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Scale Development on Educational Value of The History of Science

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ABSTRACT

This study was aimed at developing a scale for revealing the views of teachers concerning the educational value of the history of science. To this end, the draft scale form, which was composed of 37 items, was administered to primary school teachers, science and technology, mathematics and social science teachers, working in elementary and middle schools in various Turkish cities. While the exploratory factor analysis was conducted with 350 teachers, the confirmatory factor analysis was carried out with 161 teachers. A three-factor model, entitled "Understanding and Being Interested in Science", Understanding the Scientific Process" and "Outlook on Science and Scientists", explaining 56.94% of the total variance, was obtained through the exploratory factor analysis. The first-order and the second-order confirmatory factor analyses demonstrated that the three-factor model of the scale had a theoretical and statistical fitness.

Key Words: History of science, Opinions of teachers, Scale development

INTRODUCTION

George Sarton begins his work, *Ancient Science and Modern Civilization*, with the following words: "*When I was a child, the table of multiplication was called The Table of Pythagoras, but the teacher did not tell us who Pythagoras was; perhaps she did not know it herself.*" He continues with the criticism of not mentioning the social environment in which great scientists grew up and not uttering a word about their personalities or their prodigies whilst introducing them. These expressions hold two important evaluations: the way the history of science is handled in lessons and relevant teacher competencies.

The way the history of science is handled in lessons is quite problematic. The history of science aims at specifying which phases have been experienced throughout the scientific journey, describing the emergence and development of scientific theories, the contribution of other cultures during this period, how scientists endeavor, a revelation of the methods,

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instruments and tools they employ and knowing and promoting scientific activity from all aspects (Topdemir & Unat, 2008). However, schools, curricula and books are only interested in scientific products so they often ignore the experiences, efforts and explanations that have taken place during this process (Laçin-Şimşek, 2009; Laçin-Şimşek, 2011b; Monk & Osborne, 1997; Narguizian, 2002; Wang, 1998). The history of science is merely used for identifying those who have made the discoveries and inventions.

Teacher competencies are another aspect of the problem. In order to use the history of science in education effectively, it should be appreciated and valued by teachers (Laçin-Şimşek, 2011a). Also, they should have adequate knowledge regarding this issue. Although previous studies have reported that including the history of science in lessons helps students to understand the nature of science, it has been stated that schools are not really interested in the history of science (Lin & Cheng, 2002); teachers are not really eager to teach about the issue (Brush, 1974); the process-based nature of science is rather ignored (Wang & Marsh, 1998); and teachers are not aware of the importance of the history of science (Wang & Marsh, 2002). In a study conducted with pre-service teachers and elementary and middle education science teachers, it was reported that the teachers were not competent enough to reflect the history of science in their lessons, even though they were aware of its importance (Wang & Cox-Petersen, 2002). Since teachers have deficient knowledge and understanding about the history of science, they do not include issues related to it in their classes (Abd-El-Khalick & Lederman, 2000; Monk & Osborne, 1997).

Similar results have been reported in Turkey as well; some studies conducted with pre-service social sciences (Laçin-Şimşek & Şimşek, 2010) and science teachers (Laçin-Şimşek, 2011) detected that pre-service teachers had inadequate knowledge of the history of science. In the study, which inquired about the opinions of science and technology teachers regarding the history of science and introducing this aspect to their classes (Laçin-Şimşek, 2011), it was found that teachers had an inadequate understanding regarding the history of science. It was concluded that teachers who participated in that study generally focused on the conceptual aspect of science and, therefore, gave coverage to the history of science in their classes only within the framework of an attempt to offer scientific knowledge to students. Moreover, it was determined that they mostly skipped the aspects of how science works, how scientists conduct research, under what conditions studies are carried out, and how social, cultural and financial characteristics influence these studies.

There are only a limited number of studies in Turkey on the history of science and its use in classes. Therefore, this study aims at developing a scale to determine teachers' opinions on the use of the history of science in classes and its contribution to students. In relation to the benefits of using the history of science in courses, the literature provides the following aspects: the contribution of the history of science to conceptual comprehension, the contribution of the history of science to comprehending the process, and the contribution of the history of science to comprehending the context (Laçin-Şimşek, 2011; Wang & Marsh, 1998; Wang & Marsh, 2002).

