



## PERSONAL PROFESSIONAL DEVELOPMENT EFFORTS SCALE FOR SCIENCE AND TECHNOLOGY TEACHERS REGARDING THEIR FIELDS

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**Abstract.** This study has developed “Personal Professional Development Efforts Scale for Science and Technology Teachers Regarding Their Fields”. Exploratory factor analysis of the scale has been conducted based on the data collected from 200 science and technology teachers across Turkey. The scale has been observed through varimax rotation method, composing of 6 factors and 27 items. Mentioned factors are educational and cultural knowledge, specialisation, following scientific developments and technological developments, following curriculum, following media and publications. Internal consistency of 5 point likert scale has been determined with Cronbach Alpha coefficient. Cronbach Alpha coefficient of the sub-dimension scale ranges between .64 and .83, which is .82 throughout the scale. This study is important with regard to providing information by examining of, assessing regarding different variables of and helping improve the deficiencies of the personal professional development efforts of science and technology teachers regarding their fields.

**Key Words:** Science and Technology, Teacher, Scale, Personal Professional Development, Effort

### 1. Introduction

Every teacher has to ask himself/herself some important questions about his/her profession, which mainly are: “Am I a successful teacher? How well have I developed/am I developing myself considering the criteria required by teaching profession and my field? What do I do/have I done/should I do for furthering my personal professional development? Do I feel confident regarding my field? Am I helpful to the people around me, my students and particularly to the society?” It is unlikely, or it should not be possible, that there is a teacher who does not ask himself/herself these questions. Trough answering these key questions which are very important for teaching profession, the teachers may become aware of their knowledge and the value of their impact on the people around them. This way, it would become possible to raise good teachers based on the quality of the education system (Wössmann, 2002; Nye et al., 2004; OECD, 2005; Hanushek, 2008). In the light of such information, the importance and sensitiveness required by the teaching profession is clearly visible.

The goal of the teaching profession is raising next generation as good persons who are beneficial to themselves, their families, the people around them, who are constructive, creative and know their culture (Murray, 2012). It is of great importance to a country to have successful teachers raising successful individuals, leading the country to a bright future (Tekişik, 1987). There are a number of definitions of this important teaching profession. According to Erdem (1998): “Teaching is a profession with contemporary, cultural, scientific and technological dimensions based on expertise, knowledge and skills, which requires constant updating of oneself and professional formation.” According to Özbay (2008), there main requirements for performing teaching profession, which are: (i) to have field knowledge in a specific field, (ii) to have information and skills required for transmitting the field knowledge to the others and (iii) to have personal features which will ensure co-existence of the other two requirements. In this respect, it is obvious that if the teachers who assume important duties do not develop themselves, they would be behind the times, and thus would not be

quite beneficial to their students and society. Particularly from the day they start their career, the teachers should update themselves constantly and follow up-to-date information and thus, fulfil their duties and responsibilities, which are the requirements of being a contemporary teacher and the role they assume (Darling-Hammond, 2006; Cochran-Smith & Lytle, 1999). A teacher who cannot keep up with the developments cannot absolutely help the students to adapt to the changes.

In order to have a voice across the world, the countries are all the time in a struggle for constant development, change and renewal. A country can develop only when all its segments develop. Trying to trigger such development at the smallest units of the society, the teachers should reach the highest level of professional and personal development, particularly in their fields.

There are some actions which should be taken by every contemporary teacher. According to Öztop (1994), the actions which should be taken by the teachers for their personal and professional development are; increasing their academic knowledge, participating in in-service training courses, seminars, conferences, panels, using technology in every field of their life, following the publications on their profession and current life, reading in order to be competent in intellectual and artistic fields, improving their personality, ensuring coordination between the school and other institutions, building communication and interaction with their colleagues and students. In this respect, professional personal development of the teachers regarding their fields is of utmost importance. According to Özkan (2003), personal development is the self-improvement process of a person towards achieving or raising his/her goals and aims. Personal development is the change of a person towards a better status. Since the person constitutes a whole with his/her thoughts, emotions and way of life, he/she would have a positive change, during development process, with all these components (Özkan, 2003; Çoruk, 2007). Bayram defines the professional development of a teacher as the activity or process where positive changes are aimed regarding knowledge, skills and behaviours (Bayram, 2010).

