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The development of a self-efficacy scale for scientific research and an evaluation of prospective teachers' views about that scale

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Abstract

As with any profession, information changing because of developing technology or making the spreading of information easier exposes teachers to the need for new skills. On the one hand, teachers transfer the knowledge they gained during their school education to their students; on the other hand, they have to follow new information, question this information scientifically, and configure it according to a scientific methodology. Success in this process is closely related to whether the teachers come from a scientific research culture. This research is planned on the basis of the state of this problem. Within this research, firstly a scale has been developed to assess prospective teachers' scientific research self-efficacy. Through the implementation of this scale, prospective teachers' self-sufficiency in scientific research has been compared in terms of gender, department and the idea of academic career.

Keywords: Teacher Training, scientific research self-efficacy, views of prospective teachers, developing scale

Introduction

Developments in science and technology have shortened the life time of knowledge. It is therefore required that knowledge to be taught, should be constantly questioned regarding its actuality and accuracy. This task, from the viewpoint of the educational institutions, lies on the shoulders of the teachers. In fulfilling this task, the most needed skills of teachers would be scientific method skills.

Karasar (2009:12) acknowledges scientific method as the most reliable mean which is known and has certain processes for solving factual problems and producing science. However, scientific method should not be perceived as a path guiding to the absolute truth (Sönmez, 2008:32). Knowledge obtained through scientific methods is not absolutely accurate but, it is knowledge, accuracy of which is highly probable. Scientific methods having been tested many times during the course of time may be an important indicator of their validity.

It is necessary to base scientific methods upon communal foundations. Because, scientific method culture not only contributes to individual development but establishes ground for community development. It is for this reason that in the Bologna Process which aims to improve higher education, the necessity of raising individuals with efficacy on research is referred to (YÖK, 2009). The importance of teacher education is revealed right at the point of

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having these research skills developed (Kurt et al, 2011). In this context; teachers' knowledge, skills and self-efficacy need to be determined and deficiencies found need to be rapidly overcome.

The concept of self-efficacy is described in many researches, based on Bandura's (1977) view indicating that it is "the belief in one's capabilities to organize and successfully execute the courses of action required to manage prospective situations". Snyder & Lopez, (2002: 278) are of the view that self-efficacy is an internal belief responding to the question "what can I do" but not a perceived, observed skill. Besides, it is also possible that self-efficacy is described as self confidence needed to fulfill a certain task which requires effort and persistence (Kinzie, Delcourt & Powers, 1994). According to Donald (2003:219), the key elements in describing self-efficacy are sentences starting with the question "can I achieve this?" (Acar, 2007). It is indicated that individuals with high self-efficacy approach challenging tasks with the purpose of overcoming them rather than avoiding them. (Bıkmaz, 2004; Aşkar & Umay, 2001). According to Çetin (2008), perception of self-efficacy includes cognitive processes, emotions and behaviors that humans are capable of controlling. In another research, it is indicated that self-efficacy affects right or wrongdoing behaviors and it is associated with level of persistence in dealing with difficulties (Akkoyunlu & Orhan, 2003). Schunk (2000:109) suggests that students with low self-efficacy absent themselves from learning situations. Yi and Hwang (2003) are of the view that self-efficacy has an important role in describing human behaviors. All these study findings indicate the importance of self-efficacy in terms of the qualities of future's learners and teachers.

There are a limited number of researches in the literature regarding prospective teachers' scientific research self-efficacies. One of such researches was carried out by Nartgün et al (2008). According to research findings, there was a significant difference between scientific research self-efficacies in favor of prospective teachers who took the scientific research method course. In another research, it was determined that post graduate students' research self-efficacy beliefs were moderate (İpek et al, 2010). Taşdemir and Taşdemir (2011) who examined prospective teachers' efficacies on studying scientific researches came to the conclusion that prospective Turkish lesson teachers' efficacies regarding a scientific article's problem status, method, conclusion and suggestions were lower compared to their efficacies regarding researches' compatibility with spelling rules. Saracaloğlu, Varol and Ercan (2005) found that attitude towards the research changed with regard to whether courses on research experience, research methods and monitoring and evaluation were taken or not.Bard et al (2000) suggest that research trainings received by students affect their attitudes towards research and researching skills. There were also some research findings indicating that taking courses on research methods increased research self-efficacy levels (Lei, 2008;Unrau and Beck, 2004: Cit. Saracaloğlu, Varol and Ercan, 2005) and that individuals having high level of self-efficacy were more interested in participating in future researches (Bard et al, 2000; Bieschke, Bishop and Garcia, 1996; Kahn and Scott, 1997: Cit. Saracaloğlu, 2008).