What conceptual comprehension refers to here is what scientific thinking and concepts mean. In order to achieve this, the history of science is used to enrich the presentation of scientific knowledge and highlight the changeable nature of the science. Concepts are explained by using the examples from the history of science. Comprehending the process refers to the research process. Examples are drawn from how to conduct research, how data is collected and evaluated and how the experiments are designed and conducted. Thus, the aim is to make students understand how a scientific study is conducted. Contextual comprehension draws the attention to the sociological, social, cultural and personal characteristics. It is about the lives of scientists, the cultures they lived in, how these influenced their viewpoints and studies, and the personal characteristics of scientists.

The absence of such a scale in Turkey made its development necessary. Elementary education was re-organized in 2004, which introduced the history of science to science, the social sciences and mathematics courses as a separate acquisition. However, it is not thoroughly known what teachers now think about the use of the history of science in classes. Therefore, it is necessary to reveal what they think about the use of the history of science in class and the value they attach to this practice, thus, there was a need for such a scale. There is only one scale in the international literature about the use of the history of science in classes (Wang & Marsh, 1998). There are two sections in this scale. The first section has 13 items, with teacher perceptions regarding the use of the history of science in classes. The other section also has 13 items, which deals with to what extent they can reflect it in their classes. The purpose of this study is to develop a scale to reveal teacher opinions about the educational value of the history of science.

METHODOLOGY

a) Study Group

The study was conducted with primary school, science, social studies and mathematics teachers working in primary or middle schools located in different provinces of Turkey. Study groups were determined through purposeful and convenience sampling. Purposeful sampling was employed because the branch teachers, who had acquisitions related to the history of science in their courses, were included in the study. Convenience sampling was employed as the data was collected with the help of the teachers, graduated by the researchers. The study was conducted in two different study groups. While the data obtained from the first study group was exposed to exploratory factor analysis, the data collected from the second study group was exposed to confirmatory factor analysis.

Confirmatory factor analyses were carried out with 350 teachers in total. Of these, 192 were primary school teachers (54.9%); 61 were science and technology teachers (17.4%); 49 were mathematics teachers (14.0%) and 48 were social sciences teachers (13.7%). The ratio of males in this group was 55%; while the ratio of females was 45%. In terms of area of work: 118 of these teachers worked in a central district; 158 worked in other districts and 69 worked in towns and villages. There were participants from both primary and middle schools. Their ages ranged from 22 to 60 (m=32.9; Sd=7.85). Confirmatory factor analyses were carried out with 161 teachers in total. Of these, 90 were primary school teachers (55.9%); 34 were science and technology teachers (21.1%); 24 were social science teachers (14.9%) and 13 were mathematics teachers (8.1%). The ratio of males in this group was 54%; while the ratio of females was 46%. Of these, 65 teachers worked in a central district; 60 worked in other districts and 36 worked in towns and villages. There were participants from both primary and middle schools. Their ages ranged from 22 to 60 (m=33.2; Sd=7.68).

b) Data Collection Tool

In order to develop a measurement tool to reveal teacher opinions regarding the educational value of the history of science, a literature review was conducted and the theoretical information was reviewed. As Wang & Marsh (1998) had developed a scale on this subject, their study was examined. Afterwards, the study conducted on teachers by Laçin-Şimşek (2011), regarding the evaluation of the use of the history of science, was examined. In that study, the data was collected through open-ended questions. The expressions provided in that study as direct quotations were reviewed. Items were created out of these expressions after receiving permission from the author. After analyzing all the data, an item pool,which had 38 items, was formed by the researchers.

