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A Research on Perceptions of Secondary School Gifted Students in BILSEM (SCIENCE AND ART CENTER) about STEM and Their Attitudes towards Digital Technologies according to Demographic Variables

BİLSEM'deki Üstün Yetenekli Ortaokul Öğrencilerinin Stem'e Yönelik Algı'larının Ve Dijital Teknolojiye Yönelik Tutumlarının Bazı Demografik Değişkenlere Göre İncelenmesi

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ABSTRACT

The aim of this study is to research on perceptions of secondary school students studying at Science and Art Centers in Kars, Ardahan, Igdır and Agrı which are in the region of SERKA (Serhat Development Agency) TRA-2 about STEM and attitudes of these students towards digital technologies according to demographic variables. The study is a descriptive survey model. The sample of the study includes 183 secondary school students who study at Science and Art Centers in Kars, Ardahan, Igdır and Agrı. As a data collection tool, "Attitude Scale towards Digital Technology" developed by Cabı (2016) and "STEM Perception Test" adapted to Turkish by Gulhan (2016) have been used. According to the results of the obtained data, it has been found out that student attitudes towards digital technologies are at average level. On the other hand, it has been figured out that the level of their attitudes towards STEM are above the average level. It has been identified that there is a significant difference among students' attitudes towards digital technologies according to gender, age, grade level and type of school variables when it is analyzed in regard to demographic variables. Moreover, it has been found out that attitudes of students towards STEM are also vary with gender, age, grade level and type of school.

Key words: Gifted Students, STEM, Digital Technologies

ÖZET

Araştırmanın amacı, SERKA (Serhat Kalkınma Ajansı) TRA-2 Bölgesi'nde yer alan Kars,Ardahan,Iğdır ve Ağrı illerinde Bilim ve Sanat Merkezi'nde öğrenim gören ortaokul öğrencilerinin STEM'e yönelik algılarının ve dijital teknolojiye yönelik tutumlarının bazı demografik değişkenlere göre incelenmesidir. Araştırma tarama modelinde betimsel bir çalışmadır. Araştırmanın örneklemini Kars,Ardahan,Iğdır ve Ağrı'daki Bilim ve Sanat Merkezi'ndeki ortaokul düzeyindeki 183 öğrenci oluşturmaktadır. Araştırmada veri toplama aracı olarak Cabı (2016) tarafından geliştirilen "Dijital Teknolojiye Yönelik Tutum Ölçeği" ile Gülhan (2016) tarafından Türkçe'ye uyarlanan "STEM Algı Testi" kullanılmıştır.Elde Edişen verilerin analizi sonucunda öğrencilerin dijital teknolojilere yönelik tutumlarının orta düzeyde olduğu, buna karşılık STEM'e ilişkin tutum düzeylerinin orta seviyenin üstünde olduğu tespit edilmiştir. Demografik değişkenlere göre incelendiği zaman öğrencilerin dijital teknolojiye yönelik tutumlarının cinsiyet, yaş grubu, öğrenim görülen sınıf düzeyi ve okul türü değişkenlerine göre anlamlı farklılık gösterdiği tespit edilmiştir. Bunun yanında öğrencilerin STEM'e yönelik tutumlarının da cinsiyet, yaş grubu, öğrenim görülen sınıf düzeyi ve okul türüne göre farklılaştığı bulunmuştur.

Anahtar Kelimeler :Üstün zekalı öğrenciler, STEAM, Dijital Teknolojiler

1. INTRODUCTION

The technological developments in our era effect our lives in many ways. There have been changes in the areas of economy, health, psychology, education, transportation and telecommunication by means of the technological developments. Scientific developments which are in a continuous progression and evolution prepares a ground for more significant spurts and developments through technology. Especially, technological developments occurred in 21th century, brought rapid changes along to our lives. Efforts of humankind in so many areas like science, technology and art in the way of being an information society have closely effected the nature of humankind. From the beginning of existence, humanity questioning its own nature in struggle for understanding the world and the universe has entered the process of restructuring the term "learning". Basic philosophy of learning and teaching is to change in the light of scientific developments through technology. The importance of information and knowledge have increased significantly, especially in our digital era which individualism is at the forefront. Besides, using new technologies in education have an important function in the actively participation of individuals in the learning and teaching process. At the same time, it has an important role in creating rich learning and teaching environment. There have been emerged new approaches in education along with changing students in terms of quantity, quality, interest and expectations, cooperative approaches of people who are in departments related to employee structure and development of new areas of expertise. Technological developments enriches atmosphere, methods and techniques by providing new opportunities to the implementations of education (Alkan, 2011:32). Accordingly, the reasons why technology have being used in education can be itemized like this sıralanabilir (Özyurt and Badur, 2020).

- ✓ Providing access to educational process
- ✓ Increasing he quality of learning and teaching process
- ✓ Decreasing costs of education
- ✓ Orientating to technological developments

Especially in the period of Covid-19, online courses in digital platforms gained great importance in all around the world because of the compulsory break in on face to face education in schools. It is assumed that digitalization in educational processes will increase by benefiting from advantages of technology. For this reason, using digital technologies in educations has gained great importance and ensuring diversity appears as an important fact. Currently, primarily used digital applications in education are: (Ertmur, 1999; McAuley, Stewart & Cornier, 2010; Kesim and Altınpulluk,2014; Parlak, 2017;Vieira, Parsons and Byrd, 2018; Ally, 2019; Thierer, 2015; Kelly, 2008; Johnson and Samora, 2016; Engin, 2021): Massive Open Online Courses, Mobile Learning, Makerspaces, Flipped Classroom, Wearable Technology, Adaptive Learning Technologies, Games and Gamification, Analytical Technologies, The Internet of Things, Natural User Interfaces, Bring Your Own Device, 3D Printing, Tablet computers, Artificial Intelligence, Mixed Reality, Robotics, Virtual Assistants. While using these digital technologies, the importance of technological skills and technology based teaching strategies are getting higher. Especially, an increasing belief that each and every child came into the world with a certain potential causes interferences in learning and teaching processes. In this context, it becomes prominent to implement diagnostic processes for highly gifted and talented individuals to make provide an environment and opportunities for their self-development (Kaya, 2020).

