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Procedia Social and Behavioral Sciences 1 (2009) 2222–2226

Procedia Social and Behavioral Sciences

World Conference on Educational Sciences 2009

An opinion scale of constructivist approach for science teachers: a study of validity and reliability

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Received October 8, 2008; revised December 25, 2008; accepted January 6, 2009

Abstract

The purpose of this study is to develop an opinion scale of constructivist approach for science teachers. Pre-applications of this scale were conducted with 197 science teachers from the different regions of Turkey. In the end of pre-applications, validity and reliability process was made. The result of exploratory and confirmatory factor analyses demonstrated that the so-called scale consists of two main factors which were "benefits of constructivism" and "the difficulties of constructivism and deficiencies in substructure in our country". The results of analyzes displayed that this scale consisted of two factor and the reliabilities of these factors were .89 for the first factor and .81 for the second factor.

Keywords: Constructivism; opinion scale and science teachers.

1. Introduction

Constructivist approach, which claims that the individual must have an active role and background knowledge is important in constructing new cognitive structures, has an increasing popularity in recent years. The main principal argument of the constructivist approach is that every individual constructs his or her own meaning of the world around them by means of their pre-existing knowledge and social interaction (Chee, 1997; Richardson, 1997; Winitzky and Kauchak, 1997; Hendry, Frommer and Walker, 1999). In this approach, students' learning skill and success is partly dependent to the student. Although the student takes an important part in learning process, teachers have the most important function (Horstman and White, 2002). There are varied opinions in literature about constructivist teacher's role in learning process. According to Taber (2000), the role of teacher in constructivist approach is to be a guide who provides with appropriate environments for students to construct the knowledge. According to Ritchie (1998), in constructivist approach, teacher works with the students to help them discover and give meaning to correlative thoughts between different branches of science. As for Moreno-Armella and Waldegg, (1993), the role of the constructivist teacher is unraveling pre-existing knowledge of students, to determine the deficiencies and remove them if there is and to help them construct the new information. In the direction of the literature, it is observed that teacher has an important role in constructivist approach. Teachers' attitudes, beliefs and

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1877-0428
doi:10.1016/j.sbspro.2009.01.391

in-class behaviors have great importance in growing up the students and in their academic success (Can, Günhan and Erdal, 2005). Relating to the same subject, it is reckoned that, another factor having an effect on the teacher's behaviors might be their opinion concerning the approach they employ in the class environment. Hence, in the research, a study of scale development was given place, which is intended for determining science teachers' opinions about constructivist approach.

2. Method and Research Group

Pre-applications of the opinion scale of constructivist approach were practiced with science teachers who come from seven different regions in Turkey. Pre-applications were implemented approximately with 30 teachers from each city in different regions and the teachers participated in the study voluntarily. However, since 13 teachers left too much items empty or their answers to control items were inconsistent the analyses were made over the answers of 197 science teachers. % 4.1 (n=8) of the teachers were between the ages of 20-25; %16.7 (n=33) were between the ages of 26-30; %23.8 (n=47) were between the ages of 31-35; %23.4 (n=46) were between the ages of 36-40; %32.0 (n=32) were 41 or more. % 32 (n=63) of the participators were male; %68 (n=134) of them were female. %11.2 (n=22) of the teachers had worked between 1-5 years; %24.9 (n=49) of the teachers had worked between 6-10 years; %36.0 (n=71) of the teachers had worked between 11-15 years; %14.2 (n=28) of the teachers had worked between 16-20 years; %2.5'i (n=5) of the teachers had worked between 21-25 years; %11.2 (n=22) of them had worked for 26 or more years.

3. Findings

Composing the items pool, getting expertise, factor analysis and reliability process

In the development process of the scale, firstly ten open ended questions were asked to pre-service teachers who study in Department of Science Education at Dokuz Eylul University, Faculty of Education to determine their opinions concerning constructivist approach, and in the direction of the responses received, 110 items were arranged. For this reason, for the purpose of determining the scale items' subject area-representability (content validity), the scale was examined by six experts. Content validity is the expert view relating to what extend the items and the questions can explain the target area (Christensen, 2004). For determining the consistence of pre-application, in the direction of the experts' view, 5 control items and 47 opinion items (52 in sum) were left in the scale. Pre-application form of the scale consists of 26 negative and 26 positive opinion items. Likert-5 type was used in the scaling and the statements ranged as Definitely Agree, Agree, Not Sure, Don't Agree, and Definitely Don't Agree. In order to have construct validity in the study of scale development factor analysis process was carried out. Firstly, the items which had been added as the control items, numbered 5-12-13-31-51 were taken out of the scale. As to construct validity, it is actualized by explaining the scale through some structures or concepts (Cohen, Manion and Morrison, 2002). Factor analysis both tests the integrity of the scale and helps to purify the subject from the variables which are not related (Henson and Roberts, 2006). In general, factor analysis go into division as exploratory and confirmatory (Büyüköztürk, 2006). In this study, both of them were used.

