Developing, Implementing, Evaluation of an Attitude Scale for Towards Science and Technology Education

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Abstract

The aim of study is to develop, implement and evaluate a scale in order to determine students' attitudes towards science and technology lesson at primary level. Data collecting tool containing 38 items were changed in the form of the scale having 30 items. The items based on the expert opinions were applied total 30 primary students and made the needed corrections on the scale, by determining the items that students had difficulty in understanding about the lesson. Keiser-Meyer-Olkin coefficient was defined as .924. And also, significance level of Barlett test (BTS) was found as x2=4304, 059sd=496 (p=0,000). Cronbach alpha internal consistency coefficient was found as .914. In explanatory factor analyses, varimax rotation technique was applied to the data and seen to be three factors of the scale. As a result of the analyses, the developed scale can be seen in determining attitudes towards science and technology lessons of primary students.

Keywords: attitude; developing attitude scale; education; scale; scienceandtechnology

1. Introduction

When the content and objectives of the science program started being implemented in the year of 2006 was examined; "science", the name of the lesson, sis seen to have been changed to "science and technology". The aim of changing the name of the lesson is to raise students as literate not only in science but also in technology. All the topics which made by taking into account the principles of expanding and spiraling topics, were united under 4 headings. Accordingly, the program was separated into seven different learning areas. Namely; living things and life, matter and changes, physical events, earth and the universe, science-technology-society and environment relations, scientific process skills, attitudes and values (ministry of education, 2006). For "attitudes and values", which is one of the science literacy fields, it is aimed to make students develop positive scientific attitudes and values directed towards the science and technology. In the science and technology lessons, it is not seen enough that students only gain information, understanding, and skill. The necessity of gaining students certain scientific attitudes and values are emphasized (ministry of education,2006). Attitude is known as education constituted in regularly form of idea, emotion and affective behaviors related to an event or object of peoples (Anderson, 1988). Bloom (1979), stated importance of attitudes by saying to be impress of affective behaviors in the formation of cognitive behaviors in science education. Once, if is considered to be effective positive/negative behaviors, experimental learning and continuity, attitude seen as an factor influencing an individual's behavior. Student's attitudes must have a positive to be successful in science and technology subject (Balım, Sucuoğlu & Aydın, 2009; Evrekli, İnel, Balım & Kesercioğlu, 2009). When attitude scales directed towards science and technology was examined in literature, it was generally seen in the way of determining students' attitudes towards one lesson (Nuhoğlu & Yalçın, 2004; Bilgin, Özarslan & Bahar, 2006; Jenkins, 2006; Chang, Yeung, &Cheng, 2009; Aktamış & PekmezŞahin, 2011).These researches were conducted in a way to determine the level of research skills.

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On the other hand in literature, it is seen that there has been a few study in developing attitude scale directed towards science and technology lesson in the primary school level since 2006.

(Kind, James, & Barmby, 2007; Nuhoğlu, 2008; Balım, Sucuoğlu & Aydın, 2009; Najafivd, 2012).For effective teaching in science and technology lessons, measurement and evaluation of attitudes are gaining importance.The aim of this research is to determine the effectiveness and reliability of the attitude scale of primary school students in relation to science and technology lesson.

2. Method

The working group for the research consisted of 6th, 7th and 8th grade students from two different primary schools situated in Samsun, it consisted of a total of 357 students. The scale consisted of 27 items. The number of students participating in the research was 10 times that of the scale. The working group consisted of 180 male and 177 female students.122 of the students in the working group were in 6thgrade, 99 of them were in 7thgradeand 136 of them were in 8thgrade.The data related to the working group are as given in table 1.