Having high performance in one or more than one areas is prioritized through various assessments and perspectives in literature concerning gifted and talented individuals. In Marland Report (1972), general cognitive skills, particular academic aptitude, creative thinking skills, leadership, capability in visual arts and psychomotor skills were identified as prominent areas (Sayler, 2009). In another assessment Tannenbaum (2003), gifted individuals were defined as individuals showing high performance and reproductivity in any performance areas. On the other hands, Renzulli (1986) states that gifted individuals have three prominent characteristics: general and specific level of talent, creativity and responsibility. In general terms, highly gifted individuals can be described as individuals who differs remarkably from their peers in terms of intelligence, creativity, art, leadership ability and some other special areas (Özcan, 2015:24). Looking at these definitions, when different needs and characteristics of gifted students' are considered, it is obvious that technology use will meet these needs. Especially, in the education of special skilled students, these come into prominence: opportunity to discover sophistication of daily troubles, profundity at enrichment and acceleration, flexibility at learning opportunities, grouping according to capability and areas of interest, creating unique materials, profound and meaningful learning environments in an appropriate speed for individuals and groups come into prominence while different thinking skills are emphasized (Renzulli and Reis, 1997; Van Tassel Baska, 1998). Technological software, internet using, various informatics tools supports these issues and provides differentiating educational opportunities. At this point, it can be said that some of gifted students have prominent computer communication technology skills. For developing this potential, it is firstly needed to identify this skill and then students should be labeled as highly talented in technology (Siegle, 2004:31). O'Brien (2007). O'Brien (2007) emphasized that high technological knowledge of talented people in computer world could be integrated with high cognition competence. In this sense, it is important that gifted students should be acknowledged and supported by computer technology experts for developing abilities of gifted students in the realm. By this way, gifted students may satisfy their curiosity by gaining these abilities (Ahmad, Badusah, Mnasor and Karim, 2014). In figure 1, technological options regarding learning styles and needs of special skilled students are presented (VanTassel-Baska & Stambaugh, 2006).

Figure 1. Technological opportunities about learning needs and properties of highly gifted and talented students

Properties	Needs	Technological Opportunities	General Opportunities
Rapid Progress (Enhanced Content)	• Flexibility in student centered programming • Accelerating content • Group Activities • Speed	• Computer Programming Language	• Computer aided teaching • Distance Learning • Searching on the Internet • Discussion Forums • Software Programmes • Hardware
Rapid Progress (Process and	• Groups with Similar Friends • Discipline - Private Schemes	• Simulation and webQuest • Ask an Expert	• Searching on the Internet • Discussion Forums

Product Opportunity)	• Independent Study • Interdisciplinary Perspective	• Software Programme • Robots	
Complexity (Conceptional Relations)	• Deep effort for Areas of Interest • Creating New Products • Group with Similar Friends • SolvingReal World Problems • High Level of Thinking Skill	• Web Site according to area of ineterest • Service Learning Opportunities • Word, data, presentation, publication and product based	• Searching on the Internet • Virtual Field Trips • Discussion Forms

Creative thinking, critical thinking, problem solving, effective communication and cooperation with others are 21th century high level skills which are the prominent characteristics of gifted students, besides STEM education is one of the outstanding approaches in the process of bringing these skills to the individuals and developing them. This approach firstly emerged at America and STEM is an abbreviation including the first letters of the words science, technology, engineering and mathematics (White, 2014: 4; Akgündüz and others, 2015; Yazıcı, 2019: 6). In many of the countries all around the world, students are informed about STEM in all school levels with the purpose of increasing their interests in STEM, because STEM is an education theory combining science, technology, engineering and mathematics from the pre-school to the higher education and it aims to make individuals identify their problems and develop appropriate and easy solutions to these problems by means of interdisciplinary approaches (Altunel, 2018: 1). STEM education aims to raise questioning, searcher, procreator and inventor generations by removing the differences of science, technology, engineering and mathematics and by integrating them appropriately with the help of project-oriented learning theory which is presented from the pre-school to higher education. By means of STEM education theory, problem solving, critical and creative thinking abilities of students in the process of production and invention are being developed. On the other hand, they are aimed to accommodate themselves to the business life thanks to their project-oriented skills when they get a start in business (MEB, 2017: 6). Students who will receive education in the area of STEM have great importance in the future, development and economic advancement of a country (Çolakoglu and Gunay-Gokben, 2017: 46). Gifted and talented students are provided to feature the abilities that make them establish appropriate connections among determined areas (Tucker an vd.,1997). In this context, STEM education an effective approach in making students reach interdisciplinary themes (Johnson, 2013). In this sense, considering the importance of STEAM in the process of making students have 21st century skills, the importance of various projects and putting outputs of performances have been understood with enhancing higher order thinking skills of gifted students and creating opportunities to reveal their creativity.

