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EXAMINING CRITICAL THINKING DISPOSITION OF SCIENCE HIGH SCHOOL STUDENTS: 9TH GRADE EXAMPLE

(*Research article*)

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Abstract

In this study, it was aimed to examine the critical thinking dispositions of ninth grade students studying in science high schools in terms of various variables. The sample of the research consists of 98 students studying in the ninth grade of a science high school located in the Central Anatolia Region of Turkey. The UF/EMI Critical Thinking Disposition Scale was used to collect data. Within the scope of the research, the cronbach-alpha internal consistency coefficient was calculated as 0.94. As a result of the research, it was determined that there was no statistically significant difference in the critical thinking dispositions of the students studying at science high schools in terms of gender, type of school graduated and level of achievement. However, it was determined that there was a statistically significant difference in the critical thinking dispositions of the science high school students (in the dimensions of participation, cognitive maturity and UF/EMI) in terms of the vocational preference variable. According to the results of the research, it is recommended to examine the reasons for the variables that affect or do not affect the critical thinking dispositions of ninth grade students studying at science high schools.

Keywords: Critical thinking, science high school students, 21st century skills

1. Introduction

In recent years, scientific and technological developments have shown their effects in many areas such as education, health and communication. In the 21st century, where information changes rapidly and turns into new products, individual profiles and societies' expectations from individuals have changed. It has become a priority for countries to raise individuals who question, analyze the information they obtain, actively participate in the learning process and integrate their knowledge into life. Because the competitive power of countries in the global arena consists of individuals who carry the requirements of the 21st century. The skills that should be possessed by individuals living in 21st century societies have been defined in many studies (Dicerbo, 2014; Kylonen, 2012; Partnership for 21st century learning (P21), 2007; Yalçın, 2018). 21st century skills known as P21 in the literature; It has been defined in three main skill areas as “learning and innovation skills”, “career and life skills”, “information-media and technology skills” (P21, 2007). Framework for 21st century learning (P21, 2007) is given in Figure 1.

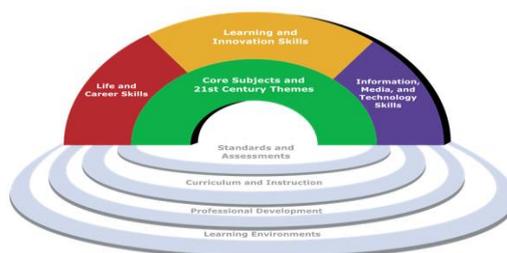


Figure 1. Framework for 21st century learning (P21, 2007)

Learning and innovation skills include four different sub-skills: critical thinking and problem solving, communication, cooperation, and creativity (P21, 2007; Trilling & Fadel, 2009). Critical thinking, which is one of the learning and innovation skills; it is defined as the ability to make inferences by analyzing problems or situations correctly (Yalçın, 2018). Individuals (students) with critical thinking skills have the following characteristics:

- ❖ Using various types of reasoning depending on the nature of the event or situation,
- ❖ Analyzing complex events in all details,
- ❖ Having an alternative point of view,
- ❖ Interpreting the information as a result of evaluation and analysis,
- ❖ To be able to think critically about learning experiences and processes (P21).

Critical thinking skills are one of the life skills that students should have. The student's ability to think critically will enable them to quickly solve simple or complex situations. In addition, critical thinking allows students to discover the truth and process information logically so that they can identify which information is important, irrelevant or useless (Amin et al., 2020). For this reason, students should receive training on critical thinking, creative thinking, communication and cooperation in order to adapt to the 21st century (Setiana, Purwoko & Sugiman, 2021). Schools and teachers have a great responsibility in trainings to develop 21st century skills (Howard, Tang & Jill Austin, 2015). In order to plan the educational process, it is important to determine the critical thinking skill levels of the students and the variables that affect this level.

When the literature on the subject is examined, it is seen that there are different national (Arslan, Gulveren & Aydin, 2014; Erdem & Genç, 2015a; Erdem & Genç, 2015b; Kılıç & Şen, 2014; Koçoğlu & Kandlı, 2019; Mete, 2021) and international studies (Aizikovitsh-Udi & Cheng, 2015; Chen & Chuang, 2021; Utami, Saputro, Masykuri & Widoretno, 2017; Setiana et al., 2021). For example, in the research conducted by Chen and Chuang (2021), digital game software was developed to improve the critical thinking of high school students. In the study conducted by Koçoğlu and Kanadlı (2019), it was aimed to determine the relationship between the autonomy support perceived by secondary school students in the lessons, their problem solving skills and critical thinking dispositions. As a result of the research, it was determined that there was a positive relationship between students' autonomy perceptions, problem solving skills and critical thinking dispositions. Erdem and Genç (2015a) examined the critical thinking skills of high school students in terms of different variables in their study. As a result of the research, it was determined that high school students have critical thinking dispositions, but not at a sufficient level. In addition, in the research, it was determined that there is a negative relationship between grade level and critical thinking dispositions. Arslan, Gulveren and Aydin (2014) determined the factors affecting the critical thinking dispositions of students studying in different departments at the university.

