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DEVELOPMENT OF CRITICAL THINKING SKILLS SCALE FOR SCIENCE LESSON

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Abstract:
The aim of this study is to develop a scale for use in determining critical thinking skills of secondary school students. In this study, both pilot and main implementation were made and as a result two different versions of the same scale were developed. The scales were applied to 807 students in the 6th, 7th and 8th grades. SPSS and LISREL programs were used to analyze the data. The reliability values and exploratory factor analyzes of the scales were calculated with the help of SPSS program. Cronbach Alpha value, Kaiser-Meyer-Olkin and Bartlett tests were performed at this stage. Afterwards, confirmatory factor analysis was performed with the help of LISREL program and fit indices of the scales were determined. Then, independent sample T-Test, one-way ANOVA and Post Hoc tests were used to answer the research questions. As a result of analyzes, scale was obtained in two versions called "Likert" and "optional" to determine critical thinking skills. In addition, it was found that female students had high critical thinking skills compared to male and sixth grade students had high critical thinking skills according to seventh and eighth grade.

Keywords: science lesson, critical thinking, critical thinking scale, Likert, optional

1. Introduction

The science course teaches ways to cope with the problems we face and try to solve in our daily life. In these ways, the development of the individual's thought system is important (Özmen, 2004). The way and type of thinking of the individual is a skill that can be taught and improved (Gardner, 2017). Reflective, creative, critical thinking is known such as a kind of thinking.

Critical thinking can be defined separately from the philosophical, psychological and educational perspectives. It was seen as a philosophically reflective and reasonable thinking (Terenzini et al., 1995). It is seen as a skill where individuals have beliefs to judge with a skeptical approach. In the philosophical sense, the harmony between what

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the individual thinks and is ready to do. It is the idea that an individual uses to make a decision (Marzano et al., 1988). From the psychological point of view, an individual's mental processes, strategies and representatives are used by people to solve problems, decide and learn new concepts (Topolovčan, Matijević, 2017). Critical thinking in educational terms contains making argument, inductive and deductive reasoning, evaluating, making decision and problem solving (Garrison, Anderson and Archer, 2001). In fact, some researchers consider the analysis, evaluation and synthesis steps in Bloom's cognitive processes as critical thinking (Lai, 2011).

The definition of educational critical thinking can be increased. Critical thinking in general; it can be defined as a functional cognitive process by transferring data in different areas so that an individual can better understand and explain ideas (Chaffee, 1994; Huber and Kuncel, 2015; Şenşekerci and Bilgin, 2008). Critical thinkers have some features and skills (Dogan, 2013; Elder, 2002; Şenşekerci and Kartal, 2010).

Table 1: Specific skills and features about critical thinking

Order	Skills	Features
1	Can organize information	Curious
2	Can transfer data between different fields	Question
3	Consistently consider different alternatives	Listen
4	Make the right choices among alternatives	Feedback
5	Can refuse incorrect data	Evaluates
6	Identify new solutions	Fair
7	Can develop metacognitive thinking ways	Analytical
8	Analyze data using evidence	Productive
9	Evaluate according to the criteria	Independent
10	Accepts missing sides	Respect

When Table 1 is examined, the skills and features of the individuals who think critically can be seen. As a result of the literature review Table 1 was formed (Chaffee, 1994; Connerly, 2006; Huber and Kuncel, 2015; Koray et al., 2007; Paul and Elder, 2005; Seferoğlu and Akbıyık, 2006; Şenşekerci and Bilgin, 2008).

Scale development studies were conducted to determine the critical thinking skills of the individual. In general, these studies gave successful results (Dogan, 2013). It has been determined that critical thinking skills have various dimensions in scale development studies (Arslantaş and Kurnaz, 2015; Şahin and Boztunç Öztürk, 2018). It was determined that the dimensions given in Table 2 were used in the majority of the studies (Fullerton, 1990; (Kurnaz, 2007; Marzano et al., 1988).

In Table 2, it is seen that critical thinking skills are examined in three dimensions as “affective properties”, “cognitive properties: macro abilities” and “cognitive properties: micro abilities” (Şenşekerci and Kartal, 2010: 23-24; Şahinel, 2007: 9-12; Dogan, 2013: 34-36; Marzano et al., 1988). It has been found that these dimensions are used in the critical thinking skill determination scales as affective properties, macro and micro abilities (Koray et al., 2007; Kurnaz, 2007).