Improving the attitudes and perceptions of students towards STEM from early ages is an important issue for raising qualified employees in the fields of occupation in science. At this point, it can be said that significant importance should be given to STEM education in improving the perceptions and attitudes of students towards STEM. Besides, “digital technology” comes to the front as an area that students needed to have positive attitudes to it and should improve themselves in the area. As it is known, technology is an issue both solving people’s problems and satisfying their needs. Technology makes people’s lives easier and helps them save their times (Arslan, 2019: 15). The important issue is to have the ability to use digital technologies effectively and according to the necessities of time (Gunbatar, 2014: 122). To provide this, firstly having positive attitudes towards digital technologies from early ages and gaining the skill of using digital technologies as suitable for their purposes are quite important.

In our country, especially secondary school mathematics, science and technology, information technologies and software courses curriculum related to STEM education is aimed to be structured with 21st century skills (Bybee, 2010). Plant (1994) emphasized the importance of integrating STEM subjects with technology can be listed as:

- ✓ Creativity being at the forefront
- ✓ Explaining the facts based upon cause and effect relation along with scientific reasons
- ✓ Having technological literacy
- ✓ Benefiting from various sources in the use of technological tools.

With this education, it is also aimed to develop the attitudes of students towards STEM. As it is known, no matter how the level and the direction of people’s current attitudes are, current attitudes effects the behaviors of individuals (İnceoğlu, 2010: 25). Feelings and behaviors towards disciplines of science, technology, mathematics and engineering are defined as an attitude towards STEM. In the studies in literature (Kang and Nam, 2017; Zhou and others, 2019: 466; Vennix and others, 2018: 1263; Vu, Harshbarger,Crow and Henderson, 2019; Barıs and Ecevit, 2019; Bircan and Koksal, 2020; Donmez and Yalmancı-Yucel,2020; Mahoney, 2010: 24; Nacaroglu ve Kızkapan, 2021) it is seen that student attitude are analyzed too often.

Moreover, it is identified that there many studies about gifted students like social media using (Kılıç and Ateşgöz ,2018); digital-based applications (Uçar vd., 2017; Manuel ve Freiman, 2017; Cubukcu and Tosuntas, 2018); digital based games (Hinterplattner vd., 2019) social behaviors in school (Kaplan-Sayı and Sahin, 2021); effect of technology to the motivation (Housand and Housand, 2012); integration of 3D models and virtual platforms (Kim, 2014) .

Assessment and evaluation of students' attitudes in STEM education, making increase their adaptation to the program by registering the positive attitudes, guiding them in terms of supporting their attitudes and increasing the teaching methods provides positive contributions to the process (Hallac, 2019: 37). Using STEM in the education process of highly gifted students will contribute to new technologies created by countries, using knowledge gained through science and engineering applications in solving daily life problems and increasing the success in international exams like PISA and TIMS (Banks ve Barlex, 2014).

When data in literature is analyzed, it is required for students to have positive attitudes towards STEM so that they can canalize themselves to STEM related jobs. It is thought that as well as attitudes of students towards STEM are closely related with their education, some demographic properties are also determinant on the interests, perspectives and attitudes towards STEM. Similarly, it is possible that attitudes of students towards digital technologies from early ages may be effected by their socio-demographic conditions. At this point, for increasing the attitudes of students towards digital technologies with STEM, factors effecting these variables should be well analyzed. In the studies related with this subject (Clark and Ernst, 2008; Dieker, Grillo and Ramlakhan, 2012), it is seen that generally attitudes of students from different class levels towards STEM and digital technologies have been analyzed and studies on BİLSEM students about this issue are quite limited. In this study within this scope, it is aimed to analyze the perceptions towards STEM and attitudes towards digital technology of BİLSEM gifted secondary school students according to demographic variables. Sub problems listed below was prepared to find out the problem question of this study:

- ✓ At what level are the attitudes of gifted BILSEM students towards technology?
- ✓ Do the attitudes of gifted BILSEM students towards technology differ significantly according to gender variable?
- ✓ Do the attitudes of gifted BILSEM students towards technology differ significantly according to age group variable?
- ✓ Do the attitudes of gifted BILSEM students towards technology differ significantly according to class level variable?
- ✓ Do the attitudes of gifted BILSEM students towards technology differ significantly according to school type variable?
- ✓ Do the perceptions of gifted BILSEM students towards STEM fields differ significantly according to gender variable?
- ✓ Do the perceptions of gifted BILSEM students towards STEM fields differ significantly according to age group variable?
- ✓ Do the perceptions of gifted BILSEM students towards STEM fields differ significantly according to class level variable?
- ✓ Do the perceptions of gifted BILSEM students towards STEM fields differ significantly according to school type variable?
- ✓ Do the attitudes of gifted BILSEM students towards technology differ significantly from their perception towards STEM?

2.METHOD

2.1. Research Model

Scanning model used commonly in descriptive studies will be used in this study. Thoughts and opinions of participants are analyzed according to some variables in the studies carried out according to scanning model (Büyüköztürk, Kılıc-Cakmak, Akgun, Karadeniz and Demirel, 2015). Demographic variables in this study are listed as age, gender, class level and type of school.

2.2. Sampling Universe of the Study

The universe of the study is composed of 239 gifted students studying at BİLSEM in which SERKA (Serhat Development Agency) opened "Technology and informatics classroom" in Kars, Ardahan and Igdır; moreover, 183 students chosen by randomly from BİLSEMs in these cities constitute the sample of this study.

2.3. Data Collection Tools

In the first part of the study is a “Personal Information Form” prepared by the researcher for identifying the findings about age group, class level, gender of participant students and school type they study.