Table 1: Information Relating to the Working Group

Grade level	No of students		gender			
	f	%	male		female	
			f	%	f	%
6	122	34,2	65	36,1	57	32,2
7	99	27,7	51	28,3	48	27,1
8	136	38,1	64	35,6	72	40,7
total	357	100,0	180	100,0	177	100,0

While the items in the scale were being prepared, screening related to science and technology lesson was done. At the end of all the studies, a pretest containing 38 items was formed. The scale consisted of 20 positive and 18 negative items with the aim of balancing out the respondent's trends. The attitude items were prepared in such a way that they took into consideration not only factual circumstances but also desired and undesired circumstances. In this research scale rating was done in this way : "strongly agree:5″ , "agree:4″ , "undecided:3″ , "disagree:2″ , "strongly disagree:1″. The grading of the negative sentences was recorded in the reverse direction. To provide reliability in the scale scope, it was consulted to expert advice. The opinions and recommendations of 2 faculty members from Samsun Ondokuz Mayıs University, Faculty of Education, Department of Primary Science Education and of 3 science and technology teachers were taken. After expert opinions and recommendations, some items were added, some items were corrected and other items completely removed from the scale. Based on expert opinions, 30 students of the 2nd level of primary school were asked the items that they found hard to understand. By determining these items corrections were done. The scale was made ready for research in a way that it would consist of 30 items. The 30 students who participated in the pretest scale were not included in the working group. After expert opinions and application of the pretest a scale containing 30 items was applied to the working group containing 357 students studying in the 6th 7th and 8th grades. In determining the adequacy of the used sample KMO (Kaiser, Mayer Olkin) and BTS (Barrett's Test) was examined by using the anti-correlationtest. With the aim of determining structural validity, factor analysis was applied and varimax rotation method was used. By considering that factorload value is an indicator of the relationship between matter and factor, it was found 40. To the scale substance, it was applied discriminant analysis based on total points for the substance correlation, and it was evaluated separately. Before the research, Cronbach Alpha reliability analysis as a correcting factor analysis was performed with the aim of determining the scale's internal consistency. At the end of the validity and reliability researches, it was given place to the correcting factor analysis. With the aim of determining whether the items belonging to the determined factors were represented adequately with these factors or not,it was benefited from the correction factor analysis. In analyzing our research's data SPSS 17 packet program was used and at the end of the analysis the scale was put in a way that it contained 27 items.

3. Result

Explanatory Factor Analysis

In application of the explanatory factor vari max perpendicular rotation technique was used. The rotations cale was found to contain 3 factors (figure 1). For good measurement the value of the load factor should be chosen as 0.45 or higher; however in the application for few items the limit can reduce to 0.30 (Büyüköztürk, 2004). By taking into consideration that there is a relationship between the factor value of the load items and the factors, the value of the load limit was determined as 0.40.

As a result of the analysis the factor loading was not supposed to be below 0.40 and the difference between the 3 factor scale load values should not be less than 0.20.After 3 item measurements that did not fit to these rules were removed the analysis was repeated. As a result of the new factor analysis, the scale with 3 factors was found as KMO: 0.924 and BTS: $x^2=4304, 059sd=496(p=0,000)$. In table 2 rotated basic components analysis is seen.
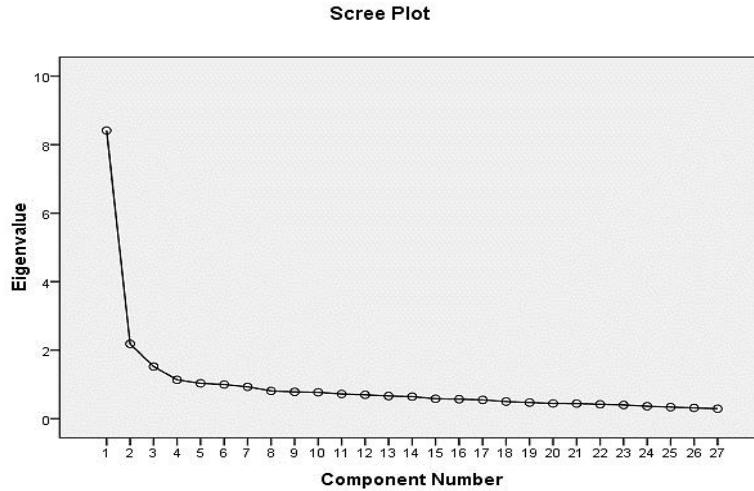

Figure 1: Content Values – Factor Graph

Table 1: Attitude Scale Factor Analysis Results for Science and Technology Lesson