Table 2: Dimensions of critical thinking skills

A) Affective Properties	**B) Cognitive Properties: Macro Abilities**
1. Independently thinking	10. Strengthening generalizations and avoiding excessive simplifications
2. Refusal of egocentricity or group thinking	11. Comparing similar situations: Transferring agreed things to new situations
3. Act impartially	12. Developing a personal perspective: exploring beliefs, arguments and theories
4. Discover the implicit emotions in their thoughts	13. Lighting problems, results and beliefs
5. Show intellectual humility and postpone judgment	14. To understand and analyze the meaning of words and sentences
6. Demonstrating intellectual courage	15. Examination of criteria for evaluation: Lighting values and norms
7. Being well-intentioned and honest	16. Evaluating the validity of information sources
8. Intellectual resistance	17. Asking deep questions: Asking and deepening basic and specific questions
9. Trust in reason	18. Evaluating and analyzing arguments, comments, opinions or theories
C) Cognitive Properties: Micro Abilities	19. Find and evaluate solutions
27. Comparing and contrasting ideals with reality	20. Analysis and evaluation of actions and policies
28. Clear thinking about thinking: Applying to an appropriate vocabulary	21. Critical reading: Clarifying or analyzing texts.
29. Specifying distinct similarities or differences	22. Critical listening: Master in active listening
30. Examining or evaluating numbers	23. Building interdisciplinary relationships
31. To distinguish meaningful phenomena from non-meaningful ones	24. Socratic discussion: Illumination and problematization of views, theories or perspectives
32. Assumption, prediction or interpretation	25. Comparative thinking: comparing theses, comments or theories
33. Giving reasons and evaluating evidence and alleged facts	26. Dialectical thinking: Assessing situations, interpretations or theories
34. Separation of contradictions	
35. Examine findings and results	

It is important to determine the critical thinking skills of students in science lesson. It is necessary to develop a scale that can define critical thinking skills in the lesson of science with its effect in similar studies in different fields. In general, “Likert survey” style scales were used in scale development. Although Kurnaz's (2007) study has seen an "optional survey”, it is related to a different lesson. There is no use of optional survey for the science lesson. Therefore this study is gaining specificity. So, the aim of this study is to develop the scales that can be used to determine the critical thinking skills and to determine the significance level of the secondary school students.

2. Purpose of the Research

The aim of this study is to develop critical thinking skills scale for the use for science lesson in secondary school students. Within the scope of this aim, the answers of the following research questions are sought.

1) Can developed a critical thinking skill scale be used in the science lesson?
    a. Can developed a "Likert survey" critical thinking skill scale be used in the science lesson?
    b. Can developed an "optional survey" critical thinking skill scale be used in the science lesson?
2) What is the level of critical thinking skills of secondary school students?
    a. Is there a significant difference between the students' critical thinking skills according to gender?
    b. Is there a significant difference between the students' critical thinking skills at the group level?

2.1 Limitations of Research

Research is limited to a secondary school 6th, 7th and 8th grade students. The study is limited to the development of a scale that can be used to define critical thinking skill for the science lesson. Study implementation only public school in Eastern Anatolia

3. Methodology

The survey model was used in the study. Survey models are investigations aimed at describing the past or the present situation study. These studies are carried out on large groups (Karasar, 2009). In addition, scale development steps/stages were followed in the study (DeVellis, 2003; Karakoç and Dönmez, 2014). These stages have been used to achieve the result as in the following steps. In the study, the critical thinking skill scale for the science lesson was developed. The study was carried out in five stages. These stages are presented in detail in Table 3.

Table 3: Stages followed in the study

A	**Preliminary Study**	**C**	**Implementation**
	Literature review		Implementation of Likert scale
	Determination of features		Implementation of optional scale
	Determination of dimensions	**D**	**Reliability and Validity Study**
B	**Scale Preparation**		Reliability study
	Writing scale items		Validity Study
	Expert opinion		Data analysis
	Pilot implementation	**E**	**Implementation Results**
	Analysis of pilot implementation data		Results by gender
	Reliability and validity of pilot data		Results obtained by grade levels
	Arranging the scale		Final status of scales

A. Preliminary Study

At this stage of the study, a literature survey was conducted to develop the critical thinking scale. Previous studies have been examined. Then, the characteristics of critical thinking were determined. In addition to the features presented in the introduction of the study, all data containing critical thinking feature were collected in a pool. The collected data are dimensioned according to the characteristics of critical thinking.