It is not possible for the constantly developing and changing knowledge to be continuously transferred as it is to individuals through programs in educational institutions. Therefore, it is extremely important that especially graduates of educational institutions are raised as individuals who analyze, investigate and question. Knowledge of scientific research method gains particular significance, viewed from the perspective of basic teaching skills such as following current knowledge and conveying it in an organized manner. This research was planned from this stand point and the level of prospective teachers' research self-efficacy perceptions was examined.

Method

Research model can be analyzed in two dimensions. The first dimension was on developing a scale and the second dimension was based on survey model. During scale development, Explanatory Factor Analyses (EFA) and Confirmatory Factor Analyses (CFA) were used. In the assessment of data obtained by the use of developed scale, independent samples t test, one-way variance analyses and Kruskal Wallis H tests were made use of.

Aim of the Study

The general aim of this study can be described as the development of Scientific Research Self-Efficacy (SRSE) scale and assessment of prospective teachers' scientific research self efficacy perceptions. In this context, it

was examined whether there was a significant difference between prospective teachers' opinions regarding their scientific research self-efficacy in terms of the variables;

- Their will for academic career,
- Gender
- Their department of education.

Population and Sample

Developing the research scale was carried out with the involvement of senior class students of three departments (N=105), namely, Computer and Teaching Technologies Teaching (N=49), Social Sciences Teaching (N=35) and Elementary School Mathematics Teaching (N=21) Departments of Fırat University, Faculty of Education. Students who were involved in scale development were excluded from the research in the second phase. Scientific Research Self-Efficacy (SRSE) scale, validity and reliability of which was confirmed, was applied on samples who were not involved in scale developing and whose details are given below in table 1:

Table 1: Details on SRSE scale applied samples

		N	%
Gender	Female	55	52,9
	Male	49	47,1
Department	Science Teaching	26	25,0
	Classroom Teaching	23	22,1
	Turkish Teaching	28	26,9
	Elementary School Mathematics Teaching	27	26,0
Willing to Make Academic Career	Yes	59	56,7
	No	45	43,3
Whether Scientific Research Methods Course Received	Yes	104	100,0
	No	0	0,00

As seen in the table, the total of 104 prospective teachers who participated in the research took Scientific Research Methods courses during their bachelor's education. More than half of prospective teachers (59 people, 56.7%) were planning to have an academic career in the future. Furthermore, gender distributions of prospective teachers in the research were 55 (52.9 %) female and 49 (47.1 %) males.

Developing of Scientific Research Self-Efficacy Scale (SRSE)

Scientific Research Self-Efficacy (SRSE) scale items were written according to literature screening. Raw version of the scale consisted of 14 items. In parallel with the views of three academicians from Education Sciences Department, item expressions were reviewed and excluding any of the items in the scale was not seen necessary. To determine the validity of the scale, explanatory factor analyses (EFA) and confirmatory factor analyses (CFA) were conducted.

Explanatory factor analysis was conducted for theory development and confirmatory factor analyses was conducted to test the theory (Rennie, 1997). Explanatory factor analysis was preferred due to its helping achieve variable reduction and significant conceptual structures, most widely use, relative ease in making assessments and being a multivariate statistic within factor analyses (Büyüköztürk, 2002:117). Confirmatory factor analyses, on the other hand, is a more complex technique compared to explanatory factor analyses, which was used in the later stages of the research for testing a theory on implicit variables (Tabachnick and Fidell, 2001).

Suitability of data for factor analyses was tested with Kaiser-Meyer-Olkin (KMO) coefficient and whether variables correlated with each other or not was tested with the values of Barlett's sphericity test. Factor analyses cannot be carried out in cases where the value of Bartlett's sphericity test exceeds .05 (Şencan, 2005). In cases where KMO is lower than .50 (Tavşancıl, 2005:50) or smaller than .60 (Büyüköztürk, 2002) factor analyses cannot continue. As a result of the explanatory factor analyses of SRSE scale, carried out considering the above given information, it was determined that total explained variance was 65.528% with four factored structure of the scale. On the other hand, two items were removed from the scale due to insufficient factor load. Other findings obtained through explanatory factor analyses are given in table 2.