Science high schools in Turkey aim to train students in the fields of science and mathematics, and social sciences high schools aim to be a source for the training of students in the fields of literature and social sciences as scientists (Ministry of National Education [MoNE], 2019, p.3). For this reason, students studying in science high schools should be able to adapt to the requirements of the age and have 21st century skills such as critical thinking, creative thinking, communication and cooperation. As a matter of fact, the development of 21st century skills and the acquisition of students are included in the philosophy, professional development processes, basic education and lifelong learning goals of the 2023 Education Vision published by the Ministry of National Education (MoNE, 2018). When the relevant

literature was examined, it was determined that the critical thinking dispositions of science high school students were not analyzed in terms of different variables. In this study, it is aimed to examine the critical thinking dispositions of ninth grade students studying in science high schools in terms of various variables. In line with the purpose of the research, answers to the following questions were sought:

- ❖ Does the critical thinking disposition of ninth grade students studying at a science high school differ significantly in terms of gender?
- ❖ Does the critical thinking disposition of ninth grade students studying at a science high school differ significantly in terms of the graduated school?
- ❖ Does the critical thinking disposition of ninth grade students studying at science high schools differ significantly in terms of their success levels in the High School Entrance System (LGS)?
- ❖ Does the critical thinking disposition of ninth grade students studying at a science high school differ significantly in terms of their professional preferences?

2. Method

2.1. Research pattern

In this study, scanning model, which is one of the quantitative research methods, was used. Scan model; It is defined as a screening arrangement made on the universe or the sample selected from the universe, aiming to reach a general judgment about the universe consisting of many elements (Karasar, 2006).

2.2. Participants

The sample of the study was determined by using the convenient sampling method. The sample of the research consists of 98 students studying in the ninth grade of a science high school located in the Central Anatolia Region of Turkey. The distribution of demographic information of ninth grade science high school students in the sample of the study is presented in Table 1.

Table 1. *Demographic information of students*

Demographic information		N	%
Gender	Female	44	44.9
	Male	54	55.1
School	State school	61	62.2
	Private school	37	37.8
LGS Success Level (%)	0-0.49	48	49.0
	0.5-0.99	50	51.0
Professional Preference	Engineer	38	38.8
	Doctor	24	24.5
	The scientist	12	12.2
	Indecisive	24	24.5

2.3. Data Collection Tool

In this study, "UF/EMI Critical Thinking Tendency Scale" was used, which was adapted to Turkish and analyzed for validity and reliability by Kılıç and Şen (2014). Scale; It is a 5-point Likert type consisting of 25 questions with three factors: "Participation", "Cognitive Maturity" and "Innovation". The questions in the scale were scored based on the statements

“1: Strongly Disagree, 2: Disagree, 3: Undecided, 4: Agree, 5: Strongly Agree”. The Cronbach-Alpha internal consistency coefficient was calculated for the reliability of the scale. The Cronbach-Alpha internal consistency coefficient values for the scale and its sub-factors are given in Table 2.

Table 2. Cronbach's alpha reliability coefficient values of the scale and its sub-factors

Scale dimensions	Cronbach's alpha	
	Kılıç ve Şen (2014)	Karakaya ve Yılmaz
Participation	0.88	0.90
Cognitive Maturity	0.70	0.83
Innovation	0.73	0.84
UF/EMI	0.91	0.94

According to the findings in Table 2, the fact that the total UF/EMI consisting of 25 items is more than 0.80 and its three sub-factors are more than 0.60 constitutes proof in terms of reliability (Güngören, Bektaş, Öztürk & Horzum, 2014).

