dimensions of working with children and social impact, the average scores of pre-service teachers in Germany and the USA were the highest, while it was the lowest in Australia and Norway.

In the literature, studies addressing teachers' career motivations from FIT-Choice framework generally focus on teacher candidates and few studies on the career motivation of in-service teachers. Some studies have been focused on in-service teachers' job motivation in Turkey, however, we have not located any study using the FIT-Choice framework to map in-service teachers' career motivation. The FIT-Choice framework is based expectancy-value theory which is developed to understand individuals' career related choice (Alpaslan et al., 2018). Furthermore, the FIT-Choice is related to teachers' teaching career motivation, defined as a long-term endeavor and process last the whole life; thus, it is different from job motivation, which is more related to the work for earning money (Watt & Richardson, 2007). Therefore, it is important to investigate in-service teachers' career motivation, especially science teachers in Turkey, that it will be a source for future studies and that it will contribute to the improvement of the teaching profession in education policies. This study focused on the following research questions.

1. What are science teachers' career perception and motivation levels?
2. Do teachers' career motivations change according to demographic characteristics (gender, school location and professional year)?

METHOD

Research Model

To address research questions, cross-sectional and relational research models were used. While the cross-sectional model was used to reveal the existing situation, the relational research model was to determine the relationships between two or more variables (Büyüköztürk et al., 2013).

Participants

Science teachers who worked at middle schools in Mugla Province were determined as the accessible population to save money and time. There were 451 science teachers working at middle schools in Muğla in the spring semester of 2018-2019 academic year. We tried to reach out all science teacher to maximize the sample. The sampling method of the study was the simple random sampling and maximum variation. In the simple random sampling method, all participants have an equal chance of being selected, and the number of those entering the sample is left to chance (Karasar, 2016). Data collection tools were sent out to all schools in the Mugla District. 136 science teachers working in public and private middle were voluntarily participated in the study and filled the surveys. The demographic characteristics of the teachers participating in the study were given in Table 1.

Table 1. Demographic characteristics of participants

		f	%
Gender	Female	88	62.9
	Male	48	35.1
School location	Rural	45	15.9
	Urban	91	82.1
Professional experience	0-5 years	11	7.3
	6-10 years	34	15.8
	11-15 years	31	23.8
	16-20 years	31	21.2
	21 years and above	29	20.5
Total		136	100

Data Collection Tool

In this study, “Personal Information Form” and “FIT Choice Scale” were used as data collection tools.

Personal Information Form

In the personal information form, there were questions about gender, school location (rural/urban), and how many years of science teaching experience they had.

FIT Choice Scale

The FIT- Choice Scale was developed by Watt and Richardson (2007) to evaluate teachers' career motivation according to the FIT- Choice framework. The FIT- Choice Scale was adapted into Turkish culture by Eren and Tezel (2010) and has been used by different researchers (Alpaslan, Ulubey, & Yildirim, 2018; Deniz, Doğan and Şahin, 2018; Kılınç, Watt and Richardson, 2012). The FIT- Choice Scale consists of two upper dimensions (motivation and perception) and eighteen sub-dimensions in total. Motivation upper dimension consists of twelve sub-dimensions: *time for family, social influences, ability, make social contribution, job transferability, shape future of students/adolescents, working with children, fallback career, job security, enhance social equity* and *prior teaching experiences*. Perception upper dimension consists of *salary, difficulty, social status, expertise, social dissuasion,* and *satisfaction with choice*. The FIT- Choice scale was developed on a 7-point Likert type ranging from “1= not at all” to “7= extremely much” and consists of 59 items in total. Sample item for each sub-dimension was given in Table 2. Deniz, Doğan, and Şahin (2018) performed confirmatory factor analysis for the construct validity of the scale and showed that the fit values (χ^2 (84) = 613.40, RMSEA= .066, CFI= .979) had a good fit index. In addition, Deniz, Doğan, and Şahin (2018) showed that the Cronbach Alpha values of the motivation dimension for the internal consistency coefficient were between .53 and .93, and the perception dimension ranged between .59 and .89. In this study, Cronbach's alphas for internal reliability were calculated and given in Table 2. Cronbach’s alpha values of the FIT- Choice scales ranged from .71 to .86 and were at an acceptable level.