According to this, dimensions were determined "affective properties", "macro" and "micro" abilities in prepared scales.

B. Scale Preparation

At this stage, the scale items were written. The scale is prepared with three options. While preparing the items of this scale, "be pure and sordid", "self-centred" and "critical" thinking style properties were taken into consideration.

> *"What do you do if your friends don't like your sentences in science lessons that you know right?*
> *a) I do not like their thoughts.*
> *b) All I know is true and everyone likes it.*
> *c) I have to be able to say something that I know right, even if my friends don't like it."*

When the above question is examined, it is prepared as affective properties dimension. This question's a option "be pure and sordid", b option "self-centred" and c correct option is shown to be "critical" thinking style properties. All of the question items prepared as seen in the given example are written in the topics mentioned in options a, b and c. In the writing of the scale items, both a science teacher and two field experts were assisted. The prepared scale was piloted and the data was analyzed and the final shape of the scale was arranged. The data for the pilot implementation are presented in the findings section of the study. As a result of the analysis of the data obtained from the pilot implementation, two separate scales were arranged. In addition, some items of the scales were corrected.

C. Implementation

Due to the pilot data analysis, both the Likert-type and optional-type scales were applied. The optional scale consists of 15 items and consists of the options as described above. Likert scale consists of 15 items. In addition, marked "*disagree*", "*undecided*" and "*I agree*" consists of three options Likert. It consists of the same substances on both scales. The optional scale consisted of the items and options given above, while the Likert scale was adapted as follows.

> *"I should be able to tell some sentences that I know correctly in science lesson."*

As given in the example, the Likert scale was placed in front of the items presented in triple Likert.

D. Reliability and Validity Study

As a result of the pilot implementation, the reliability and validity values were not reached. Then two scales, Likert and optional were prepared and implemented. The reliability and validity studies of the scales and the results of the analysis of the scales data are presented in the findings section.

E. Implementation Results

At the end of the study, the data about the last state of the scales and critical thinking skills in the samples were obtained. These data are presented in the findings section and explained in the conclusion section.

4. Working Group

The pilot implementation of the study was carried out in a public school located in the Marmara region, while the main implementation was in a public school in Eastern Anatolia. Likert and optional scales were applied to the same group of students. Since four students leave blank some of the items in the option scale, their data has not been processed.

Table 4: Number of students participating in the research

	Gender	6th grade	7th grade	8th grade	Total	In general
Pilot apply	Female	47	45	46	138	307
	Male	61	62	46	169	
Main apply	Female	62	87	67	216	500
	Male	77	127	80	284	
		247	321	239	807	807

As shown in Table 4, a total of 307 students (138 female and 169 male) participated in the pilot implementation. In the main implementation, 216 female and 284 male up 500 students participated. In general, 355 female and 453 male students participated in the study.

4.1 Data Analysis

SPSS and LISREL programs were used to analyze the data. All data, especially pilot study data, were calculated with the help of SPSS program and the reliability values and exploratory factor analyzes of the scales were calculated. Cronbach Alpha value, Kaiser-Meyer-Olkin (KMO) and Bartlett tests were performed at this stage. After that, confirmatory factor analyzes were performed with the help of LISREL program. Then, independent sample t-test, one-way ANOVA and Post Hoc (Tukey and Games-Howell test) tests were conducted to answer the research questions.

5. Results of Research

The data obtained in this section are presented in two parts. Validity values of the scales were given after the reliability values. In addition, data related to the level of significance of the scores obtained are presented.

5.1 Reliability

Cronbach's alpha values were examined for the reliability of the factors. According to analyze the reliability value of the optional scale was calculated as 0.66 in pilot

implementation. After the pilot implementation, the reliability values of the two scales increased. Accordingly, the value of the Likert scale was 0.699 and the value of the optional scale was calculated as 0.755.

5.2 Validity

The values calculated as a result of exploratory factor analysis within the framework of the validity studies of the critical thinking skill scale for the science course are given in Table 5.

Table 5: Calculated values of exploratory factor analysis

	Acceptable Value	Pilot (optional)	Likert	Optional	Factor
Kaiser-Meyer-Olkin (KMO)	≥0.50	0.73	0.82	0.86	doable
Bartlett's Test of Sphericity	≥N	449.219	712.68	770.17	doable
p	≤0.05	0.000	0.000	0.000	doable

As seen in Table 5, the KMO values of all scales are above the acceptable value. Bartlett's Test of Sphericity test values show high jump values depending on the number of participants. Finally, "*p*" significance indicates that the data are meaningful (Field, 2000). The values in Table 5 show that these scales can be taken to confirm factor analysis.