2.4. Analysis of Data

The data obtained within the scope of the research were analyzed using the statistical package program (IBM SPSS 26). In order to determine the normal distribution of the data obtained in the study, skewness and kurtosis values were calculated. The skewness values for the scale and its sub-factors were determined respectively (UF/EMI=-1.824; Participation=-1.505; Cognitive Maturity=-1.708; Innovation= -1.580). Kurtosis values for the scale and its sub-factors were calculated as (UF/EMI=5.883; Participation=4.207; Cognitive Maturity=4.978; Innovation=3.775). Skewness and kurtosis values between ± 1.5 indicate that the distribution is normal (Tabachnick & Fidell, 2013). Accordingly, it can be said that the obtained data do not show a normal distribution. For this reason, nonparametric tests were used in the evaluation of the obtained data.

2.5. Ethical Statement of the Study

T.R. Yozgat Bozok University Ethics Commission discussed at the meeting dated 19.01.2022 and numbered 29/06 and decided that the study was ethically and scientifically appropriate.

3. Findings

In the research, "Does the critical thinking disposition of ninth grade students studying at a science high school differ significantly in terms of gender?" the answer to the question has been sought. The findings are presented in Table 3.

Table 3. Mann-Whitney U test analysis results according to gender

Factors	Gender	N	Rank average	U	p
Participation	Female	44	50.35	1150.5	.788
	Male	54	48.81		
Cognitive Maturity	Female	44	54.49	968.5	.116
	Male	54	45.44		
Innovation	Female	44	52.03	1076.5	.424
	Male	54	47.44		
UF/EMI	Female	44	51.61	1095.0	.506
	Male	54	47.78		

*p<.05

When the findings given in Table 3 are examined, it is seen that the ninth grade students studying at science high schools scored on the critical thinking disposition scale ($U=1095.0$; $p>.05$), participation ($U=1150.5$; $p>.05$), cognitive maturity ($U=968.5$; $p>.05$) and innovativeness ($U=1076.5$; $p>.05$) factors were not significantly different according to gender.

In the research, "Does the critical thinking disposition of ninth grade students studying at a science high school differ significantly in terms of the graduated school?" the answer to the question has been sought. The findings are presented in Table 4.

Table 4. *Mann-Whitney U test analysis results according to the graduated school*

Factors	School	N	Rank average	U	p
Participation	State school	61	51.99	976.5	.264
	Private school	37	45.39		
Cognitive Maturity	State school	61	50.63	1059.5	.612
	Private school	37	47.64		
Innovation	State school	61	52.65	936.5	.157
	Private school	37	44.31		
UF/EMI	State school	61	52.16	966.0	.233
	Private school	37	45.11		

* $p<.05$

When the findings in Table 4 are examined, it is seen that the ninth grade students studying at science high schools scored on the critical thinking disposition scale ($U=966.0$; $p>.05$), participation ($U=976.5$; $p>.05$), cognitive maturity ($U=1059.5$; $p>.05$) and innovativeness ($U=936.5$; $p>.05$) factors were not found to be significantly different according to the type of school graduated.

In the research, "Does the critical thinking disposition of ninth grade students studying at science high schools differ significantly in terms of their success levels in the High School Entrance System (LGS)?" the answer to the question has been sought. The findings are presented in Table 5.

Table 5. *Mann-Whitney U test analysis results according to the success levels in LGS*

Factors	Level of success	N	Rank average	U	p
Participation	0-0.499	48	47.28	1093.5	.448
	0.5-0.99	50	51.63		
Cognitive Maturity	0-0.499	48	49.83	1184.0	.909
	0.5-0.99	50	49.18		
Innovation	0-0.49	48	52.65	1049.0	.281
	0.5-0.99	50	46.48		
UF/EMI	0-0.499	48	49.25	1188.0	.932
	0.5-0.99	50	49.74		

* $p<.05$

When the findings in Table 5 are examined, it is seen that the ninth grade students studying at science high schools scored on the critical thinking disposition scale ($U=1188.0$; $p>.05$), participation ($U=1093.5$; $p>.05$), cognitive maturity ($U=1184.0$; $p>.05$) and innovativeness ($U=1049.0$; $p>.05$) factors were not found to be significantly different in terms of achievement levels in LGS.

In the research, "Does the critical thinking disposition of ninth grade students studying at a science high school differ significantly in terms of their professional preferences?" the answer to the question has been sought. The findings are presented in Table 6.