Attitude items	Factors and load of factors		
	F1	F2	F3
s29*	,692		
s27*	,689		
s25*	,680		
s31*	,567		
s14*	,552		
s35*	,552		
s4*	,538		
s20*	,535		
s6*	,527		
s2*	,511		
s16*	,488		
s1		,676	
s7		,655	
s17		,621	
s9		,620	
s3		,581	
s15		,564	
s11		,539	
s24		,463	
s19			,706
s23			,676
s28			,631
s34			,536
s32			,496
s21			,483
s26			,461
s5			,460

(*) to determine negative expressions

When table 2 was analyzed it was seen that the first factor consisted of 11 items, the factor load value ranged between 0.48 and 0.69. The second factor consisted of 8 items and factor load value ranged between 0.46 and 0.67 and the third factor's factor range value ranged between 0.46 and 0.70.

Factor 1

The total factor was made up of 15.56 % of the variance. Factor load values ranged from 0.488 and 0.692, it was made up of 11 attitude items. First factor values are shown in table 3.

Table 2:1. Attitude items and Factor Loads Found in the Factor

1. Factor	Variables	Attitude items	Factor loads
Cronbach Alpha: .852	s29*	Science and technology lesson is one of the least important lessons.	,692
	s27*	I get bored when studying science and technology	,689
	s25*	I refrain from science and technology lessons.	,680
	s31*	I'm not interested in news about science and technology in newspapers and magazines.	,567
	s14*	I don't like the science experiments that i do at school.	,552
	s35*	If possible I would take another lesson in place of science and technology lesson.	,552
	s4*	The topics in science and technology are not the ones that in interested in.	,538
	s20*	I don't understand science and technology lesson.	,535
	s6*	If I didn't have to I wouldn't study science and technology lesson	,527
	s2*	I become sad when I study science and technology lesson.	,511
	s16*	I don't like participating in class activities.	,488

When the 11 attitude items consisting of factor 1 were examined they were seen to measure the student's negative items directed towards science and technology lesson. Factor one was named as "point of view towards science and technology". The Cronbach Alpha internal consistency coefficient was found as 0.852.

Factor 2

The total factor formed 15.41 % of the variance. Data of factor 2 consisting of 8 attitude items whose factor load values ranged from0.463 and 0.676 are shown in table 4.

Table 3: 2. Attitude items and Factor Loads Found in the Factor

2.Factor	Variables	Attitude items	Factor loads
Cronbach Alpha: .836	s1	Science and technology is one of the lessons that i love.	,676
	s7	I am comfortable in the science class.	,655
	s17	I would like the number of hours assigned to science and technology lesson to be increases.	,621
	s9	Science and technology is a lesson that makes people's lives easier.	,620
	s3	I find everything about science and technology interesting.	,581
	s15	I like reading books about science and technology.	,564
	s11	I feel important when i work with science tools.	,539
	s24	I get pleasure out of science and technology lessons.	,463

When the 8 items in 2 factor were examined it was seen that the items measured the perspective of valuing science and technology lesson. Factor 2 was named as "Valuing science and technology". The Cronbach Alpha internal consistency coefficient was found as 0.836. Factor 3 The total factor formed 13.51 % of the variance. Data of factor 3 consisting of 8 attitude items whose factor values ranged from 0.460 and 0.706 are shown in table 5.

Table 4:3. Attitude Items and Factor Loads Found in the Factor

3.Factor	Variables	Attitude items	Factor load
Cronbach Alpha: .822	s19	I love science and technology experiments.	,706
	s23	I do science and technology experiments cheerfully.	,676
	s28	I love class studies and activities in science and technology lesson.	,631
	s34	When I'm doing science experiments I get excited because I'm curious about the results.	,536
	s32	When I share scientific news and events i feel important.	,496
	s21	Science and technology gives us knowledge that we will need in the future	,483
	s26	I do my science and technology homework without getting bored, with pleasure.	,461
	s5	I love class studies and activities in science and technology lesson	,460

When the 8 items in factor 3 were examined, it was seen that they were the items which evaluate associating science and technology lesson with everyday life, and doing experiments and activities for better understanding of science and technology. Factor 3 was named as "assimilation of science and technology". The Cronbach Alpha internal consistency coefficient was found as 0.822.