Five academics were consulted to evaluate the validity of the form composed of these expressions, in terms of clarity, content validity and face validity. The academics were selected because they had written publications on the history of science, the nature of science and scale development. In accordance with the opinions and criticisms of the academics,, the scale items were rearranged; some were corrected and some were removed from the scale. In the end, a pilot scale consisting 37 items, was created. The validity and reliability of these items was investigated. There were seven negative and 30 positive items in the scale. A 5-point Likert-type rating was employed to express the agreement levels with the items. The rating was as follows: "*I strongly agree (5), I agree (4), I partially agree (3), I disagree (2), I strongly disagree (1)*".Moreover, an instruction was put in the beginning of the scale about the purpose of the scale, as well as the types of responses expected for the items.

c) Data Analysis

Initially, a confirmatory factor analysis was carried out to test the construct validity of the data obtained from the pilot study. During the confirmatory factor analysis, in determining the number of the factors in the scale, the contribution of each factor to the covariance had to be not less than 5% (Seçer, 2013);eigen values had to be 1 at least (Büyüköztürk, 2006) and the fractures in scree plot had to be taken into consideration (Çokluk, Şekercioğlu & Büyüköztürk, 2010). Furthermore, factor loadings had to be at least 0.32 (Tabachnick & Fidel, 2001), being part of only one factor and a difference of a minimum 0.10 between the load values of the items, which are part of two factors (Büyüköztürk, 2006) were taken as the basic principles. Internal consistency and split-half test reliability analyses were conducted for the reliability of the scale. Also, for the item analysis, the corrected item-total score correlation was calculated and the significance of the differences between the item averages of the top 27% ,and the bottom 27% ,was acquired through the *t* test.

The item-factor structure, which was obtained through confirmatory factor analysis, was tested for model fit via confirmatory factor analysis. To evaluate the fit of the model in confirmatory factor analysis, the criteria were >.90 for GFI, AGFI, NFI, CFI, IFI, and TLI and <.08 for RMR and RMSEA (Jöreskog & Sörbom, 1993; Tabachnick & Fidel, 2001; Şimşek, 2007, Bayram, 2010). Moreover, a value of $\chi 2$/sd between 0 and 2 refers to a perfect fit (Tabachnick & Fidel, 2001).

SPSS 15 and AMOS 7.0 were used for all the validity and reliability analyses.

FINDINGS

Testing the Validity and Reliability of the Scale

The first phase of ensuring the scale's construct validity involved exploring the internal consistency and the item-total correlation of 37 items. Seven negative items with a low item-total correlation (e.g., "The history of science in the class is *only* good for telling about the lives of scientists."; "Quoting from the history of science in classes is good for drawing the attention of students only for a second.") and 1 positive item with a low item-total correlation, which means eight items in total (the 9th, 10th, 16th, 20th, 22nd, 24th, 32nd and 37th items), were excluded from the scale. The rest of the items were tested for construct validity. In order to determine whether the scale was appropriate for factor analysis or not, Kaiser-Meyer Olkin (KMO) and Barlett's test of sphericity were conducted. At the end of the analysis, the KMO value was found to be 0.95 and Bartlett's test of sphericity was found to be ($\chi^2_{(406)}$=5367.31; p<0.01) significant. A KMO value higher than 0.90 indicates that factors can be extracted from the data (Şencan, 2005; Büyüköztürk, 2006). At the end of the analyses, the resulting values met the aforementioned basic assumptions at a pretty good level. Therefore, the factor analysis could be conducted. Principal component analysis was used as a factoring method and the direct oblimin method, which is one of the oblique rotation methods, was used as a rotation method to reveal the factor structure of the scale.

At the end of the analysis, it was seen that 29 items in the scale had an eigenvalue over 1, with a four-component structure. Taking into account the contribution of these components to total variance, scree plot, and the number of the factors identified during the development phase of the tool, a 3-factor structure was accepted.

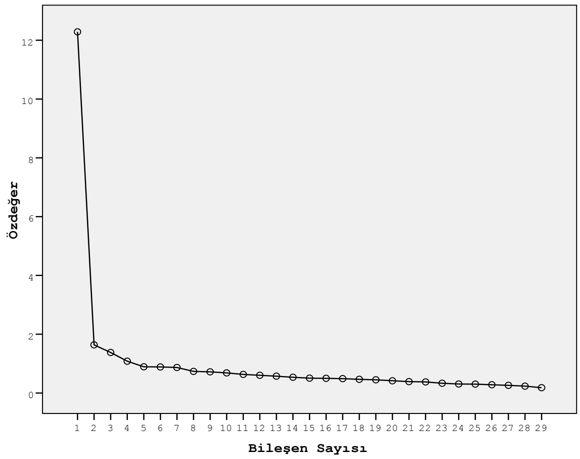

Figure 1. *Scree Plot*

According to the scree plot in Figure 1, there is a fast curve downwards (i.e., fracture) until the third factor, but after that it is fixed. Therefore, the 3-factor structure was approved.