For determining the attitudes of the participant students towards digital technologies, “Attitude Scale towards Digital Technology” developed by Cabı (2016) will be used. This attitude scale consists of 8 factors and 39 items. When looking at the Cronbach Alfa parameter of 8 factors in the Attitude Scale towards Digital Technology which are Competence (3,7, 21, 29, 30, 31, 32, 33, 37, 38); Social Networks (16, 17, 18, 19); Technology Use in the Classroom (6, 15, 26, 28); Interest in Technology (8, 9, 11, 12, 14); Technology for me (1, 2, 4, 5); Negative Aspects (13, 20, 22, 24, 27); Using for Fun (10, 23, 25, 39); Using Consciously (34, 35, 36), it is reported between 0,61 and 0,86.

STEM Semantic Survey adapted by Knezek and Christensen (1998) has been used for determining the perception of students towards STEM (Knezek, Christensen, Tyler-Wood and Periathiruvardi, 2013). This survey was adapted to Turkish by Gulhan (2016), additively validity and reliability of it was tested. There are five adjectives for the science, technology, engineering, mathematics, career lower dimensions and 5 antonym adjectives in “STEM Perception Test”. There are 7 options between these two edges. Points of positive adjectives were determined as -7; points of negative adjectives were determined as 1 in the evaluation of the test. In this way, total score were calculated for every lower dimensions.

2.4. Analyzing the Data

In this study, SPSS 25.0 program was used to analyze the data. Frequency-analysis was used to determine the percentage distribution of demographic data of participant students. One Sample Kolmogorov – Smirnov Test was used to determine the suitability of scale points for normal distribution and it was seen that scale points were not suitable for normal distribution. On the one hand Whitney U Analysis was used to compare scale points according to gender and school type, on the other hand Kruskal Wallis H Analysis was used to compare scale points according to age groups and class levels of students. While analyzing the correlation among scale points, Spearman Correlation Analysis was used.

3. FINDINGS

Table 1. Frequency and percentage distributions of demographic data of participant students

Variable	Sub Variables	f	%
Gender	Girl	96	52,5
	Boy	87	47,5
Age Group	10 years old	47	25,7
	11 years old	41	22,4
	12 years old	59	32,2
	13 years old	36	19,7
Class Level	5th grade	40	21,9
	6th grade	43	23,5
	7th grade	61	33,3
	8th grade	39	21,3
Type of School	Public	108	59,0
	Private	75	41,0

%52,5 of participant students are girl and %47,5 are boy. %25,7 of students are 10 years old, %22,4 of them are 11 years old, %32,2 of them are 12 years old, %19,7 of them are 13 years old, % 21,9 of them are 5th grades, %23,5 of them are 6th grades, %33,3 of them are 7th grades, %21,3 of them 8th grades, %59 of them are students in a public school and %41 of them are students in a private school.

Table 2. Descriptive Statistics Related with Scale Points of Participant Students

Lower Dimension	$\bar{X}$	SS
Competence	3,37	0,56
Social Networks	2,88	1,03
Technology Use in the Classroom	3,33	0,63
Interest	3,28	0,62
Technology for Me	3,40	0,96
Negative Aspects	3,28	0,58
Using for Fun	3,37	0,66
Using Consciously	3,39	0,79
STEM Science	5,24	1,40
STEM Mathematics	4,84	1,75
STEM Engineering	4,70	1,41

STEM Technology	5,05	1,33
STEM Career	4,56	1,31

In the attitude towards digital technology scales, score interval is 1-5; however, it is 1-7 in the STEM perception scale. Analyzing the table, it is observed that attitudes of participant students towards digital technology are at average level in all lower dimension, but STEM perception levels of them are above the average level in all of the lower dimensions.

Table 3. Results of Whitney U Analysis Related with Comparison of Gender Related Scale Points of Participant Students

Lower Dimension	**Gender**	**N**	**X̄**	**SS**	**U**	**p**
Competence	Girl	96	3,40	0,56	3921,0	,468
	Boy	87	3,33	0,55		
Social Networks	Girl	96	3,36	0,94	1814,5	**,000***
	Boy	87	2,37	0,87		
Using Tecnology in the Classroom	Girl	96	3,33	0,66	4105,0	,833
	Boy	87	3,33	0,61		
Interest	Girl	96	3,26	0,62	4123,5	,874
	Boy	87	3,30	0,62		
Technology for Me	Girl	96	3,33	1,06	4038,0	,690
	Boy	87	3,47	0,85		
Negative Aspects	Girl	96	3,25	0,57	3891,0	,417
	Boy	87	3,31	0,60		
Using for Fun	Girl	96	3,30	0,66	3551,5	,077
	Boy	87	3,44	0,65		
Using Consciously	Girl	96	3,25	0,86	3380,0	**,024***
	Boy	87	3,55	0,67		
STEM Science	Girl	96	5,28	1,37	4158,5	,952
	Boy	87	5,19	1,44		
STEM Mathematics	Girl	96	5,13	1,57	3418,0	**,033***
	Boy	87	4,53	1,89		
STEM Engineering	Girl	96	4,68	1,42	4133,5	,897
	Boy	87	4,72	1,39		
STEM Technology	Girl	96	5,08	1,26	4075,5	,770
	Boy	87	5,01	1,40		
STEM Career	Girl	96	4,62	1,31	4007,0	,628
	Boy	87	4,51	1,32		

*p<0,05

Analyzing the table, it is seen that digital technology attitude levels of girl students are significantly higher than boy students (p<0,05); the level of conscious using of digital technology of boy students is remarkably higher than girl students (p<0,05); in the digital technology attitude scale, there is not statistically any significant difference (p>0,05) between the levels of attitude of boy and girl students; perceptions of girl students towards STEM science are significantly higher than boy students (p<0,05); in other lower dimensions related with STEM there is not statistically any significant difference among the levels of perception according to gender (p>0,05).