Table 2. Internal-consistency values of FIT- Choice scale sub-dimensions

	Sub-dimensions	**Sample item**	**Internal-consistency**
Perception	Salary	Do you think teaching pays well?	.75
	Difficulty	Do you think teaching is a difficult job?	.71
	Social status	Do you think teachers feel that their profession has a high status in society?	.72
	Expertise	Do you think the teaching requires a high level of specialist knowledge?	.79
	Social dissuasion	Have others influenced you to consider careers other than teaching?	.76
	Satisfaction with choice	How carefully did you consider becoming a teacher?	.81
Motivation	Intrinsic career value	I chose teaching because I have an interest in teaching.	.84
	Time for family	I chose teaching because being a part time teacher will allow me to spend more time with my family.	.73

Social influences	I chose teaching because the people I work with think I should be a teacher.	.74
Ability	I chose teaching because I have the qualities of a good teacher.	.76
Make social contribution	I chose teaching because teaching will allow me to pay off my debt to society.	.78
Job transferability	I chose teaching because as a teacher I can work in different countries	.74
Shape future of students/adolescents	I chose teaching because teaching will allow me to shape the values of children/adolescents.	.84
Working with children	I chose teaching because I love working with children/adolescents.	.83
Fallback career	I chose teaching because I wasn't sure what career I wanted.	.86
Job security	I chose teaching because teaching will offer me a secure career.	.77
Enhance social equity	I chose teaching because teaching would allow me to be of benefit to low socioeconomic children.	.84
Prior teaching experiences	I chose teaching because I had teachers who inspired me.	.80

Data Collection and Analysis

The data were collected in the spring term of 2018-2019 in line with the permission of the Mugla Provincial Education Directorate. Ethics committee approval was not obtained because the ethics committee was not requested for academic studies in the period of data collection. Participants were given 30 minutes to complete the data collection tool. More than one statistical method was used in data analysis. First, internal consistency was analyzed in data. Then normality and distributions were examined. Since the skewness and kurtosis values given in Table 3 were between -1 and +1, the data were accepted as showing a normal distribution. For the first research question, the mean value and standard deviation were calculated in order to determine the level of teachers in each variable. In order to address the second research question, t-test and one-way ANOVA analysis were performed in SPSS statistical software.

RESULTS

In this part of the study, first, descriptive statistics on science teachers' career perceptions and motivations were presented. Then, the results of the relational analysis regarding the relations of teacher career motivation with demographic characteristics (gender, school location, and the professional experience) were given.

Descriptive Results

The results regarding the mean (M) and standard deviations (SD) of science teachers' career perceptions and motivations were given in Table 3. The results showed that science teachers had moderate mean scores in both perception (M= 3.98) and motivation (M= 4.75) dimensions (1.00-3.00 = low, 3.01-5.00 = moderate and 5.01-7.00 = high). In the sub-dimensions of perception, the highest were in difficulty (M = 5.38) and the lowest were measured in salary (M = 2.64). In the motivation, the highest mean value was computed in social contribution (M =5.47) and the lowest was in the fallback career (M =2.79).

Table 3. Descriptive statistics on science teachers' career perceptions and motivation

Sub- dimensions	Mean	SD	Skewness	Kurtosis
Perception	3.98	1.13	0.22	-0.19
Salary	2.64	0.88	0.10	-0.21
Difficulty	5.38	1.07	-0.84	0.59
Social status	3.07	0.94	0.13	-0.22
Expertise	5.11	1.15	-0.30	-0.50
Social dissuasion	3.08	1.47	0.50	-0.24
Satisfaction with choice	4.58	1.30	-0.14	-0.43
Motivation	4.75	0.96	-0.39	0.10
Time for family	3.85	1.14	-0.28	0.14
Working with children	5.03	1.12	-0.66	0.85
Enhance social equity	4.91	1.15	-0.51	0.19
Intrinsic career value	5.25	1.25	-0.68	0.23
Job transferability	3.95	1.29	-0.01	-0.45
Job security	4.33	1.11	-0.17	-0.15
Shape future of students/adolescents	5.42	1.10	-0.86	0.58
Prior teaching experiences	5.24	1.19	-0.88	0.65
Social influences	4.13	1.41	-0.25	-0.44
Make social contribution	5.47	0.92	-0.42	-0.31
Fallback career	2.79	1.48	0.60	-0.47
Ability	5.40	0.96	-0.34	-0.33