At the end of the repetitive analyses, which were carried out for the 3-factor structure, six items (the 6^{th}, 7^{th}, 8^{th}, 18^{th}, 19^{th}, and 25^{th}) were excluded due to overlap, and another item (11^{th} item) was excluded because it had a lower factor load value in comparison to the other factor load values. Seven items were excluded in total. The analysis conducted afterwards revealed that the contribution of the first factor to total variance was 45.03%; that of the second factor was 6.29%; and that of the third factor was 5.61%. The total contribution of these three factors was 56.94%. In multiple factor designs, it was expected for the factor covariance to be over 41% (Kline, 1994). Accordingly, it is possible to say that the percentage of the total variance explained by three factors is quite good and adequate.

At the end of the analysis, a scale consisting of 22 items was obtained. Table 1 shows the factor design of the scale, as well as its factor load values, factor covariances, item-total correlations and internal consistency coefficients. In addition, it indicates the comparison results of the bottom and top groups for each item.

Table 1. *Findings Regarding the Scale Items and Factors at the End of the Factor Analysis*

		Load Values After Rotation				Reliability			Bottom Group (27%)		Top Group (27%)		
Item	**FactorCovariance**	**1^{st} Factor**	**2^{nd} Factor**	**3^{rd} Factor**	**Item-Total Correlation**	**Internal Consistency**	**Split Half Test**		**$\overline{X}$**	**S**	**$\overline{X}$**	**S**	**T**
i28	.65	.88			.69	.93	.91	95	3.08	.68	4.62	.57	16.91*
i29	.62	.86			.69			95	3.06	.83	4.53	.54	14.36*

i34	.56	.74			.68			95	3.07	.71	4.56	.60	15.55*
i13	.65	.73			.70			95	3.03	.83	4.42	.63	13.00*
i27	.58	.71			.69			95	3.21	.77	4.74	.47	16.53*
i14	.60	.70			.71			95	3.02	.79	4.65	.52	16.81*
i31	.55	.68			.68			95	3.08	.82	4.54	.54	14.39*
i33	.56	.67			.70			95	3.08	.74	4.68	.49	17.61*
i26	.54	.65			.66			95	3.33	.88	4.79	.41	14.68*
i36	.51	.63			.66			95	3.12	.71	4.52	.58	14.84*
i12	.56	.63			.66			95	3.02	.84	4.43	.63	13.12*
i35	.45	.63			.60			95	2.99	.90	4.50	.73	12.70*
i30	.55	.55			.69			95	3.30	.74	4.68	.51	15.03*
i3	.65		.79		.57			95	3.63	.69	4.66	.52	11.71*
i4	.60		.74		.52			95	3.21	.88	4.40	.75	10.02*
i1	.59		.72		.57	.83	.81	95	3.14	.87	4.53	.67	12.36*
i5	.56		.67		.58			95	3.66	.80	4.66	.54	10.13*
i2	.64		.63		.68			95	3.40	.75	4.63	.53	13.10*
i17	.55			.70	.46			95	3.58	.78	4.60	.66	9.74*
i23	.60			.68	.54	.73	.70	95	3.33	.74	4.52	.76	11.00*
i21	.55			.64	.53			95	3.26	.83	4.50	.74	10.80*
i15	.45			.43	.58			95	3.25	.93	4.73	.61	12.89*
Total						.94	.89	95	70.84	7.19	100.87	5.54	32.25