Table 4. Results of Kruskal Wallis H Analysis related with comparison of scale points of participant students according to their age groups

Lower Dimension	**Age Group**	**N**	**X̄**	**SS**	**x^2**	**p**
Competence	10 years old	47	3,02	0,45	71,2	**,000***
	11 years old	41	2,96	0,46		
	12 years old	59	3,57	0,54		
	13 years old	36	3,70	0,34		
Social Networks	10 years old	47	2,46	0,99	10,4	**,016***
	11 years old	41	2,86	1,02		
	12 years old	59	2,88	0,95		
	13 years old	36	3,20	1,09		
Technology Using in the Classroom	10 years old	47	3,23	0,71	5,5	,139
	11 years old	41	3,15	0,76		
	12 years old	59	3,36	0,59		
	13 years old	36	3,51	0,46		
Interest	10 years old	47	3,10	0,58	7,2	,066
	11 years old	41	3,28	0,69		
	12 years old	59	3,27	0,62		
	13 years old	36	3,43	0,57		
Technology for Me	10 years old	47	3,03	1,14	7,4	,060
	11 years old	41	3,17	1,14		

	12 years old	59	3,53	0,84		
	13 years old	36	3,69	0,67		
Negative Spects	10 years old	47	3,24	0,70	0,1	,992
	11 years old	41	3,29	0,55		
	12 years old	59	3,30	0,61		
	13 years old	36	3,27	0,50		
Using for Fun	10 years old	47	3,27	0,62	1,6	,661
	11 years old	41	3,40	0,51		
	12 years old	59	3,36	0,72		
	13 years old	36	3,43	0,72		
Conscious Using	10 years old	47	3,59	0,68	3,2	,355
	11 years old	41	3,40	0,79		
	12 years old	59	3,41	0,80		
	13 years old	36	3,23	0,83		
STEM Science	10 years old	47	4,85	1,52	8,8	**,032***
	11 years old	41	5,08	1,55		
	12 years old	59	5,34	1,42		
	13 years old	36	5,76	0,75		
STEM Mathematics	10 years old	47	4,93	1,79	2,2	,528
	11 years old	41	4,67	1,78		
	12 years old	59	4,98	1,72		
	13 years old	36	4,70	1,78		
STEM Engineering	10 years old	47	5,06	1,39	7,3	,063
	11 years old	41	4,79	1,38		
	12 years old	59	4,38	1,41		
	13 years old	36	4,67	1,38		
STEM Technology	10 years old	47	5,06	1,33	0,3	,966
	11 years old	41	5,02	1,32		
	12 years old	59	4,97	1,41		
	13 years old	36	5,18	1,24		
STEM Career	10 years old	47	4,63	1,11	0,1	,996
	11 years old	41	4,49	1,58		
	12 years old	59	4,59	1,28		
	13 years old	36	4,53	1,34		

*p<0,05

When the table is analyzed, it is seen that digital technology competence and social networks attitudes of participant students differs remarkably from each other (p<0,05); competence attitudes of 12-13 years old students are significantly higher than 11 years old students as a result of paired comparison made through Mann Whitney U Test used for determine which groups have differences (p<0,05); the level social networks attitudes 13 years old students are remarkably higher than 11 years old students (p<0,05); among the attitude levels of students from different age groups, there is not statistically any significant difference in the digital technology attitude scale (p>0,05); perceptions of students towards STEM science differs significantly according to age groups (p<0,05); attitudes of 12-13 years old students towards STEM science is remarkably higher than 11 years old students as a result of paired comparison made through Mann Whitney U Test used for determine which groups have differences (p<0,05); in other lower dimension related with STEM there is not any significant difference in the levels of perception according o age groups (p>0,05).

Table 5. Results of Kruskal Wallis H Analysis Related with comparison of scale points of participant students according to their class levels

Lower Dimension	**Class Level**	**N**	**$\bar{X}$**	**SS**	**x^2**	**p**
Competence	5th grade	40	2,94	0,44	106,6	**,000***
	6th grade	43	2,87	0,40		
	7th grade	61	3,64	0,44		
	8th grade	39	3,79	0,26		
Social Networks	5th grade	40	2,65	0,95	4,3	,233
	6th grade	43	2,93	1,05		
	7th grade	61	2,84	0,97		
	8th grade	39	3,10	1,14		
Technology Using in the Classroom	5th grade	40	3,23	0,67	7,0	,074
	6th grade	43	3,13	0,74		
	7th grade	61	3,39	0,59		
	8th grade	39	3,51	0,50		
Interest	5th grade	40	3,11	0,58	12,9	**,005***
	6th grade	43	3,16	0,71		
	7th grade	61	3,29	0,60		
	8th grade	39	3,52	0,53		
Technology for Me	5th grade	40	3,05	1,16	13,1	**,004***

	6th grade	43	3,02	1,08		
	7th grade	61	3,63	0,77		
	8th grade	39	3,71	0,70		
Negative Spects	5th grade	40	3,17	0,67	2,8	,422
	6th grade	43	3,25	0,57		
	7th grade	61	3,30	0,62		
	8th grade	39	3,36	0,46		
Using for Fun	5th grade	40	3,25	0,72	2,7	,448
	6th grade	43	3,35	0,52		
	7th grade	61	3,38	0,73		
	8th grade	39	3,48	0,61		
Conscious Using	5th grade	40	3,50	0,73	3,4	,340
	6th grade	43	3,28	0,79		
	7th grade	61	3,48	0,78		
	8th grade	39	3,28	0,84		
STEM Science	5th grade	40	4,90	1,49	9,9	**,019***
	6th grade	43	4,80	1,70		
	7th grade	61	5,50	1,20		
	8th grade	39	5,65	1,04		
STEM Mathematics	5th grade	40	5,02	1,72	5,1	,167
	6th grade	43	4,42	1,92		
	7th grade	61	5,09	1,56		
	8th grade	39	4,74	1,84		
STEM Engineering	5th grade	40	5,07	1,30	4,2	,240
	6th grade	43	4,68	1,53		
	7th grade	61	4,53	1,37		
	8th grade	39	4,62	1,40		
STEM Technology	5th grade	40	4,96	1,35	1,6	,663
	6th grade	43	5,15	1,36		
	7th grade	61	4,91	1,40		
	8th grade	39	5,24	1,17		
STEM Career	5th grade	40	4,58	1,13	1,2	,756
	6th grade	43	4,39	1,51		
	7th grade	61	4,70	1,22		
	8th grade	39	4,53	1,41		

