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TEACHING EVOLUTION SELF-EFFICACY SCALE: THE DEVELOPMENT, VALIDATION AND RELIABILITY STUDY

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Abstract: The purpose of this study is to develop a valid and reliable instrument for measuring prospective biology teachers' self-efficacy beliefs about teaching evolution. The research was conducted on a study group consisted of 212 prospective biology teachers. Content validity was established through review of related literature and expert opinions. Exploratory Factor Analysis and Confirmatory Factor Analysis are performed in order to establish the scale's construct validity. The scale's reliability coefficient and item-total correlations are calculated. Cronbach alpha coefficient of the scale is 0,87. Internal consistency coefficients for the sub-scales varied between 0,81 and 0,83 and found to be within admissible limits. In light of these results, it could be argued that the scale is reliable and valid instrument and can be used in identifying prospective biology teachers' self-efficacy beliefs about teaching evolution.

Keywords: Teaching evolution, self-efficacy beliefs, reliability, validity

Introduction

The theory of evolution is one of the best substantiated theories in the history of science, supported by evidence from a wide variety of scientific disciplines, including paleontology, geology, genetics and developmental biology. Its role and importance in understanding life on earth have been emphasized many times by important international scientific communities (National Research Council, 1998). Without a doubt, one of the important actors in the teaching of the theory of evolution in school science is biology teachers. In order for effective teaching of the theory, biology teachers should have a substantial content knowledge regarding the theory of evolution and positive attitudes towards teaching of it in the schools. On the other hand, one of the important factors influencing effective teaching of the theory of evolution is the self-efficacy beliefs of biology teachers about the teaching of the theory. Self-efficacy is defined as people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives (Bandura, 1986, cited in Senemoglu, 2012). Tschannen- Moran and Woolfolk-Hoy (2001) describe teacher's self-efficacy belief as a judgment of his or her capabilities to bring about desired outcomes of student engagement and learning. One of the important features of self-efficacy beliefs is its domain-specific nature (Lin & Tsai, 2013). Therefore, general trend in the literature has been to develop domain-specific instruments to measure students' and teachers' self-efficacy beliefs in various domains. Considering the importance of the theory of evolution in learning about biology and life, it is crucial to develop an instrument that measures self-efficacy beliefs of teachers regarding the teaching of the theory of evolution. To this end, this study reports on the results of the development and validity study of an instrument which aims to measure prospective biology teachers' self-efficacy beliefs regarding teaching the theory of evolution.

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Method

Study was conducted at Marmara University in 2015-2016 academic year. Data was gathered from 212 prospective biology teachers. Participants were seniors who were enrolled in biology education program and graduate students who were enrolled in teaching certification program at the same university. Having been completed the subject area courses was the criterion for inclusion in the study. An item pool consisting of 34 statements was prepared and sent to the five experts for consultation about wording and content validity. Items and content were revised according to five experts' opinions and recommendation following Lawshe technique (Lawshe, 1975).

SPSS 20.0 and LISREL 8.80 were used for data analysis. In order to conduct construct validity study, Exploratory Factor Analysis (EFA) was carried out. Data was examined with Kaiser-Meyer Olkin (KMO) parameter and the Bartlett sphericity test before the factor analysis. After exploratory factor analysis, Confirmatory Factor Analysis (CFA) was carried out and the model established in EFA is tested. Cronbach's alpha coefficient was calculated for the scale's reliability.

Results and Discussion

Content validity is examined via Lawshe technique. After receiving feedbacks from five experts, for each item, Content Validity Ratios (CVR) were calculated, as a result 12 items with negative ratios were eliminated from the item pool. Content validity index of the scale (CVI) was calculated as well. After the first revision 5-point Likert type scale with 22 items, 14 positive and 8 negative statements, was attained. In order to study the construct validity of the scale EFA is conducted. For sampling adequacy the KMO value was found to be .867, and for normality the Bartlett sphericity test was significant with values of $\chi^2=955.049$ and $p<0.01$). These parameters were considered to be appropriate for conducting factor analysis (Field, 2005). A principal component analysis was used, and the calculations were made by taking the eigenvalue as 1. The criterion was designated that significant factor loadings should be greater than .45, items with less loadings were eliminated from the scale. After reviewing the scree plot, two-factor scale with 11 items is identified (Table 1). The total explained variance is 57.9%, the first factor explains 29.1% of the total variance while the second factor explains 28.8% of the total variance. The factors were named by analyzing the content of items in each factor in light of the related literature. Accordingly, the first factor was named as "self-efficacy about evolution content knowledge" and the second factor was named as "self-efficacy about teaching evolution".