Table 2: Explanatory factor analyses results of SRSE Scale

		Factor Loading	$\bar{X}$	SS
Literature				
1.	I can do literature review	,715	3,81	,948
2.	Based on the literature, I can write the problem status from general to the specific	,791	3,50	,971
3.	I can clearly describe the aim of the research	,663	3,70	,960
	Eigen value : %4,473 and Variance: %37,271			
Method				
4.	I can determine sub-goals based on the general goals of the research	,855	3,38	,892
5.	I can select the suitable analyses based on the type of data	,710	3,51	,971
6.	I can accurately determine the research method	,579	3,67	,925
7.	I can determine sample and working group suitable for the research model and purpose	,538	3,63	,981
	Eigen value : %1,358 and Variance: %11,315			
Conclusion and Discussion				
8.	I can interpret analyses results	,668	3,34	1,007
9.	I can collectively organize research results	,729	3,40	1,034
10.	I can discuss research results based on the literature	,788	3,44	1,028
	Eigen value : %1,077 and Variance: %8,978			
Suggestions and Reference Writing				
11.	I can bring forward suggestions based on research findings	,750	3,54	1,000
12.	I can conduct my researches in accordance with international reference writing rules.	,790	3,46	,981
	Eigen value : %1,006 and Variance: %7,964			
	Explained total variance (%)	65,528		
	Kaiser - Meyer – Olkin (KMO)	,825		
	Bartlett's Test	(X^2=378,551,Sig.=000)		
	Cronbach Alfa Coefficient	,846		

As seen in table 2, KMO value obtained as a result of explanatory factor analyses of SRSE scale was .825 and Bartlett's test was found significant (p=.000). Furthermore, item factor loads in the scale varied between .538 and .855. Despite the narrowly described sufficiency criteria in the literature, it is expected that factor loads of items in the scale or factors to be around .320. (Tabachnick and Fidel, 2001; Çokluk et al, 2010:223). Cronbach alpha coefficient of the whole scale was calculated as. 846.

As explained previously, the theory developed by the results of the explanatory factor analyses needs to be tested by confirmatory factor analyses. Results of the confirmatory factor analyses carried out for this purpose are given in figure 1.

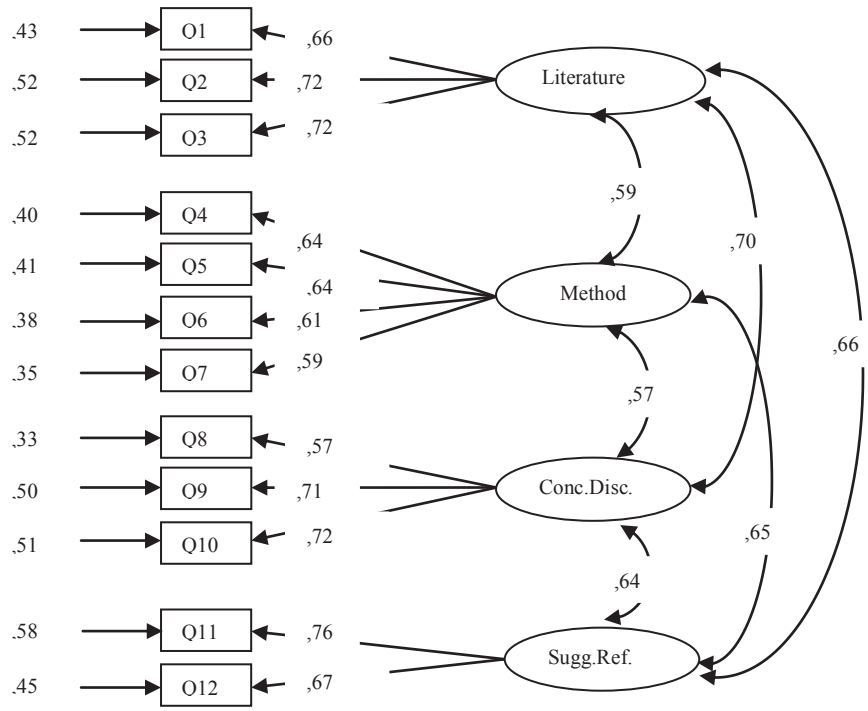

Figure 1: Confirmatory Factor Analyses of SRSE Scale

According to confirmatory factor analyses results in figure 1, standardized item factor loads varied between .59 and .76. Upon review of scale items, these four items were named as "Literature self-efficacies", "Method self-efficacies", "Conclusion-discussion self-efficacies" and "Suggestions and reference writing self-efficacies". Goodness indexes regarding this four factored structure are given in Table 3.

Table 3: Goodness indexes of SRSE scale.