Table 6: Compliance indexes calculated by confirmatory factor analysis

Compliance Indexes	Acceptable Value	Pilot (Optional)	Likert	Optional
Chi-Square / Degree of Freedom	≤3.00	5.949	1.287	1.307
GFI	≥0.90	0.829	0.986	0.975
AGFI	≥0.80	0.77	0.974	0.964
NNFI	≥0.90	0.545	0.978	0.954
CFI	≥0.90	0.615	0.985	0.964
RMSR	≤0.10	0.085	0.018	0.0097
RMSEA	≤0.06 or ≤0.08	0.127	0.024	0.025

GFI = goodness-of-fit index; AGFI = adjusted goodness-of-fit index;
NNFI = non-normed fit index; CFI = comparative fit index;
RMSR = root mean square residual; RMSEA = root mean square error of approximation.

When the Table 6 is examined, it is determined that the majority of the values of the results of the pilot implementation are not within the acceptable value limits. As a result of the main implementation, it was observed that the compliance indexes of both the Likert and optional scales were above the acceptable values (Schermelleh-Engel, Moosbrugger, and Müller, 2003). Based on these data, the pattern charts of the Likert and optional scales are given below.

Figure 1 shows a pattern chart of the Likert scale. When the relationship between the dimensions of the scale was examined, it was observed that affective features and macro ability 0.90, macro and micro ability 0.89 and affective properties and micro

ability 0.88 were double-sided relationships between the dimensions. The error variances of the substances are given to the left of Figure 1. Factor loads related to substances are shown on the unidirectional arrows that move from the dimensions of the scale to the scale items.