For the purpose of assuring structure validity, it was decided to apply exploratory factor analysis firstly. Exploratory factor analysis explains how many factors there are among a group of data and to what extent they are related to factors and the main objective of this analysis is to unfold the hidden factors those explain the covariances between the measured data (Kahn, 2006). At the first analyses of the scale, KMO coefficient was .86 and Bartlett test was considered as significant (χ^2 =4425, 93, df=1081, p=.000<.001). KMO and Bartlett tests display the appropriacy of the data for factor analysis (Peterson, Wahlquist and Bone, 2000; Liu and Treagust, 2005; Ang and Huan, 2006). Principal component analysis and Maximum Likelihood method with varimax rotation were used in the factor analysis performed. Having the Eigen Value more than 1 is one of the most frequently used criteria in factor analysis (Ritter, Boone and Rubba, 2001; Henson and Roberts, 2006). At the end of the analysis it occurred that the scale consisted of thirteen factors which have eigen value more than one. However, considering unrotated and varimax rotated solution, scree plot graphic, factor loading and the number of item in other factor, the scale consists of two factor was found out. In addition, items numbered 35-36-34-23-30-7-33-38-4-26-8-1, which were lower .40 factor loadings accepted meaningful in the so-called two factors, were taken out. After that, this analyze was repeated for two factor structure through maximum likelihood and principal component analyze methods with

varimax rotation. In the result of this analyze, items numbered 42-20-43-2-6-48-40-50-14-27-45-46-47-28, of which factor loadings were lower than .50, were removed from the scale (Tsai and Liu, 2005).

For the purpose of testing the accuracy of the two factor structures which were determined, CFA was conducted. In CFA, many fit indexes have been used. In CFA process, chi-square fit index (χ^2), Goodness Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Comparative Fit Index (CFI), Normed Fit Index (NFI), Non-Normed Fit Index (NNFI), Root Mean Square Error of Approximation (RMSEA) were calculated (Sanders, et al., 2005). .05 ≥RMSEA, $\chi^2 \leq .05$, χ^2/df ratio ≤ 3and CFI, NNFI, NFI, GFI, AGFI ≥ .90 are the criteria of fit in the factor structure (Heubeck and Neill, 2000; Sanders, et al., 2005; Kahn, 2006; Hoe, 2008). In the first CFA analyze, χ^2=261,27, df=188, p=.00<.05; RMSEA, .045; χ^2/df=1.38; NFI=.83; NNFI=.93; CFI=.93; GFI=.89; AGFI=.86 were found out. It was determined that the fit indexes were in acceptable level, however; when modification indexes were observed, the factors were correlated and the error variances of 27th and 22nd item related. In looking into correlation matrix, the correlation between the so-called items was approximately .80. It was seen that the items, which were in the same latent variable, were similar when examining the means of the items. In this situation; according to Büyüköztürk, et al., (2004), one of them can be removed from the scale and therefore, 22nd item was taken out. In repeated CFA analysis after the covariance between factors had been added to the model and removed 22nd item, χ^2=224,25, df=169, p=.00<.05; RMSEA, .041; χ^2/df=1.33; NFI=.84; NNFI=.94; CFI=.95; GFI=.90; AGFI=.87 are calculated. In the consequence of this analyze, two factor structure determined by means of exploratory factor analyze was in an acceptable level. The CFA results demonstrated in Figure 1.

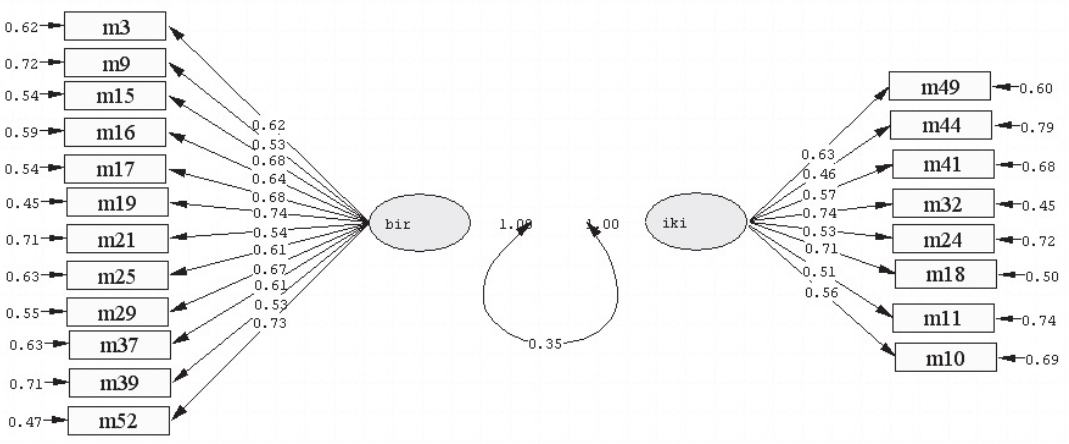

Figure 1. DFA results about Opinion Scale of Constructivist Approach for Science Teachers