X^2	df	X^2/df	GFI	CFI	IFI	SRMR	RMSEA
65,396	48	1,362	,910	0,935	,950	0,0620	0,059

There are similar views regarding the goodness indexes in the literature. The result of the goodness rate described as X^2 /df being below 2 or 3 indicates perfect goodness (Schreiber et al., 2006), whereas it indicates a moderate goodness of fit if it is below 5. (Sümer, 2000). The value of Goodness of Fit Index (GFI) being .95 or more indicates a perfect goodness of fit with the given model (Schreiber et al., 2006). However, the value of GFI being over .85 is deemed sufficient for indicating model-data goodness (Sümer, 2000). For CFI index, .90 and exceeding values are sufficient for accepting the model and .95 and higher values mean perfect goodness of fit (Sümer, 2000). Furthermore, IFI being higher than .90 is also a required criterion (Wilson and Muon, 2008).

FINDINGS

In this section, it was examined whether there were significant differences in prospective teachers' views regarding SRSE scale, in terms of their will for academic career, gender and department of education. First, prospective teachers were asked within the purpose of the scale, whether they were willing to follow an academic career or not. 59 of prospective teachers expressed their will for an academic career while 45 of them expressed their unwillingness. It was compared according to independent samples t test whether there was a significant difference between prospective teachers' self-efficacy perceptions regarding the scale items, in terms of their willingness for an academic career and obtained results are provided in table 4.

Table 4: Comparison of prospective teachers' views regarding SRSE scale, in terms of willingness for an academic career.

					Levene test			t test	
Dimension	Acad.Car.	N	$\bar{X}$	S. Dev.	F	Sig.	df	t	Sig.
Literature	Yes	59	4,03	,900	,908	,343	103	1,098	,275
	No	45	3,85	,122					
Method	Yes	59	4,02	,529	1,198	,276	103	1,990	,049*
	No	45	3,76	,773					
Conc. and Disc.	Yes	59	4,03	,529	3,491	,065	103	-,218	,828
	No	45	4,10	2,18					
Sugg. and Ref.	Yes	59	3,91	,623	3,675	,058	103	,170	,866
	No	45	3,84	3,13					
Whole of the scale	Yes	59	3,96	,440	4,090	,046*	103	1,639	,104
	No	45	3,75	,863					

As seen in table 4, in comparison of prospective teachers' views regarding the four dimensions and the whole of the scale, a significant difference could be determined in favor of students willing to follow an academic career, only in the method dimension. $t(103)=1.990$, $p<.05$.

Another comparison was carried out to determine whether there was a significant difference between prospective teachers' views regarding SRSE scale, in terms of gender. Independent samples t test results regarding this comparison can be found in table 5.

Table 5: Comparison of prospective teachers' views regarding SRSE scale, in terms of gender.

					Levene test			t test	
Dimension	Gender	N	$\bar{X}$	S.Dev.	F	Sig.	df	t	Sig.
Literature	Female	55	4,11	,638	1,947	,166	103	-2,397	,018*
	Male	49	3,76	,831					
Method	Female	55	3,95	,533	1,900	,171	103	-,790	,431
	Male	49	3,85	,772					
Conc. and Disc.	Female	55	4,24	1,88	,474	,493	103	-1,280	,203
	Male	49	3,87	,810					
Sugg. and Ref.	Female	55	4,05	2,77	,664	,417	103	-,873	,385
	Male	49	3,69	,850					
Whole of the scale	Female	55	3,98	,627	,291	,591	103	-1,711	,090
	Male	49	3,75	,687					

According to independent samples t test results in the table, only in the literature self-efficacy dimension could there be found a significant difference $t(103)=-2.397$, $p<.05$. It was determined that the significant difference was in favor of female students.

The final issue which needed to be clarified in the research was whether there was a significant difference in prospective teachers' views regarding the SRSE scale, in terms of the department of education variable. Results of the Anova analyses carried out on this issue are given in table 6.