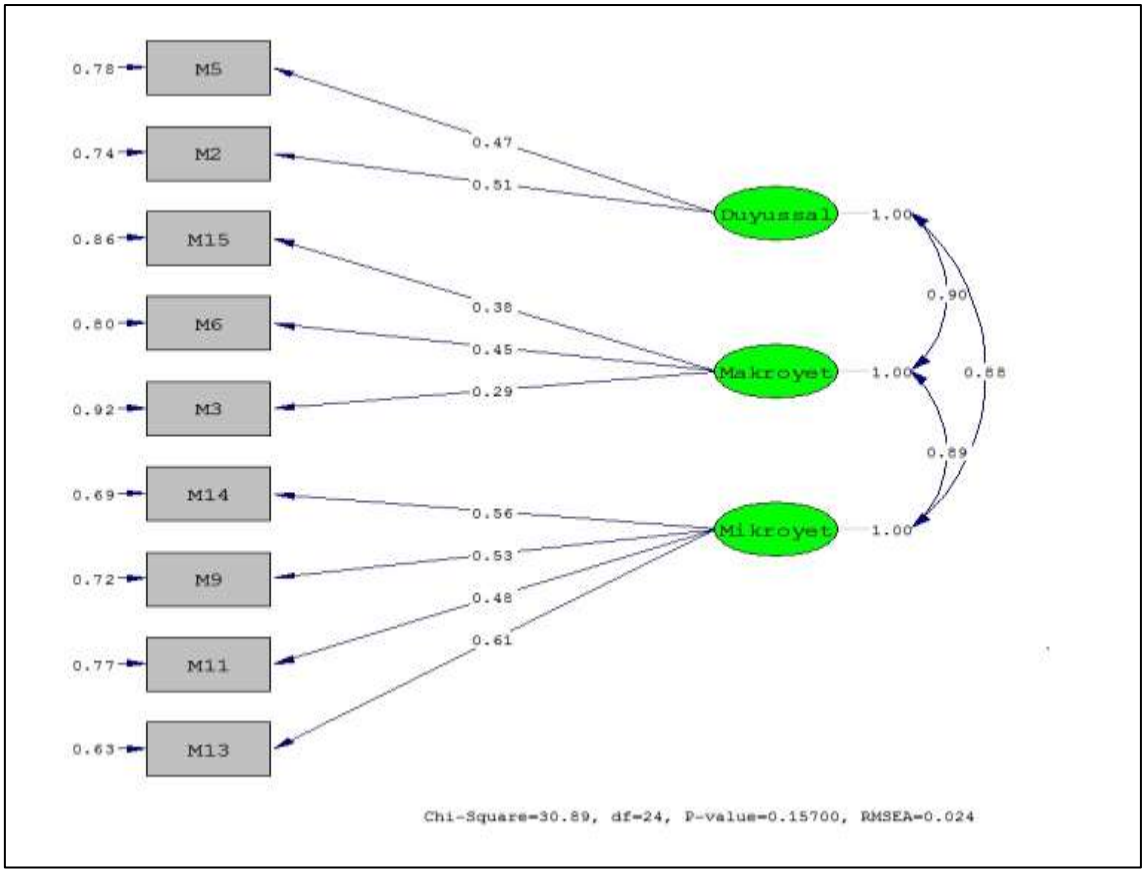

Figure 1: Likert style critical thinking skills scale factor loads and pattern chart in science lesson

Figure 2 shows the pattern chart of the optional scale. When the relationship between the dimensions of the scale was examined, it was observed that affective features and macro ability 0.97, macro and micro ability 0.96 and affective properties and micro ability 0.89 were double-sided relationships between the dimensions. The error variances of the substances are given to the left of Figure 2. Factor loads related to substances are shown on the unidirectional arrows that move from the dimensions of the scale to the scale items.