Teacher Motivation and Demographic Variables

First, the relationship between teacher motivation and gender was examined (See Table 4). According to the results, female teachers' mean values were 3.97 for perception and 4.87 for motivation. For male science teachers, the mean value was 3.98 for perception and 4.70 for motivation. In the perception dimension, both male and female teachers had the lowest mean value in the salary sub-dimension (M=2.53 and M= 2.85, respectively), while the highest mean value was in the difficulty sub-dimension for both group (M= 5.46 and M= 5.25, respectively). In terms of gender difference between the perceptions and motivations of female and male teachers, the difference was not statistically significant (p>.05). Yet, in the sub-dimensions, statistically significant difference was found in salary (t (134) =2.08 p< .05) and in expertise (t (134) =2.41, p< .05). While the difference in salary was in favor of male teachers, the difference in expertise sub-dimension was in favor of female teachers. In the motivation sub-dimensions, significant difference was found in the social influences (t (134) =2.10 p< .05) and fallback career (t (134) =2.03, p< .05) sub-dimensions. While the difference in fallback career was in favor of male teachers, the difference in the social influences was in favor of female teachers.

Table 4. T-test results of the relationship between gender and motivation

	Female		**Male**		
Sub- dimensions	***M***	***SS***	***M***	***SS***	***t***
Perception	3.97	0.51	3.98	0.58	0.16
Salary	2.53	0.82	2.85	0.96	2.08*
Difficulty	5.46	1.07	5.25	1.06	-1.12
Social status	3.05	0.93	3.11	0.96	0.36
Expertise	5.28	1.11	4.80	1.17	-2.41*
Social dissuasion	3.00	1.55	3.23	1.30	0.85
Satisfaction with choice	4.52	1.25	4.70	1.40	0.79

Motivation	4.87	.75	4.70	.76	1.27
Time for family	3.86	1.14	3.82	1.15	-0.22
Working with children	5.09	1.14	4.92	1.10	-0.83
Enhance social equity	4.97	1.11	4.80	1.24	-0.86
Intrinsic career value	5.31	1.21	5.14	1.34	-0.77
Job transferability	4.02	1.29	3.83	1.28	-0.84
Job security	4.38	1.07	4.24	1.17	-0.70
Shape future of students/adolescents	5.47	1.13	5.33	1.04	-0.75
Prior teaching experiences	5.29	1.19	5.16	1.18	-0.64
Social influences	4.31	1.34	3.79	1.48	-2.10*
Make social contribution	5.47	0.89	5.45	0.97	-0.13
Fallback career	2.61	1.49	3.18	1.41	2.03*
Ability	5.45	0.98	5.30	0.94	-0.92

* p< .05

An independent sample t-test was conducted to test the relationship between school location and science teachers' career motivation and results were given in Table 5. While the perception mean value of science teachers in schools in rural locations was 3.86, their motivation mean value was 5.10. Whereas the mean value of perception of science teachers working in urban location was determined as 4.00, the motivation mean value was 4.76. Whereas no statistically significant difference was found in the mean value of perception in the school location, a statistically significant difference was found in the motivation (t (134) = 2.21, p< .05). This difference was in favor of the teachers working in rural locations. In terms of sub-dimensions of perception, statistically significant differences were found in difficulty (t (134) =2.71, p< .01), social status (t (134) =2.34, p< .05) and social dissuasion (t (134) =1.99, p< .05). While the difference was in favor of teachers working in schools in urban schools in difficulty and social dissuasion, it was in favor of science teachers working in rural schools in social status. In the motivation sub-dimensions, statistically differences existed in enhance social equality (t (134) = 2.07, p< .05), shape of future of students (t (134) = 2.50, p< .05), prior teaching experiences (t (134) = 2.72, p < .01) and make social contribution (t (134) = 2.12, p< .05). The differences in these sub-dimensions were in favor of teachers working in rural schools.

Table 5. T-test results of the relationship between school location and career motivation

	Rural		**Urban**		
Sub- dimension	***M***	***SS***	***M***	***SS***	***t***
Perception	3.86	0.51	4.00	0.54	1.14
Salary	2.81	1.05	2.61	0.85	0.94
Difficulty	4.70	1.31	5.51	0.97	2.71**
Social status	3.43	0.83	3.06	2.06	2.34*
Expertise	5.18	1.28	5.10	1.13	.31
Social dissuasion	2.61	1.18	3.27	1.10	1.99*
Satisfaction with choice	4.70	1.31	4.56	1.31	.43
Motivation	5.10	0.61	4.76	0.77	2.21*
Time for family	3.90	1.07	3.84	1.16	.21
Working with children	5.42	1.01	4.96	1.13	1.74
Enhance social equity	5.32	1.09	4.84	1.15	2.07*
Intrinsic career value	5.34	1:50	5.23	1.21	.35
Job transferability	4.19	1.31	3.91	1.29	.92