*p<.001

Considering Table 2, it is seen that the first factor covers thirteen items which are the 12th, 13th, 14th, 26th, 27th, 28th, 29th, 30th, 31st, 33rd, 34th, 35th and 36th items. The load values of these items range from 0.55 to 0.88. The second factor of the scale has the load values ranging from 0.63 to 0.79. It covers five items in total, which are the 1st, 2nd, 3rd, 4th and 5th items. The third factor covers items whose load values range from 0.43 to 0.70. It covers four items in total which are the 15th, 17th, 21st and 23rd items. In terms of sizes, the factor load values follow a course from "good" to "perfect" (Tabachnick & Fidel, 2001). Taking the content of the items falling under each factor and their suitableness for the construct together, the factors were named, based on the theoretical background, as follows: the first factor was "*understanding the science and having an interest in it*" (*conceptual comprehension*); the second factor was "*understanding the scientific process*" (*scientific process comprehension*); and the third factor was "*viewpoints regarding science and scientists*" (*contextual comprehension*). Twenty-two items associated with the educational value of the history of science scale had factor covariance values over 0.20, which indicates high contribution to the variance (Çokluk, Şekercioğlu & Büyüköztürk, 2010).

In relation to the discrimination capacity and homogeneity of the scale, the item-total correlations were calculated and a *t* test was conducted to identify the significance between the item-total scores of the bottom 27% and the top 27% groups. It was seen that the item-total correlations of the scale ranged from 0.46 to 0.71, and t values for the difference between the scores of the top 27% and the bottom 27% groups (sd=188) ranged from 9.74 to 17.61. Having item-total correlations over 0.30, and the significance of the difference between the total scores of the top and the bottom groups, indicated that each item disciminates the characteristic it measures; items measure similar behaviour and the internal consistency of the scale is high (Büyüköztürk, 2006). In relation to the reliability of the scale, the internal consistency (alpha) coefficient was found to be 0.93, while the split half reliability coefficient was found to be 0.89. The internal consistency of the first factor of the scale was found to be 0.93, while its split half reliability coefficient was found to be 0.91. The internal consistency of the second factor was found to be 0.83, while its split half reliability coefficient was found to be 0.81. The internal consistency coefficient of the third factor was found to be 0.73, while its split half reliability coefficient was found to be 0.70. All these findings are indicative of the fact that the scale is reliable at a satisfactory level.

Confirmation of the Scale Construct

In order to see whether the factor structure of the scale, which was developed as its validity and reliability was tested through confirmatory factor analysis would be confirmed or not, the first order and the second order confirmatory factor analyses were conducted. Confirmatory factor analysis (CFA) is an analysis to evaluate model-data fit by testing the hypotheses formulated for the relationship between variables (Daniel, 1989).

The confirmatory factor analysis concentrated on the model-fit indices of the three-factor scale. The results of the order CFA are given in Figure 2.