Table 6: Comparison of prospective teachers' views regarding SRSE scale, in terms of their department of education

Dimension	Dep.	N	$\overline{X}$		Sum of Sq.	df	Mean of Sq.	F	Sig.	(Diff.)
Literature	Science T	26	3,71	B.Grp.	5,319	3	1,773	3,345	,022*	-
	Class T.	23	3,71	W.Grp.	52,996	100	,530			
	Math. T.	27	4,12	Total	58,315	103				
	Turk. T.	28	4,20					Levene (F=3,718, Sig.=,014*)		
	Total	104						KWH (X^2=7300, Sig.=,063)		
	Dep.	N	$\overline{X}$		Sum of Sq.	df	Mean of Sq.	F	Sig.	(Diff.)
Method	Science T	26	3,77	B.Grp.	1,028	3	,343	,793	,501	-
	Class T.	23	3,91	W.Grp.	43,218	100	,432			
	Math. T.	27	4,05	Total	44,240	103				
	Turk. T.	28	3,89							
	Total	104						Levene (F=,710, Sig.=,548)		
	Dep.	N	$\overline{X}$		Sum of Sq.	df	Mean of Sq.	F	Sig.	(Diff.)
Conclusion and Disc.	Science T	26	3,73	B.Grp.	7,473	3	2,491	1,138	,337	-
	Class T.	23	4,02	W.Grp.	218,834	100	2,188			
	Math. T.	27	4,01	Total	226,307	103				
	Turk. T.	28	4,46							
	Total	104						Levene (F=1,203, Sig.=,313)		
	Dep.	N	$\overline{X}$		Sum of Sq.	df	Mean of Sq.	F	Sig.	(Diff.)
Sugg. And Refer.	Science T	26	3,48	B.Grp.	16,532	3	5,511	1,259	,293	-
	Class T.	23	3,76	W.Grp.	437,583	100	4,376			
	Math. T.	27	3,72	Total	454,115	103				
	Turk. T.	28	4,51							
	Total	104						Levene (F=,974, Sig.=,408)		
	Dep.	N	$\overline{X}$		Sum of Sq.	df	Mean of Sq.	F	Sig.	(Diff.)
Whole of the scale	Science T	26	3,66	B.Grp.	2,037	3	,679	1,573	,201	-
	Class T.	23	3,82	W.Grp.	43,164	100	,432			
	Math. T.	27	3,72	Total	45,200	103				
	Turk. T.	28	4,51							
	Total	104						Levene (F=,878, Sig.=,455)		

According to Anova analyses results in the table, a significant difference could not be noticed between prospective teachers' views regarding the scale items of "Method", "Result and Discussion", "Suggestion and Reference" and the whole of the scale, in terms of the department variable. It was understood by Levene test results that prospective teachers' views regarding literature self-efficacy was not homogeneously distributed in the scale. Therefore, non-parametric Kruskal Wallis H test was conducted and according to its results, a significant difference could not be found in terms of this dimension.

Discussion and Suggestions

Scientific research self-efficacy is among the required qualifications for teachers. Contemporary teachers are expected to not only convey knowledge but also to do research and to organize the research findings so as to be used in education.

There are various researches in the literature, aiming to exhibit the status of teachers, post-graduate students and prospective teachers in terms of scientific research. Among these, according to İpek et al. (2010), there is a correlation between research self-efficacy and computer attitude. Sarı (2006), on the other hand, suggests that means of access to scientific knowledge is merely limited by media sources. When these two researches are assessed together, it may be suggested that the method of acquiring knowledge can be a factor which could influence research efficacy.

Vasil (1992) suggests that research self-efficacy varied with gender whereas Bailey (1999) suggests the contrary. In this research, it was determined that research self-efficacy varied with gender only in the literature self-efficacy dimension.

It was found in other researches on scientific research self-efficacy perceptions that one of the influential variables was the courses taken. It may be suggested that one of the findings of these researches indicates that there was a significant difference between prospective teachers who took scientific research course and who did not (Nartgün et al, 2008). Aslan (2010) on the other hand, determined that when compared in terms of their academic self-efficacies, post-graduate students perceived themselves as inadequate mostly in courses such as Research Methods and Techniques, Monitoring and Evaluation, Statistics. Tomakin (2007) determined a correlation between being a researcher teacher and Scientific Research Methods courses. Considering these results, it may be suggested that Scientific Research courses or Monitoring and Evaluation and Statistics courses which are closely related, are being started to be considered necessary.

In the light of all these findings, we may suggest that the most practical way of increasing the scientific research potential is education. Because, through education, we can raise individuals who are self aware of their skills having critical thinking ability. Besides, with realistic education policies in line with our future expectancies, we can make certain that in the long term, individuals voluntarily undertake services for the society. In enhancing the quality of services provided by individuals, their raising with scientific research culture will play an important role.

Teachers need to be raised within the scientific research culture. Teachers' explaining of how they obtained the knowledge they convey to their students occasionally, will have positive impacts on students' attitudes towards research culture.

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