Table 6. *Kruskal-Wallis H test analysis results according to professional preferences*

Factors	Professional preference	N	Rank average	sd	X ²	p
Participation	Engineer	38	40.58	3	8.840	.032*
	Doctor	24	62.31			
	The scientist	12	52.88			
	Indecisive	24	49.13			
Cognitive Maturity	Engineer	38	40.36	3	8.835	.032*
	Doctor	24	59.50			
	The scientist	12	60.63			
	Indecisive	24	48.42			
Innovation	Engineer	38	44.00	3	4.309	.230
	Doctor	24	59.00			
	The scientist	12	46.33			
	Indecisive	24	50.29			
UF/EMI	Engineer	38	40.79	3	8.718	.033*
	Doctor	24	62.63			
	The scientist	12	50.79			
	Indecisive	24	49.52			

*p<.05

When the findings in Table 6 are examined, it is seen that the ninth grade students studying at science high schools scored on the critical thinking disposition scale ($x^2=8.718$; $p<.05$), participation ($x^2=8.840$; $p<.05$) and cognitive maturity ($x^2=8.835$; $p<.05$) factors were found to be significantly different according to professional preferences. However, it was determined that there was no significant difference in innovation ($x^2=4.309$; $p>.05$) factor according to professional preferences.

4. Discussion and Results

In this study, critical thinking dispositions of ninth grade students studying at science high schools were examined in terms of various variables. In the study, it was determined that the ninth grade students studying at science high schools did not show a statistically significant difference according to the gender variable in the critical thinking dispositions and the scores they got from the factors of participation, cognitive maturity and innovativeness. According to these results, it can be said that gender is not a variable that affects the critical thinking dispositions of ninth grade students studying at science high schools. When the literature is examined, there are studies showing that students' critical thinking dispositions do not differ statistically according to gender (Demir & Aybek, 2014; Demirbilek & Kırbaç, 2021; Erdem & Genç, 2015b; Koçoğlu & Kanadlı, 2019; Mete, 2021). However, when the literature is examined, it has been determined that students' critical thinking dispositions and skills differ statistically significantly according to gender (Akar, 2017; Arslan et al., 2014; Doğru Oral, 2018; Gülveren, 2007; Köksal & Çöğmen, 2018). For example, Köksal and Çöğmen (2018) concluded that secondary school students' scores in the dimensions of evaluation, inference, interpretation, explanation and self-regulation, which constitute their critical thinking skills, make a significant difference in favor of female students. Akar (2017) stated that students' critical thinking dispositions differ in favor of female. As a result of the research conducted

by Arslan et al. (2014), it was determined that there is a positive relationship between the critical thinking disposition of university students and the gender variable.

In the study, it was determined that the ninth grade students studying at science high schools did not show a statistically significant difference according to the graduated school variable in the critical thinking dispositions and the scores they got from the factors of participation, cognitive maturity and innovativeness. According to these results, it can be said that the graduated school is not a variable that affects the critical thinking dispositions of the ninth grade students studying at a science high school. Studies have shown that the type of school graduated is not a factor that does not affect students' critical thinking dispositions (Erdem & Genç, 2015b; Gelen, 2002; Korkmaz, 2008).

In the study, it was determined that the ninth grade students studying at science high schools did not show a statistically significant difference in the scores of critical thinking dispositions and the factors of participation, cognitive maturity and innovativeness according to the success level variable in LGS. According to these results, it can be said that the level of academic achievement is not a variable that affects the critical thinking dispositions of ninth grade students studying at science high schools. When the literature is examined, it has been determined that students with high academic achievement levels also have high levels of critical thinking and tendencies (Doğru Oral, 2018; Göktepe-Yıldız, 2020). This is thought to be due to the fact that the students studying at science high schools have high academic levels and are relatively equivalent to each other, and the lack of differentiation is effective. Akbıyık and Seferoğlu (2006) stated as a result of their research that students who have the same level of academic success have a similar level of critical thinking disposition. This result supports the findings of the study.

In the study, it was determined that the ninth grade students studying at science high schools showed a statistically significant difference in the critical thinking dispositions and the scores they got from the factors of participation and cognitive maturity according to the vocational preference variable. It was determined that the average of the students who want to be a doctor in the dimension of participation, a scientist in the dimension of cognitive maturity, and a doctor in general in the scale. However, it was determined that the scores of the students from the innovativeness factor did not show a statistically significant difference according to the vocational preference variable. According to the results of the study, it can be said that vocational preferences are a variable that affects participation, cognitive maturity and critical thinking dispositions of ninth grade students studying at science high schools. Arslan et al. (2014) stated that there is a positive relationship between students' departments and their critical thinking dispositions. This result is in line with the findings of the study.

As a result, the high level of critical thinking disposition of ninth grade students in science high schools is important for the country's global competitiveness. For this reason, it is necessary to determine the factors affecting students' critical thinking dispositions and to examine them in depth with qualitative data. It is thought that the findings will be a reference source for education policies and strategies.

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