*p<0,05

When the table is analyzed, digital technology competence, interest and technology for me attitudes statistically differ from each other remarkably according to class levels (p<0,05);competence, interest and technology attitudes of 7th and 8th grade students are significantly higher than 5th and 6th grade students as a result of paired comparison made through Mann Whitney U Test used for determine which groups have differences (p<0,05); there is not statistically any significant difference among the levels of attitude of students according to their class levels in other dimensions in digital technology attitude scale (p>0,05); perceptions of students towards STEM science statistically differs remarkably according to their class level (p<0,05); attitude levels of 7th and 8th grade students towards STEM science are remarkably higher than 5th and 6th grade students as a result of paired comparison made through Mann Whitney U Test used for determine which groups have differences (p<0,05); statistically there is not any significant difference among levels of perception in other lower dimensions in regards to STEM according to class levels (p>0,05).

Table 6. Results of Mann Whitney U Analysis Related with comparison of scale points of participant students according to types of school

Lower Dimension	Type of School	N	X̄	SS	U	p
Competence	Public	108	3,36	0,51	3934,0	,600
	Private	75	3,38	0,62		
Social Networks	Public	108	2,85	0,98	3882,5	,503
	Private	75	2,93	1,09		
Technology Using in the Classrom	Public	108	3,29	0,66	3670,0	,202
	Private	75	3,38	0,60		
Interest	Public	108	3,36	0,62	3296,5	**,020***
	Private	75	3,18	0,61		
Technology for Me	Public	108	3,36	0,97	4009,0	,754
	Private	75	3,44	0,96		
Negative Aspects	Public	108	3,31	0,60	3759,5	,308
	Private	75	3,23	0,57		
Using for Fun	Public	108	3,36	0,68	4048,0	,838
	Private	75	3,38	0,64		
Conscious Using	Public	108	3,33	0,80	3767,0	,316
	Private	75	3,48	0,77		

STEM Science	Public Private	108 75	4,97 5,58	1,55 1,10	3099,5	**,004***
STEM Mathematics	Public Private	108 75	4,42 5,39	1,79 1,56	2515,0	**,000***
STEM Engineering	Public Private	108 75	4,64 4,78	1,43 1,38	3881,5	,502
STEM Technology	Public Private	108 75	4,90 5,23	1,35 1,29	3493,5	,077
STEM Career	Public Private	108 75	4,41 4,76	1,37 1,22	3521,5	,092

When the table is analyzed, levels of interest and attitude of public school students in this study are significantly higher than private school students (p<0,05); there is not any significant difference between the levels of attitude in other dimensions in digital technology attitude scale (p>0,05); perceptions of private school students towards STEM science and mathematics are remarkably higher than public school students (p<0,05); there is not any significant difference statistically among levels of perception towards STEM according to types of school (p>0,05).

Table 7. The Results of Spearman Correlation Analysis with Regard to Relation of Scale Points of Participant Students

		STEM Science	STEM Mathematics	STEM Engineering	STEM Technology	STEM Career
Competence	r p	,037 ,617	,084 ,256	,155 **,037***	-,023 ,761	,071 ,339
Social Networks	r p	,011 ,886	-,051 ,494	-,051 ,492	-,030 ,686	-,026 ,724
Using Technology in ther Classroom	r p	,122 ,099	,092 ,217	,165 **,026***	,052 ,488	,057 ,440
Interest	r p	-,036 ,630	,031 ,675	-,005 ,942	-,081 ,278	-,111 ,136
Technology for Me	r p	,064 ,390	,154 **,038***	,095 ,200	,059 ,429	,113 ,126
Negative Aspects	r p	-,031 ,680	,055 ,457	-,044 ,554	-,091 ,220	,004 ,953
Using for Fun	r p	-,132 ,075	-,036 ,628	,034 ,645	-,065 ,383	,162 **,029***
Conscious Using	r p	-,034 ,647	-,074 ,319	,020 ,789	-,084 ,258	,013 ,863

*p<0,05

When the table is analyzed, there is a positive and low level of meaningful relation between levels of STEM Mathematics perception and level of digital technology for me among particioant students (r = 154; p<0,05); there is a positive and low level of meaningful relation between engineering perception levels of students and level of digital technology attitude (r=155; p<0,05); similarly, there is a positive and low level of meaningful relation between STEM career perceptions and attitudes of technology using for fun (r=162; p<0,05); there isn't any significant relation among other lower dimension (p>0,05).

4. RESULTS, DISCUSSIONS AND SUGGESTIONS

It is determined that attitudes of participant students in this study towards digital technology are at average level. Within this framework, it can be said that students are interested in technology. In a similar study related with this topic, generation z students have positive attitudes towards technology; besides, it is determined that they have adequate level of consciousness about the problems rising from using technology out of purpose and excessively (Erten, 2019: 190). Bayram and Kaya (2020) also are indicated in their study with gifted students that self-sufficiency in technology of gifted students are at a "good" level.