Table 1: Factor structure of self efficacy about evolution teaching scale

Item No	Common factor variance	Factor-1 Loading	Factor loadings after Varimax rotation	
			1	2
4	0,575	0,723	0,675	
8	0,512	0,560	0,711	
10	0,643	0,657	0,790	
12	0,527	0,722	0,567	
15	0,611	0,669	0,760	
22	0,605	0,729	0,708	
Explained variance %			29.1	
Factor 1 Cronbach alpha			0.83	
3	0,508	0,627		0,682
6	0,535	0,632		0,706
7	0,612	0,723		0,721
11	0,546	0,607		0,726
13	0,704	0,698		0,822
Explained variance %			28.8	
Factor 2 Cronbach alpha			0.81	
Total variance explained %			57.9	
Cronbach alpha of the scale			0.87	

Using LISREL 8.80, CFA was carried out in order to test the validity of the two-factor structure of the scale (Table 2). The relationships between the factors' items are as follows; item-factor loadings for "self-efficacy about evolution content knowledge" vary between $.57 \leq \lambda \leq .71$; item-factor loadings for "self-efficacy about

teaching evolution” vary between $.62 \leq \lambda \leq .77$. Additionally, the general adaptability parameters for the model are $\chi^2/sd = 3.14$, CFI = .95, NFI = .93, RMR=.061; RMSEA = .80; SRMR =.061; TLI =.93.

Table 2: Self efficacy about teaching evolution fit indices from CFA

Fit indices	Perfect fit values	Acceptable fit values	Fit indices from CFA	Result
χ^2 /sd	$0 \leq \chi^2 /sd \leq 2$	$2 \leq \chi^2 /sd \leq 5$	3.14	Acceptable
CFI	$.95 \leq CFI \leq 1.00$	$90 \leq CFI \leq .95$	.95	Perfect
NFI	$0.95 \leq NFI \leq 1.00$	$0.90 \leq NFI \leq 0.95$	.93	Acceptable
RMR	$.00 \leq RMR \leq .05$	$.05 \leq RMR \leq .10$	.061	Acceptable
RMSEA	$.00 \leq RMSEA \leq .05$	$.05 \leq RMSEA \leq .08$	.80	Acceptable
SRMR	$.00 \leq RMR \leq .05$	$.05 \leq RMR \leq .10$	.061	Acceptable
TLI (NNFI)	$.95 \leq TLI \leq 1.00$	$.90 \leq TLI \leq .95$	.93	Acceptable

(Kline, 2011)

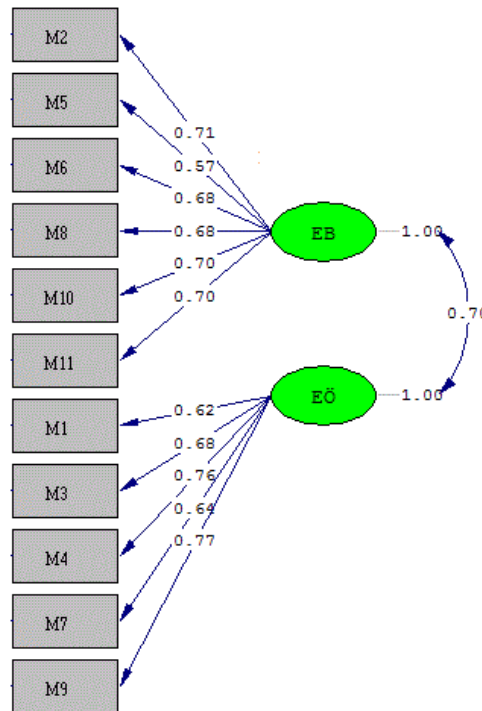


Figure 1: Pathway and factor loadings

The obtained indices confirm that model fit is acceptable. The scale's reliability coefficient and item-total correlations are calculated. Cronbach alpha coefficient of the scale is .87. Internal consistency coefficients for the sub-scales varied between .81 and .83 and found to be within admissible limits. In light of these results, it could be argued that the scale is reliable and valid instrument and can be used in identifying prospective biology teachers' self-efficacy beliefs about teaching evolution.

References

- Kline, R.B. (2011). *Principles and practice of structural equation modeling*. New York: The Guilford Press.
- Lawshe, C. H. (1975). A quantitative approach to content validity1. *Personnel Psychology*, 28(4), 563-575.
- Lin, T. J., & Tsai, C. C. (2013). A multi-dimensional instrument for evaluating Taiwanese high school students' science learning self-efficacy in relation to their approaches to learning science. *International Journal of Science and Mathematics Education*, 11(6), 1275-1301.

- NRC (National Research Council).(1998). *Teaching about evolution and the nature of science*. Washington, DC: National Academy Press.
- Senemođlu, N. (2012). *Geliřim öğrenme ve öğretim kuramdan uygulamaya* (21. Baskı). Ankara: Pegem Akademi.
- Tschannen-Moran, M., & Hoy, A. W. (2001). Teacher efficacy: capturing an elusive construct. *Teaching and Teacher Education*, 17(7), 783-805.