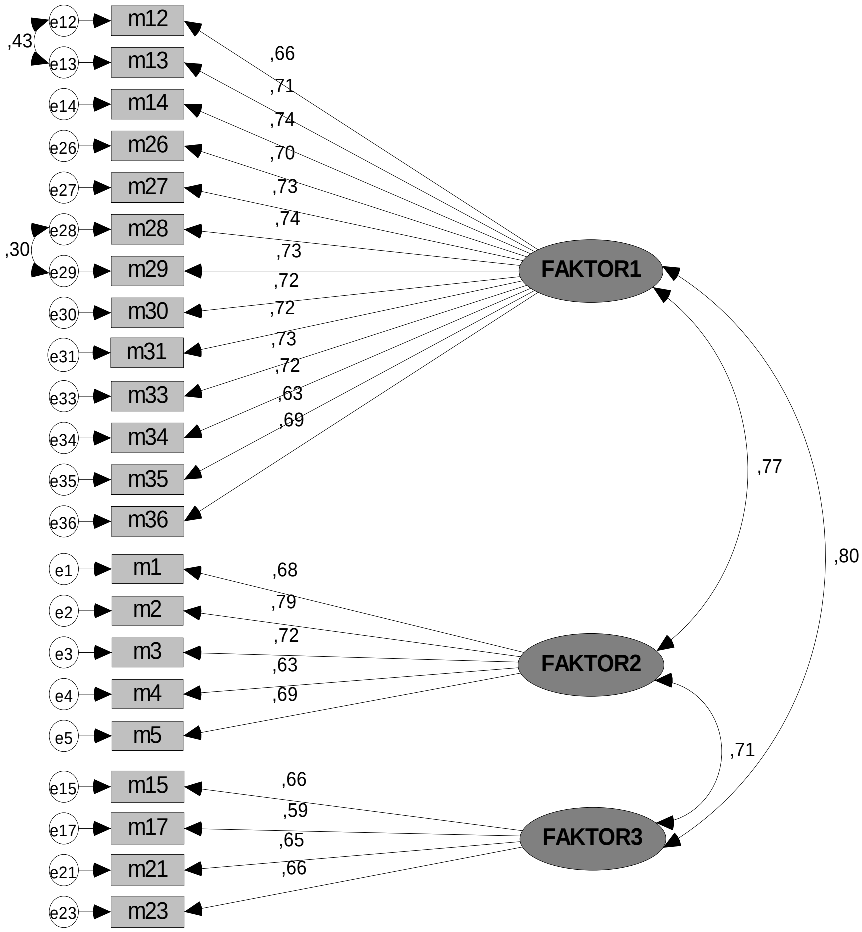

Figure 2.*The First Order CFA Results Regarding the Educational Value of the History of Science Scale*

At the end of the CFA, it was seen that the Educational Value of History of Science Scale (EVHSS), which consisted of 22 items and three factors, had significant model fit indices ($\chi2$=389.4; sd=204; p=.00; $\chi2$/sd=1.91). Since $\chi2$ is not a statistic that can be used by itself, $\chi2$ was proportioned to the degree of freedom, and $\chi2$/sdrate was seen to be 1.91. This value refers to the perfect fit. Fit index values were found to be RMSEA=.05; RMR=.03; GFI=.91; AGFI=.89; NFI=.91; CFI=.95; and TLI=.95. Considering the RMSEA=.05 and

RMR=.03 values of the scale, it is possible to say that the RMSEA value corresponds to good fit while the RMR value refers to perfect fit. Considering the GFI and AGFI values, GFI corresponds to good fit, whereas AGFI corresponds to poor fit. Considering the NFI, CFI and TLI values, NFI corresponds to good fit, while CFI and TLI correspond to perfect fit. Associations were made between i12 and i13 and between i28 and i29, which were included in the first factor, in order to yield better fit values, since they contributed to a decrease in the $\chi 2$ value in the relevant model in the first order CFA analysis. It is possible to say that relationships emerged between the error variances of these items because they were under the same factor and measured the same aspects.

Many studies emphasize the necessity of conducting the second order CFA for multiple dimension scales (Çokluk, Şekercioğlu & Büyüköztürk, 2010; Meydan & Şeşen, 2011).The second order CFA results regarding this three-dimension model are given in Figure 3.