While perceptions of students towards digital technology do not differ significantly in the lower dimensions of competence, using technology in the classroom, technology for me, negative aspects and using for fun according to gender variable of participant students, it is indicated that the level of attitude of students towards digital technology, social networks and conscious using lower dimensions differ according to gender. It was found out according to the data that scores of girl students in social networks are higher than the scores of boy students; however, scores of boy students in conscious using are higher than girl students. It may be thought about these result that aims of girl and boy students while using technology are different from each other. Lynn and others (2010) indicated that gifted girl students use digital technology with the aim of learning and communication although gifted boy students use it with the aim of fun and game. In another study conducted on secondary school students, it is reported that attitudes of students towards digital technology differ according to gender (Gurbuzoglu-Yalmancı and Aydın, 2014: 125). In a similar study conducted on generation z, there wasn't found any significant difference between groups statistically; however, it was found that attitudes of boy students towards digital technologies were higher than girl students (Erten, 2019: 196).

Looking at age groups, it was found that attitudes towards digital technology, competence and social networks lower dimensions points of students were remarkably different, nevertheless there wasn't found any remarkable difference in other lower dimensions related with attitudes towards digital technology according to age group variable. In the lower dimensions of competence and social networks on the other hand was found significant difference in favor of juniors. Underlying reason of this situation may be thought that the more students get older, the more become higher of their frequency of social media using and they become more conscious while using social media. In a similar study conducted on secondary school students, it is reported that attitudes of 11, 12, 13 years old students towards social media are higher when compared with 14 years old students and in this frame work it is reported that as students get older, their attitudes towards social media get higher (Tuglu, 2017: 60).

When the data was analyzed according to class level of students, it was found that there was significant difference in the attitudes of students towards digital technology among the lower dimensions of competence, interest and technology for me; however, findings of other lower dimensions about digital technology did not differ according to class level. Moreover, there was found remarkable difference in favor of older students in the lower dimensions of competence, interest and technology for me. The underlying reason of this problem may be thought that older students have lived with technology for a long time. Findings of studies in literature also supports this idea. In a similar study, it was aimed to analyze the attitudes of secondary school students towards technology and it was reported that attitudes of 8^{th} grade students were higher compared with attitudes of 6^{th} and 7^{th} grade students (Gurbuzoglu-Yalmancı and Aydın, 2014: 125). In addition, it was determined that the level of attitude towards social media lower dimension of digital technology was in favor of 8^{th} grade students when compared with lower class students (Tuglu, 2017: 61). It is seen that findings of this study in literature support the idea that attitudes towards digital technology are in favor of older age groups.

When looking at the type of school variable, there wasn't found any significant difference among the scores in lower dimensions of social networks, technology use in the classroom, technology for me, negative aspects, using for fun and conscious using of technology. On the other hand, it is indicated that there is a significant difference among the groups in the lower dimension of interest. According to the results obtained, level of scores of public school students related with interest lower dimension are higher than level of scores of private school students.

Perception levels of participant students towards STEM are at average level in all lower dimensions, on this basis it can be said that students are interested in science fields of STEM. It is reported in similar study findings that attitudes of students from different class levels towards science and level of attitudes of them related with STEM lower dimensions are at average level (Badur, 2018:205; Sevim and others, 2021:7). In another study, it is indicated that gifted students have lower attitudes in the lower dimensions of mathematics and science (Donmez and Yalmancı-Yucel, 2020).

When analyzing the STEM attitudes of participant students according to gender variable, findings related with mathematics lower dimension are higher in favor of girl students. However, levels of attitude towards lower dimensions of engineering, technology and career do not differ according to gender. Study findings conducted on students from different class levels support the idea that lower dimensions related with STEM differ according to gender (Kırıktaş, 2019: 86; Knezek,Christensen and Tyler-Wood, 2011; Vu, Harshbarger, Crow and Henderson, 2019). In a similar study about this issue, it was aimed to analyze the career attitudes of 8^{th} grade students towards STEM jobs according to demographic factors and it was found that demographic properties of students effected the career attitudes towards STEM jobs. In the study mentioned, career attitudes of boy students towards STEM jobs are higher according to gender and it was reported that tendencies of boy students to work in the occupations in the fields of mathematics, engineering and technology in the future were higher (Aktas, 2019-58). In another STEM study conducted on 3th and 4^{th} grade students in primary school, it was aimed to analyze the demographic variables effecting the attitudes of students towards STEM education and perspectives of them towards STEM related jobs; 758 primary school students participated in the study. The study shows that attitudes of students towards STEM applications differ remarkably according to gender. Additively, it was indicated that attitudes of boy students towards STEM applications more positive than the girl students according to the results of the study. In the same study, it was found that STEM career interests of students differ according to gender, also it was indicated that career interests of boy students were higher than the girl students (Azgın, 2019: 5). In another study conducted on secondary school students, it was found that attitudes of students towards lower dimensions of STEM technology and engineering differ significantly according to gender and in the same study, it was reported that attitudes of boy students towards technology and engineering are higher compared with girl students (Badur, 2018: 217). Underlying reason of this difference among the attitudes of students towards STEM according to gender can be thought because of different perspectives of girl and boy students towards science and because of the fact that success in science courses differs according to gender.

When the attitudes towards STEM according to age group are analyzed, there is a significant difference in the lower dimension of science in favor of older students. Underlying reason of this result can be thought that as the class level get higher, knowledge and experience of students in science get higher. However, it has been found that attitudes of students towards the lower dimension of engineering, technology and career do not differ according to age groups. While studies discussing the attitudes of students towards STEM according to age group variable are restricted in literature, it is reported in the studies discussing the attitudes of students towards science that age group is a determinant on the attitudes towards science (Okur-Akçay, 2020: 15).