Job security	4.59	0.91	4.28	1.14	1.16
Shape future of students/adolescents	5.86	0.81	5.34	1.13	2.50**
Prior teaching experiences	5.78	0.93	5.15	1.21	2.72**
Social influences	4.51	1.53	4.06	1.38	1.34
Make social contribution	5.84	0.88	5.40	0.91	2.12*
Fallback career	2.55	1.54	2.83	1.47	.80
Ability	5.37	0.97	5.40	0.97	.13

* p< .05, ** p< .01

A one-way ANOVA test was conducted to test the relationship between science teachers' professional experiences and career motivations and results were given in Table 6. No statistically significant difference was found in the perception and motivation ($F(5,130) = 0.41$, $p > .05$ for perception and $F(5,130) = 1.18$, $p > .05$ for motivation). However, a statistically significant difference was found in the sub-dimension of job security. The post-hoc tests showed that this difference was between teachers with 11-15 years of experience and 21 and above, in favor of teachers with 11-15 years of teaching experience.

Table 6. ANOVA results of the relationship between professional experience and motivation

Sub-dimension	0-5 y.	6-10 y.	11-15 y.	16-20 y.	21 y. +	*F*
Perception	3.92	4.03	3.97	4.04	3.89	0.41
Salary	2.91	2.57	2.77	2.76	2.36	1.36
Difficulty	4.85	5.24	5.35	5.56	5.61	1.41
Social status	3.08	3.09	3.15	3.08	2.95	0.16
Expertise	4.59	5.45	5.06	5.15	4.92	1.54
Social dissuasion	3.27	3.22	2.91	2.99	3.13	0.25
Satisfaction with choice	4.82	4.62	4.55	4.70	4.37	0.36
Motivation	4.99	4.77	5.02	4.78	4.63	1.18
Time for family	3.43	4.01	3.94	3.85	3.71	0.70
Working with children	5.73	5.01	5.05	5.11	4.67	1.91
Enhance social equity	5.21	4.95	5.11	4.89	4.56	1.11
Intrinsic career value	5.73	5.30	5.39	5.32	4.79	1.52
Job transferability	4.12	3.88	4.22	3.98	3.65	0.81
Job security	4.45	4.36	4.68	4.44	3.76	2.97*
Shape future of students/adolescents	5.39	5.20	5.68	5.24	5.61	1.22
Prior teaching experiences	5.79	5.15	5.45	4.92	5.28	1.48
Social influences	4.03	4.09	4.28	4.20	3.98	0.21
Make social contribution	5.61	5.30	5.76	5.38	5.38	1.26
Fallback career	2.58	2.86	2.57	2.91	2.87	0.32
Ability	5.38	5.21	5.63	5.30	5.49	0.94

* p< .05, ** p< .01

CONCLUSION, DISCUSSION AND RECOMMENDATIONS

In this study, it was aimed to examine the relationship between science teachers' career perceptions and motivations and demographic variables. For this purpose, independent sample t-test and ANOVA tests were used to determine the differences on the level of career perception and motivation of science teachers, based on demographic variables including gender, school location and professional experience.

Descriptive findings of science teachers' career perceptions showed that teachers' perception levels (M = 3.98) were at a moderate level. Of the six sub-dimensions (salary, difficulty, social status, career expertise, social dissuasion, and satisfaction with choice), the salary has the lowest mean score, indicating that science teachers perceived their wages as low Similarly, in the study conducted by Deniz, Doğan and Şahin (2018), it was found that pre-service teachers viewed teachers' salary inadequate. Watt, Richardson, Klusman, Kunter, Beyer, Trautwein and Baumert (2012) similarly found that teachers working in the United States had low salaries but were satisfied with their career choices. Among the perception sub-dimensions, the difficulty sub-dimension had the highest mean. This finding showed that science teachers thought that their profession required a high level of expertise and technical knowledge; therefore, it was a difficult task. It seems that new changes with technological requirements urge teachers to develop themselves professionally and this may lead to teachers to see their job difficult.