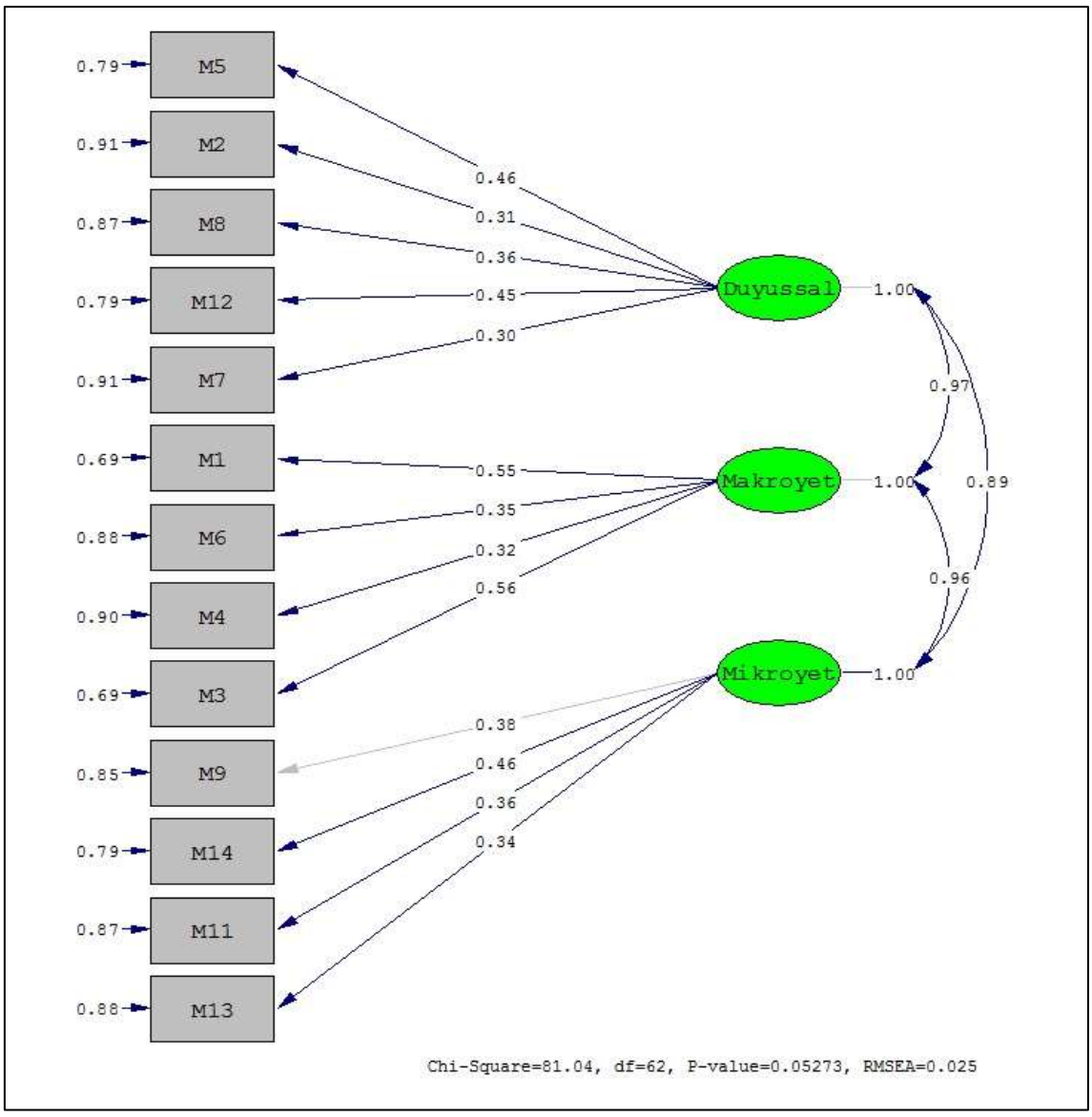

Figure 2: Optional style critical thinking skills scale factor loads and pattern chart in science lesson

This study also examined the relationship between gender and scores as evidence of the validity of the scale scores.

Table 7: Independent samples t-test for meaning of scores by gender

Scales	Gender	N	X	Standard deviation	df	t	p
Likert	Male	284	2.23	0.35	498	-2.32	0.02
	Female	216	2.30	0.34			
Optional	Male	282	2.21	0.27	494	-7.93	0.00
	Female	214	2.40	0.26			

When Table 7 is examined, it is seen that "*p*" value of both scales is less than 0.05. In addition, the mean scores of female students on both scales were higher than the male students. In addition, the significance of the scores obtained at the level of the groups was examined.

Table 8: ANOVA tests for meaning of scores by groups

Scales	Groups	N	X	Standard deviation	df	f	Homogeneity	p
Likert	6th grade	139	2.13	0.39	498	15.38	0.00 (p> 0.05 should be)	0.000
	7th grade	214	2.3	0.33				
	8th grade	147	2.33	0.27				
Optional	6th grade	137	2.23	0.27	494	6.7	0.57 (p> 0.05 should be)	0.001
	7th grade	214	2.3	0.27				
	8th grade	145	2.35	0.28				

When Table 8 is examined, it is seen that "*p*" values on both scales are less than 0.05. Here, there is meaningfulness between the scores. But the Post Hoc Test should be done to determine which groups are in favor of this level. For the Post Hoc Test, the "homogeneity" values of the scales should be considered. If homogeneity is less than 0.05, Post Hoc-Games-Howell should be used. In Table 7, the Likert scale has a homogeneity value of less than 0.05 and Post Hoc-Games-Howell test is used. If the homogeneity value is greater than 0.05, Post Hoc-Tukey or Gabriel should be used. In Table 7, due to the homogeneity of the optional scale was greater than 0.05, Post Hoc-Tukey test was used.

Table 9: Post Hoc tests for the meaning of the scores according to the groups

Scales	Tests	Grade	Groups	Mean Difference	Std. Error	p
Likert	Games-Howell	6th grade	7sinif	-.17101*	0.04011	0.000
			8sinif	-.19847*	0.04009	0.000
		7th grade	6sinif	.17101*	0.04011	0.000
			8sinif	-0.02747	0.03168	0.661
		8th grade	6sinif	.19847*	0.04009	0.000
			7sinif	0.02747	0.03168	0.661
Optional	Tukey HSD	6th grade	7sinif	-.07302*	0.03002	0.041
			8sinif	-.11850*	0.03263	0.001
		7th grade	6sinif	.07302*	0.03002	0.041
			8sinif	-0.04548	0.02945	0.271
		8th grade	6sinif	.11850*	0.03263	0.001
			7sinif	0.04548	0.02945	0.271

When Table 9 is examined, it is understood that the "*p*" value of the sixth grade is meaningful compared to the seven and eighth grades according to the Games-Howell results. When the Tukey test results of the scale in the same table are examined, it is determined that the "*p*" value of the sixth grade is significant compared to the other classes.

6. Discussion

This section is explained below in the order of the research questions.

A. Developed a critical thinking skill scale (1 question)

Researchers believe that reliability value of 0.7 and above will give more reliable results in scale development (Büyüköztürk et al., 2009; Büyüköztürk, 2014; Güngör, 2016). Accordingly, the reliability coefficient of the scale used in the pilot study was 0.66. In order to increase this value, the scale was corrected in the main implementation. Different versions of the scale were prepared. This method aims to increase not only reliability values but also validity values. In fact, the confirmatory factor analysis compliance indexes obtained from the pilot implementation (Table 6) show that the scale used in the pilot implementation is weak and cannot be used (Çetinkaya and Çimenci, 2014; Gülbahar and Büyüköztürk, 2008). For these reasons, the scales were developed as "Likert" and "optional" by making the necessary arrangements according to the data obtained from the pilot implementation. As a result of the implementation, the data of both scales were analyzed and it was determined that acceptable values were obtained.