When the attitudes of students towards STEM according to class level are analyzed, it has been found that there is a significant difference in the lower dimension of science which is in favor of 7^{th} and 8^{th} grade students. Underlying reason of this result can be thought that number of units taught to 7^{th} and 8^{th} grades are high in number if it compared with the number of units taught to 5^{th} and 6^{th} grades; in parallel with this situation, it can be thought that knowledge of 7^{th} and 8^{th} grade students in science is higher than 5^{th} and 6^{th} grade students. On the other hand it has been figured out that attitudes of students towards the lower dimensions of engineering, technology and career do not differ according to class level. In parallel with increasing class levels of students, it is possible that increasing number of subjects taught in the science courses effect the attitudes of students towards STEM positively. In similar studies in literature, it is reported that attitude of students towards STEM differ according to class level (Badur, 2018: 220). In some studies related with this subject, it has been found that levels of attitudes of students towards the lower dimensions of STEM are in favor of the students in higher classes (Kırıktaş, 2019: 88).

When it analyzed according to type of school, findings related with the lower dimensions of STEM science and engineering differ significantly which are in favor of private school students. We can think the underlying reason of this result is that documents related with science courses are more in number and are various in private schools. Besides, when it is compared with public schools, private schools use various teaching methods which are different from traditional ones and this situation may be the underlying reason of this result. Similar studies in literature show that equipment which schools have and different teaching methods from which schools benefit improve the attitudes of students towards STEM. In a study carried out by Uçar (2019:7), it was aimed to determine in which way STEM education program, enriched by argumentation method, effects the attitudes of secondary school students towards science courses and interests of them in STEM career. Experimental student group took course about the "Solar System and Beyond" Unit, which is in the curriculum, with STEM education program enriched by argumentation method; on the other hand, control student group took the course about the same unite with traditional teaching method. It was reported at the end of the study that interest in the course, critical thinking skill and interest in career related with STEM jobs increased in experimental student group much more than the control group. In another study carried out by Daymaz (2019: 3), it was aimed to analyze the effects of teaching the Circle Unit in the curriculum of 7^{th} grades with STEM activities both on the success of students at mathematics courses and on their attitudes towards STEM jobs. 20 7^{th} grade students participated in the study. It was determined at the end of the study that STEM applications effects both the success of students at the lessons and their motivation towards the lesson in a positive way. At the end of the practice, findings of the study was evaluated and it was reached the conclusion that STEM activities increased the level of perception towards STEM jobs. In a study carried out by Akın (2019: 4), it was aimed to analyze the effects of giving science lessons to 7^{th} grade through STEM applications on the attitudes of students towards science, academic success and their opinions about STEM jobs. Totally 39 students participated in the study. 18 of them were experimental group and 21 of them were control group. In the study, experimental group took the science courses through STEM applications; however, control group kept on taking the course through traditional methods which were in the 2013 curriculum of science lesson. At the end of the study, both attitudes and approaches of experimental group towards science courses got more positive and attitudes of them towards jobs related with science improved more than the control group.

In similar studies in literature about attitudes towards STEM according to type of school variable, it is indicated that type of school variable is determinant on the attitudes of students towards STEM (Kırıktas, 2019: 85). Findings of this study within this context are in parallel with the literature. When the findings of this study and the results of the studies in literature are evaluated, it can be said that course equipment of schools and teaching methods used in schools beside the type of school are determinant on the attitudes of students towards STEM. It has been determined that there is a significant positive relation between the attitudes of students towards digital technology and their attitudes towards STEM. In a similar way, it has been found that there are significant positive relations among the lower dimensions of scale. In this framework, it has been seen that attitudes of students towards digital technologies effects also their levels of attitudes towards STEM positively. While the studies discussing the relation between the attitudes of students towards digital technology and towards STEM are quite restricted, it is indicated in the studies in this field that curriculum is needed to include contents improving attitudes towards technology for developing the attitudes towards STEM (Sen and Timur, 2018: 139).

As a result, it has been found in this study which analyze the perceptions of secondary school BILSEM students towards STEM and their attitudes towards digital technology that attitudes of student towards digital technology are at average level; although, their levels of attitudes towards STEM are above the average. When analyzed in terms of demographic variable, it has been determined that attitudes of students towards digital technology differ significantly according to gender, age group, class level and type of school. Besides, attitudes of students towards STEM differ according to gender, age group, class level and type of school. When it is analyzed in terms of dependent variables, it has been found that there is a remarkable positive relation between the levels of attitudes of students towards digital technology and the levels of their attitudes towards STEM. It can be said according to the findings obtained from this study, demographic variables are important determinants both on the attitudes of secondary school BILSEM students towards digital technology and on their attitudes towards STEM; moreover, higher levels of attitudes of these students towards digital technology positively affect their attitudes towards STEM. In the light of the findings of this studies, suggestions below can be put forward:

- ✓ Similar studies can be carried out with different sampling groups in order to reach more comprehensive findings about factors effecting attitudes of secondary school students towards both digital technology and STEM.
- ✓ Studies can be carried out to analyze the attitudes of secondary school students towards digital technology and STEM according to educational levels of their parents, level of income of their family and parental attitude which are known as determinant on the educational lives of students.
- ✓ BY taking into consideration the positive relation between the level of attitude towards digital technology and attitude towards STEM, studies for improving the level of knowledge and attitudes of secondary school students towards digital technology can be carried out.

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