It was seen that the motivation levels of the teachers were moderate. At the same time, it was found that teachers' career motivation mean scores were at a higher level than their career perception means. Memişoğlu and Kalay (2017) examined teachers' motivation and found that they were at a moderate level in parallel with our research. The results showed that among sub-dimensions of teacher career motivation; make social contribution and shape the future of students had the highest mean value while the lowest mean value was for fallback career. Consistent with this study, Kilinc, Watt, and Richardson (2012) reported that the highest mean was make social contribution (M =6.16), and the lowest was fallback career (M =3.07). The results of Teaching and Learning International Survey (TALIS) of Turkey in 2018 stated that Turkish teachers had the highest mean value on contributing to society (98.3%) and to the development of young people and children (97.8%), which was above the OECD average (TEDMEM, 2019). Similarly, Deniz, Doğan and Şahin (2018) supported our findings that the highest value among motivation dimension was the shape the future of children. Results of this study suggest that in Turkey the teaching profession is seen as a profession that serves the society, contributes to the society and has a reliable income. The high mean values of shape the future of students and make social contribution might show that the teaching profession differ from other professions. On the other hand, the lowest mean value in fallback suggests that teachers are most likely to not change their profession and not consider other professions in near future job and they prioritize teaching in their career choices.

Results showed that the career motivation of science teachers did not differ statistically in terms of gender. In the study conducted by Nokay (2019), it was concluded that teacher motivation did not show a significant difference based on gender. Similarly, Karaköse and Kocabaş (2006) reported that teachers' motivation did not differ significantly according to gender, professional experience, school level and age. In terms of sub-dimensions, a statistically significant difference was found in salary and expertise. While this difference in salary was in favor of male teachers, it was in favor of female teachers in expertise. This may be because female teachers tent to include more hands-on activities in science teaching (Ambusaidi, & Al- Farei, 2017). Incorporating hands-on activities in science education requires both economics and expertise. This may lead female teachers see their salary not enough for their expenses. A significant difference was found in social influence and fallback career. In the social influence, the difference was in favor of female teachers, while in fallback career the difference was in favor of male teachers. The reason for the difference may be due to the fact that in society teaching profession seems to be identical for females rather than male. Moreover, female are more likely to choose profession focused on helping other people than do men (Watt, 2016).

Results showed that career motivations of science teachers statistically differed in their motivation and perception based on the school location. In motivation, the motivation of teachers who study in rural schools was higher than those who work in urban schools. In perception, teachers working in rural schools stated that they had more social status and felt less social dissuasion and difficulty compared to teachers working in urban schools. The reason for this difference may be less crowded classroom, the low educational level of the parents, and that parents and students valued teachers in rural areas. In the motivation, teachers working in rural schools stated that they were more motivated than the teachers in urban schools in terms of equality, shape the future of the students, make social contribution and previous experiences. The fact that the socioeconomic situation in the rural schools in Turkey is lower than in the urban schools may cause the science teachers to motivate them to contribute to the social status of the students. In addition, due to the high expectations from teachers in urban schools to be more successful (project school, etc.), teachers in urban schools may perceive the teaching profession more difficult and may feel their previous experiences are insufficient.

Motivation of science teachers according to their professional experience significantly differed only in job security. The difference in job security between teachers with 11-15 years and 21 years or more of experience may be due to economic reasons. Although the difference was not significant, the group with the lowest mean score in salary is the group of teachers with 21 years or more experience. In particular, teachers may have low motivation in the sub-dimension of job security due to reasons such as the cost of living, if they meet the needs of their adult children, and low pensions because teachers usually work in urban schools. In parallel with this study, according to TALIS (2018), there was no significant difference between teachers with five years or less experience and teachers with more than five years of experience. Consistent with the results of this study, Ateş and Buluç (2018) found that there was a significant difference in teacher motivation according to gender, there was no significant difference according to professional year.

Overall, results of this study suggest that motivation of science teachers may not be at satisfactory level considering the importance of motivation in terms of teacher quality. The fact that the salary dimension was the lowest among the career perception of science teachers suggests that teachers see salary low. Increasing teacher salaries can increase teacher motivation levels and indirectly increase the quality of education in the same direction. In order to increase this level of satisfaction, environments that support the teacher can be created. However, the excessive paperwork on teachers, the effort to catch up with the rapidly changing age, in-service courses taken in these directions, and the projects carried out by the Ministry of National Education can make the teaching profession difficult. For this reason, it can be noted that the distribution of work in schools is not focused on a single teacher. In the light of this study data, it can be deduced from the motivation sub-dimension averages of teachers that the teaching profession makes a social contribution to the society and affects the future of the students. Studies that will increase the professional satisfaction of teachers who perform such a lofty profession can be included in the 2023 Education Vision.

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