For the measurement's reliability analysis SPSS packet program and every factor's Cronbach Alpha reliability coefficients were calculated in order. The data belonging to coefficient were as given in table 6.

Table 5: Scale factor and Coefficient Reliability

Factors	Item no.	Reliability (Cronbach Alpha coefficient)	Percent of variance
factor 1	11	0.852	15,56
factor 2	8	0.836	15,41
factor 3	8	0.822	13,51
Total scale	27	0.919	44,48

Cronbach Alpha internal consistency coefficient was considered in order to determine the reliability of the scale. It was found as 0.85 for the first factor 0.83 for the second factor and 0.82 for the third factor. Cronbach Alpha internal consistency coefficient for the whole scale was found as 0.919.

Items item-Total Correlation and Factor's Reliability in the Scale

Afteritemand factor analysis, place was given to collection formation related to scale reliability process. During this period Cronbach Alpha reliability coefficients related to factors and scale were calculated. Item – total correlation and factor reliability were as in the scale given in table 7.

Table6: Factor Analysis as a Result of the Scale Related to the Item Analysis Results

Factor	Item	Item-total corelation	Average %27 top group	%27 sub group	T value	P
1. factor / Cronbach Alpha: 0.852						
	s29	,471	4,524	2,802	10,491	.000***
	s27	,618	4,688	2,609	14,955	.000***
	s25	,435	4,552	3,063	9,605	.000***
	s31	,425	4,232	2,659	8,909	.000***
	s14	,529	4,688	2,938	11,210	.000***
	s35	,560	4,708	2,583	13,405	.000***
	s4	,465	4,438	2,850	10,024	.000***
	s20	,480	4,411	2,681	9,738	.000***
	s6	,493	4,635	3,028	10,479	.000***
	s2	,590	4,458	2,500	13,574	.000***
	s16	,470	4,542	2,979	9,636	.000***
II. factor / Cronbach Alpha:.836						
	s1	,581	4,688	2,967	13,543	.000***
	s7	,508	4,500	2,815	11,251	.000***
	s17	,427	4,104	2,398	9,502	.000***
	s9	,478	4,552	3,133	9,763	.000***
	s3	,492	4,413	2,882	10,642	.000***
	s15	,526	4,452	2,530	12,384	.000***
	s11	,472	4,594	3,000	10,143	.000***
	s24	,455	4,396	2,720	10,748	.000***
III. factor / Cronbach Alpha:.822						
	s19	,560	4,855	3,198	-11,895	.000***
	s23	,513	4,724	3,076	12,145	.000***
	s28	,576	4,769	2,873	14,251	.000***
	s34	,415	4,573	3,156	8,996	.000***
	s32	,463	4,396	2,849	10,659	.000***
	s21	,481	4,771	3,356	9,719	.000***
	s26	,638	4,671	2,438	16,576	.000***
	s5	,471	4,740	3,253	10,618	.000***

***p<.001 level significant difference.

When table 7 was examined the items in the scale-total correlation was found to be between 0.47 and distinctiveness of 0.64. Items were significant in the 0.01 level.

4. Conclusion

In the study, opportunity was given to Item analysis related to the research scale and the validity and reliability period .The research was conducted to the students in the primary 6th, 7th and 8th grades. The results of the research were analyzed by using SPSS 17.As a result of the analysis; items related to the scale were collected under 3 factors. The variances which factors explained were found as follows 15.56%, 15.41%, and 13.51%.The total variance accounted was 44.48%.For the total scale, Cronbach Alpha coefficient was found as 0.919. In accordance with the obtained results, it is thought that;

- The scale developed is a valid and reliable method of measurement to determine primary school students' attitudes towards science and technology.
- When these characteristics of the scale are put into consideration it can be used in related researches.

- It can supply feedback to researchers in determining primary level students' attitudes towards science and technology.
- Similar scale development researches can be done by taking secondary and university levels into consideration.

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