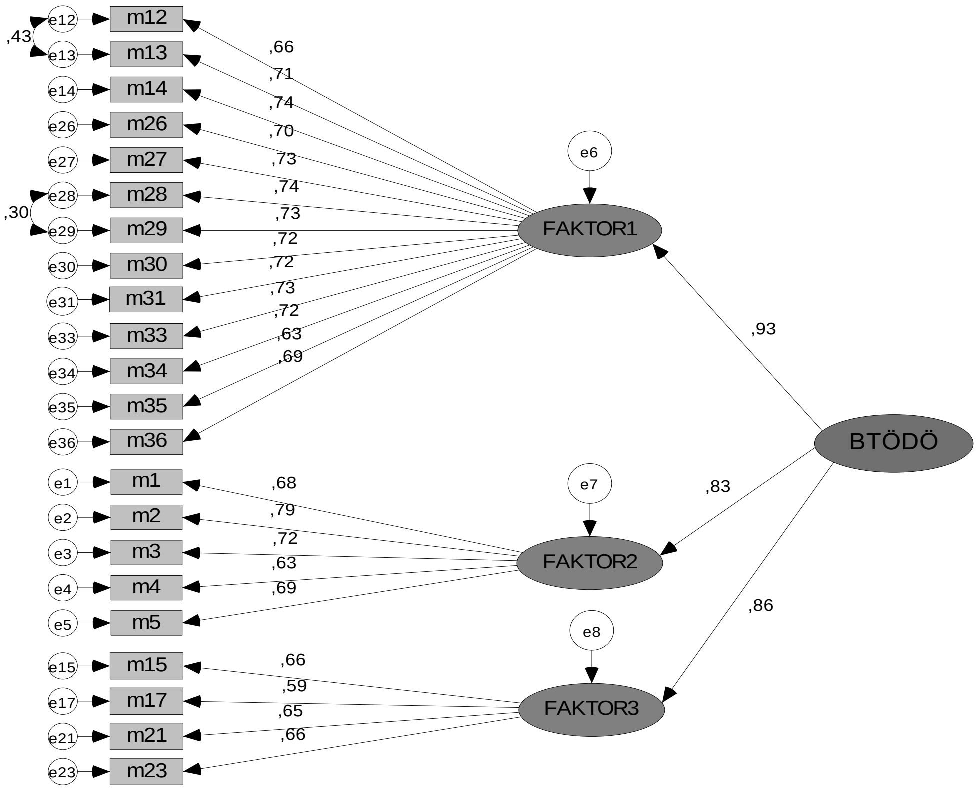

Figure 3.*The Second Order CFA Results Regarding the Educational Value of the History of Science Scale*

According to the results of the second order CFA, conducted in relation to the three-factor structure of EVHSS, the model fit indices were significant ($\chi 2$=389.4; sd=204; p=.00; $\chi 2$/sd=1.91). The fit index values were found to be RMSEA=.05; RMR=.03; GFI=.91; AGFI=.89; NFI=.91; CFI=.95;and TLI=.95. Since modification was made in the first order CFA, the same modification was kept the same in the second order. It is seen that all the values produced in the second order CFA were the same. This indicates that the second order relationships do not have any influence on parameter values in the model (Şimşek, 2007). As a high order latent (hidden) variable of the second order CFA, EVHSS explains FACTOR 1, FACTOR 2 and FACTOR 3 variables. The variable having the highest association with EVHSS is FACTOR 1 with a value of 0.93; whereas the variable having the lowest association with EVHSS is FACTOR 2 with a value of 0.83. As seen in Figures 1 and 2, factor loads ranged from 0.63 to 0.72 for the first factor; from 0.63 to 0.72 for the second factor and from 0.59 to 0.66 for the third factor.

DISCUSSION

This study was conducted to develop a scale in order to reveal teacher opinions regarding the educational value of the history of science course. Initially, confirmatory factor analysis was conducted and a three-factor structure explaining 56.94% of EVHSS' total variance was obtained. Explaining over 41% of the variance is deemed adequate in multiple factor scales (Kline, 1994). Therefore, it is possible to claim that the scale had construct validity at a good level and it measures what needs to be measured at a reasonably good level. Factors of "The Educational Value of the History of Science Scale" were named based on the theoretical background. The first factor was "understanding science and being interested in science"; the second factor was "understanding the scientific process" and the third factor was "viewpoints regarding science and scientist". As for the distribution of 22 items among the factors, the 12^{th}, 13^{th}, 14^{th}, 26^{th}, 27^{th}, 28^{th}, 29^{th}, 30^{th}, 31^{st}, 33^{rd}, 34^{th}, 35^{th} and 36^{th} items are under the first factor; the 1^{st}, 2^{nd}, 3^{rd}, 4^{th}, and 5^{th} items are under the second factor and the 15^{th}, 17^{th}, 21^{st} and 23^{rd} items are under the third factor. All the items have high factor load values under their own factors, whereas these values decrease in other factors. That indicates the independence of the factors.