B. Developed Likert and optional critical thinking skill scale (1: a and 1: b questions)

First of all, it was determined that Cronbach Alpha reliability values of Likert and optional scales were increased. According to this; The Cronbach's Alpha value of the Likert-style scale was 0.699 (0.7) and the Cronbach's alpha of the optional scale was calculated as 0.755. These values show that the scales give reliable results (Büyüköztürk, Çokluk and Köklü, 2013; Buyruk and Korkmaz, 2016). Accordingly, the Likert scale; Chi-Square / Degree of Freedom 1.287 (≤3.00), GFI 0.986 (≥0.90), AGFI 0.974 (≥0.80), NNFI 0.978 (≥0.90), CFI 0.985 (≥0.90), RMSR 0.018 (≤0.10) and RMSEA 0.024 (≤0.06 or ≤0.08) was calculated as. The optional scale was calculated as Chi-Square / Degree of Freedom 1.307 (≤3.00), GFI 0.975 (≥0.90), AGFI 0.964 (≥0.80), NNFI 0.954 (≥0.90), CFI 0.964 (≥0.90), RMSR 0.0097 (≤0.10) and RMSEA 0.025 (≤0.06 or ≤0.08) was calculated as. These data can be said to be highly acceptable values (Aytaç and Öngen, 2012; Kaner, Büyüköztürk and İçeri, 2013; Kızılkaya and Aşkar, 2009; Tosun, 2013).

Other than the above values when the patterns of the scales are examined, it can be said that all the data are suitable (Karakoç and Dönmez, 2014). As shown in Figures 1 and 2, the items below 0.30 were removed from the scale and their validity was increased. It was determined that the values of both scales were acceptable. Researchers such as Şeker and Saygı (2013), Yüksekbilgili (2016), Kuzu and Demir (2015), Polat and Erişti (2018) obtained similar results. In addition, some of the values did not fit in the work of Tezbaşaran and Gelbal (2018) have developed a scale.

C. Level of critical thinking skills of secondary school students (2 questions)

When all data were analyzed, it was determined that there was a significant difference between scores and gender and between groups. These data are presented below.

D. Students' critical thinking skills according to gender (2: a question)

When the level of significance between the points according to gender is examined there was a significant difference between the sexes. It can be said that it is in favor of

female students because of the mean score (Table 7). Similarly, Topolovčan and Matijević (2017) stated that female students have high critical thinking tendencies compared to male students. In addition, Kızılkaya and Aşkar, (2009) determined that girls' reflective thinking skills are higher than boys. These studies show that female students have differences thinking styles according male students.

E. Students' critical thinking skills according groups (2: b question)

It can be said that there is a significant difference between the scores of ANOVA test which is done in terms of examining the meaning of the scores obtained at the groups. Post Hoc test which is used in order to determine which groups are in favor of that can be said to be in favor of the sixth grade (Table 8: 9). Topolovčan and Matijević (2017) stated that there is no relationship between the grade levels of critical thinking disposition. In addition, critical thinking does not increase because of the increase in the class level of the student and the connection with the tools of technological communication. Also, Serin and Korkmaz (2018) with Çakırlar Altuntaş and Turan (2018) they were able to identify the meaning between groups in their studies.

7. Conclusions and Suggestions

As a result of the research scales were developed. Thanks to pilot implementation reliability and validity scales were obtained. Two different versions of the tools that can be used to define critical thinking skills in science lesson have been obtained. Accordingly, a 13-item optional-type scale (Ed 1) and 9-item Likert-type scale (Ed 2) was developed. According to this, students' critical thinking skills can be determined in the science lesson. Thanks to these scales, changes in the teaching of the course can be made by benefiting from the negative thoughts of the students about science lesson.

It is determined that female students have high critical thinking skills according male students. Positive studies can be done for the science lesson by taking advantage of the differences in the way students think. In the teaching of the course, appropriate methods and techniques can be used.