In the result of exploratory and confirmatory factor analyses, the scale consisted of two factors. The first factor expressed "benefits of constructivism"; the second factor expressed "the difficulties of constructivism and deficiencies in substructure in our country". The first factor consisted of 12 and the second factor included in 8 items. The explained variance of the first factor was %30.50 and the eigen value was 6.10; the second factor was %14.45 and the eigen value was 2.91. Total explained variance of the scale was %45.05. The calculations about corrected total-item correlations, factor loadings and distinction between %27max and %27 min Group were demonstrated in Table 1. The factor loadings of items in the first factor changed from .558 to .724; corrected item-total correlation changed from .408 to .645. At the last stage of the development of scale reliability study was given place. Cronbach alpha reliability coefficient for the first factor was found .89; the second was .81. The scale reliability was calculated .86.

Table 1. The Factor Loadings, Item-Total Correlations and Distinction between %27max and %27 min Group of Items

No	*Eigen Value: 6.10* *Explained Variance: %30.50*	*Factor Loading*	*Item-Total*	*Mean*		*t*	*p*
				%27 max	*%27 min*		
19	Constructivist approach helps to understand the essence of the subject.	.759	.698	4.56	3.57	8.46	.000
52	Constructivist approach enhances student's self-confidence.	.737	.678	4.67	3.63	8.93	.000
15	I think constructivist approach has no effect on learning the science subjects.	.724	.639	4.72	3.65	8.96	.000
29	Constructivist approach gives students feeling of responsibility.	.687	.621	4.57	3.57	7.85	.000
16	Constructivist approach decreases students' interest towards lesson.	.684	.606	4.83	3.74	11.96	.000
17	Constructivist approach facilitates students' learning.	.675	.623	4.65	3.67	9.54	.000
3	Constructivist approach increases the interaction between teacher and student.	.660	.589	4.57	3.46	8.89	.000
25	Constructivist approach decreases the interaction among the students.	.654	.574	4.53	3.64	7.19	.000
37	Constructivist approach enables knowledge to get related with daily life.	.621	.561	4.50	3.74	7.43	.000
21	Constructivist approach assures a learning environment in which all the students are eager to learn.	.597	.510	4.39	3.35	8.65	.000
9	Applying the constructivist approach in Science and Technology lesson is important for students to attain knowledge.	.581	.506	3.78	4.61	8.12	.000
39	Constructivist approach gives the student a chance to evaluate themselves.	.558	.499	4.28	3.56	5.57	.000
No	***Eigen Value: 2.91*** ***Explained Variance: % 14.55***	***Factor Loading***	***Item-Total***	***Mean***		***t***	***p***
				%27 max	***%27 min***		
18	Creating constructivist environment is very hard in the conditions of Turkey.	.750	.621	3.86	1.87	13.42	.000
32	Constructivist approach is not suitable for the circumstances of our country.	.742	.645	4.15	2.39	13.25	.000
49	Constructivist approach is not appropriate for the present socio-economic level of our country.	.715	.572	3.77	2.07	10.84	.000
10	Being a teacher in constructivist approach is hard.	.632	.518	4.09	2.54	9.47	.000
11	Applying constructivist approach in crowded classes causes to lack of much information.	.591	.472	3.58	2.12	8.68	.000
44	Constructivist approach wasn't established on strong basis in Turkey.	.577	.408	2.94	1.74	7.35	.000
41	Constructivism is an approach which the application is difficult.	.576	.485	4.16	2.79	8.81	.000
24	The evaluation of students is troublesome in constructivist approach.	.575	.475	3.85	2.44	9.60	.000

4. Discussion and Conclusion

The importance of teaching in constructivist approach was deliberated on and in this context; a study of developing a scale intended for determining teachers' opinions about constructivist approach was given place. The pre-application of the scale was responded by 197 science teachers from different regions. In the direction of analyses of pre-applications, validity and reliability processes were given place. At the end of the analyses it was determined that the scale consisted of two factor and they explained %45.05 of the total variance. The reliability analyses of the scale, cronbach alpha reliability coefficient was determined as .86. When we consider these features of the scale, it is concluded that;

- It is valid-reliable and can be used in prospective experimental and descriptive studies which are intended for determining science teachers' opinions about constructivist approach,
- The scale can be developed for determining teachers', academicians' and directors' opinions about constructivist approach and results which are obtained out of the authentic applications of the scale can cater for the feedback about teachers' attitudes towards constructivist approach,

- The scale can be examined in meta-analytical level in the prospective studies and applications which will be performed with different sample groups and owing to these studies it can achieve a more valid and reliable form.

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