Internal consistency and split half tests were employed as reliability methods in order to identify the reliability of the scale. At the end of the analyses, the internal consistency for the entire scale was found to be 0.93, while its split half reliability coefficient was found to be 0.89. Considering the sub-dimensions, the internal consistency coefficient of 'understanding science' and 'having an interest in science' was found to be 0.93, and its split half reliability coefficient was found to be 0.91. The internal consistency coefficient for 'understanding scientific process' was found to be 0.83, and its split half reliability coefficient was found to be 0.81. The internal consistency coefficient of viewpoints regarding science and scientists was found to be 0.73, and its split half reliability coefficient was found to be 0.70. Considering the fact that the reliability coefficient estimated for psychological measurement tools should be over 0.70 (Büyüköztürk, 2006), it can be said that the above-mentioned results are indicative of a consistent and stable reliability for both the entire scale and its sub-dimensions. Moreover, a *t* test was conducted on the total scores of the top 27% and the bottom 27% groups. The results indicated significant differences between all items. At the end of the item analysis, it was seen that the item-total score correlation of the scale was at a desirable level (0.30 and over). In this sense, considering all the obtained results, it is possible to say that the items in "The Educational Value of the History of Science Scale" discriminate all the characteristics they measure and measure similar behaviour and that the scale has a high internal consistency (Büyüköztürk, 2006).

The reliability of the scale was tested through confirmatory factor analysis. The final version of the scale consisted of 22 items and a three-factor structure. Finally, the scale was subjected to confirmatory factor analysis and model fit testing. At the end of the first and second order confirmatory factor analyses, the three-factor model of the scale was found to be organizationally and statistically fit. Accordingly, it is possible to assert that the theoretical construct obtained through the confirmatory factor analysis was confirmed via the confirmatory factor analysis.

Even though the literature contains numerous studies focusing on the history of science and the importance of its use in lessons, there is only one scale measuring teachers' views in this matter. This study was carried out by Wang & Mash (1998) who administered the scale to science teachers. It consisted of two sections; the first section was formed to determine teachers' perceptions regarding the importance of the history of science. The second section, on the other hand, was made up of questions investigating how they included the history of science in their lessons (i.e., how they used it in practice). No scale has been administered on this issue in Turkey. Althoug Wang & Marsh's scale was only for science teachers, our study does not have such a limitation. While the items were being formed in the present study, all the branches involving acquisitions about the history of science (teaching in primary schools, science, social studies and mathematics) were all taken into consideration. Furthermore, whereas Wang & Marsh measured what teachers did in practice, the present study does not include items for this purpose.

To conclude, all the findings obtained in the present study indicate that the developed scale is a valid and reliable tool. Therefore, it can be used to reveal teachers' opinions regarding the educational value of the history of science.

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APPENDIX-I. THE SCALE FOR TEACHER OPINIONS REGARDING THE EDUCATIONAL VALUE OF THE HISTORY OF SCIENCE

	I strongly agree	I agree	I partially agree	I disagree	I strongly disagree
1. Students understand how discoveries and inventions are made through the history of science.					
2. Lecturing with the help of the history of science makes students comprehend how scientific concepts were formed.					
3. The history of science makes students understand where scientific knowledge and tools come from.					
4.Thanks to the history of science, students realize how scientific studies are conducted.					
5.The history of science makes students aware of the contribution of inventions and discoveries to the advancement of human kind.					
12. Students become more interested in classes when the history of science is included.					
13. Examples from the history of science make it easier to understand the subjects.					
14. Examples from the history of science increase students' eagerness to conduct research.					
15. Examples from the history of science help students know scientists.					
17. Examples from the history of science helps students to know who made the discoveries.					
21. Examples from the history of science help students understand that scientific information changes with time.					
23. Examples from the history of science help students understand that science is a matter of process.					
26. Examples from the history of science help students to understand the importance of imagination for the development of science.					
27. The history of science makes students think that if they want, they can be scientists as well.					
28. Learning about the lives of scientists encourages students to conduct research.					
29. Examples from the history of science help students to develop research skills.					
30. Lecturing with the help of the history of science makes students understand that science is created as a result of human activities.					
31. Examples from the history of science help students to see the relationship/interaction of science with society and culture.					
33. Giving examples from the history of science in classes help students to acquire different perspectives.					
34. Examples from the history of science help students to see the motivation underlying the scientific studies.					
35. Examples from the history of science help students to see how scientific studies have an influence on the welfare of human kind.					
36. Examples from the history of science help students to adopt inquiry skills.					