It is determined that the sixth grade students in science lesson have high critical thinking skills according to seven and eighth grade students. This difference between class levels can be reflected on the teaching of the course. In addition, the reasons for this difference should be investigated. As the student progresses the reasons for decreasing the critical thinking skills towards the science lesson should be examined. In addition, appropriate strategies should be used for the teaching of the science lesson within the framework of these positive results. It is thought that determining the students' critical thinking skills towards the science lesson will positively affect the teaching of the course.

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Appendix

Ed 1: Optional critical thinking scale
Critical thinking power of 6th 7th and 8th grade students in science lesson

Dear Students,
In order to determine the students' critical thinking skills, 15 questionnaire questions were prepared. This survey serves a scientific study. It will certainly not be evaluated by grade. Those who do not want to participate may not participate. Would you read the questions and mark the option that best suits you?
Your class: Gender:

1. What do you know about the subjects of science lesson?
a) I don't know what I know.
b) I know a lot.
c) I do not know everything; there is a lot I do not know.

2. What do you do if you cannot learn in science lesson?
a) When I can't learn things, I say so.
b) My capacity takes everything; there is nothing I can't learn.
c) When my mind tells me that I can't learn things, I say that I can learn them.

3. What do you do if you have incomplete knowledge to solve a problem in science lesson?
a) My mother, father, or teachers tell me what I need to know.
b) I already know everything.
c) I can learn everything I need to know.

4. How much do you think in science lesson?
a) I don't think too much, thinking is a problem for people.
b) I think a lot, trying to surprise people and get what they want.
c) I think a lot about understanding and learning subjects.

5. Do you believe in all the case studies described in science lesson?
a) If I hear any event, I believe immediately.
b) I believe in what I want to believe and what I want to achieve.
c) I do not believe directly in everything that is said and told. I'il try to get some information.

6. What do you do in any dilemma you encounter in science lesson?
a) To whom, to tell my parents what to believe.
b) To whom, I know what to believe.
c) I have to think for myself, what to believe.

7. What do you think if your friends don't like your thoughts that you know right in science lesson?
a) I do not like their thoughts.
b) All I know is true and everyone likes it.
c) I have to be able to say something that I know right, even if my friends don't like it.

8. What do you do to fulfill your duties in science lesson?
a) I'm doing tasks that don't hurt me
b) I do as much as what others do.
c) I perform duties without bias

9. What do you do if you disagree with your friends in some subjects of science lesson?
a) I would like help from my mother or my father.
b) I never give up my own ideas.
c) I try to look at things through their opinion.

10 (11). How would you be fair and impartial in your criticism of science lesson?
a) I try to be fair and impartial to others.
b) I don't think of them because others can't think of my feelings.
c) When I think of others' feelings before making a criticism, I am fair and impartial.

11 (12). What do you do to solve a problem you encounter in science lesson?
a) Everyone uses which path I use
b) The way I know is the best way.
c) There is always a better way and I can find it.

12 (13). What do you do to find a logical solution to a problem you encounter in science lesson?
a) I try to think logically.
b) My thoughts already make sense.
c) If my thoughts constitute a meaningful whole, then I think logical.

13 (14). Who do you think of any invention you will do in science lesson?
a) I don't think much of myself and others.
b) If others think of me, I think about them.
c) If I don't think of others why they think me?

Ed 2: Likert critical thinking scale
Critical thinking power of 6th 7th and 8th grade students in science lesson

Dear Students,
In order to determine the students' critical thinking skills, 15 questionnaire questions were prepared. This survey serves a scientific study. It will certainly not be evaluated by grade. Those who do not want to participate may not participate. Would you read the questions and mark the option that best suits you?
Your class: Gender:

Substances	Not agree	Undecided	Agree
1 (2). When my mind tells me that I can't learn anything's, I tell my mind I can of them in science lesson.			
2 (3). I can learn everything I need to know in solving science problems.			
3 (5). I don't believe in all the cases studies described, I'll try to get some information in science lesson.			
4 (6). I have to think about what I believe in the dilemmas I encounter in science lesson.			
5 (9). If I fall in disagreement with my friends in science lesson, I try to look at things through their opinion.			
6 (11). When I think of others' feelings in criticism I will make a fair and impartial in science lesson.			
7 (13). If my thoughts about solving the problem I have encountered form a meaningful whole, then I think logical in science lesson.			
8 (14). I think of the benefit of others in any invention in science lesson.			
9 (15). I'm thinking about the possible implications of any invention in science lesson.			

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