Globalisation has caused a fierce competition among the countries. To be successful, they are highlighting the importance of science education, adopting new approaches in education and working to make their education systems contemporary. In today's information age, the aim is to make the students acquire some skills to access information rather than to transfer existing information to them. This is possible with high level mental process skills such as learning by comprehension, ability to solve problems arising with regard to new situations, and scientific method process. These skills are acquired particularly in science courses (Doğru and Aydoğdu, 2003).

There are various opinions about what the science is. According to the uneducated persons; the science deals with unspeakable things, while the philosophers aim at searching and looking for nature-related facts. Many people think that science is the total of all information related to nature, environment and universe. According to researchers and scientists, science is a set of methods used for generating scientific information (Çilenti, 1987). According to Çepni et al. (1997), science is the process of understanding information community, thinking information philosophy, and generating new information. According to Kaptan (1999), science is a set of efforts of systematically examining the nature and natural events, and foretelling the events. According to İşman et al. (2002), science is a set of efforts of understanding, interpreting, implementing the phenomena, concepts and principles in the nature as well as natural laws and theories, and making use of them in daily lives. Science lessons offered in schools are important as the information about the world and the universe is provided and cause-effect relationship is shown. In science lessons, the students both get information on their fields of interest and they may discover some of their skills. This considerable benefit enables the students to explore themselves and their skills, and thus, they make more conscious decisions about their future jobs (Temizyürek, 2003). According to Kaptan (1999), science lesson have three goals:

- Providing overall information about science,
- Making the students acquire mental and motor skills,
- Preparing the basis for vocational training in the field of science or technology.

In light of the information above, considering today's information era technologic developments play an important role in education. New generation is supposed to assume important duties in order to learn live and produce technology. In this respect, the parents, schools and teachers must concertedly be open to innovation and encourage the students (Çınar, 1999).

Due to their position, the teachers constitute examples for students. The students' sense of wonder develops with the teachers' guidance, and thus, they become enthusiastic about research and learning. Therefore, the teachers should improve themselves in a way to keep up with the developments of the era, and they should search, learn and be open to innovation. Science and technology teachers should individually make researches and overcome their deficiencies in order to comprehend the technological aspects and make their students comprehend it, to raise their students as scientific literates and to serve as a good guide (Çınar, 1999).

It is well known and often expressed in many platforms, in Turkey, that the teachers should improve themselves. Given the literature in the relevant field, no adequate scientific study is available showing whether the teachers in Turkey achieve such an improvement or not (Bilgin, 2014). There is no sanction for the teachers regarding this, nor run the reward mechanisms adequately. Therefore, achievement of some goals by the teachers, who are important and impressive components of the education, such as making the students move with the times, broadening their horizon, encouraging them and serving as a guide for them are left to their conscience. As a result of limited researches conducted on the personal development and competency of the teachers, it has been stated that the personal development and professional competency level of the teachers are inadequate (Öztop, 1994). However, there is no comprehensive study on what these inadequacies are. This study is important that it can provide information about personal professional development efforts of science and technology teachers regarding their fields.

## 2. Method

### 2.1. Developing the Scale

The scale developed by the researchers is in the form of a parallel form, and it has been prepared in a way to include the questions for science and technology teachers which request them to assess their personal professional development regarding their fields both ideally and personally in the same question. 5 point likert type grading is used in the scale. This grading is as follows: "Always (5), Often (4), Sometimes (3), Rarely (2) and Never (1)". Language and meaning validity study on Personal Professional Development Efforts Scale for Science and Technology Teachers Regarding Their Fields has been conducted by 3 voluntary Turkish teachers working in primary school. Study on content validity of the scale has been prepared by voluntary experts working as lecturers in primary education department of education sciences at education faculty of the university, 4 of whom work in the curriculum and measuring-evaluation department at education sciences, and 5 of whom work in primary school, math and science division at primary education department.

### 2.2. Scale Developing Procedures

First, the field which is subject matter of the research was examined throughout the literature, experts were consulted with, and some observations and interviews were made randomly with the science and technology teachers. Then, the researchers prepared a questions pool which is made up of 64 items. These items were initially examined and corrected by the experts working in education sciences and measuring-evaluation department in terms of their appropriateness, and thus, the form was narrowed down to 46 items. In order to ensure language and meaning validity, it was sent to Turkish teachers. For this purpose, a 10-degree form was sent to three voluntary Turkish teachers working in primary schools to determine Language and Meaning Validity Appropriateness Level of the scale. At this stage, the teachers were asked to evaluate each item in terms of its Turkish language and meaning appropriateness on a scale from 0 (zero) to 10 (ten); where 0 (zero) is "the item cannot be understood at all" and 10 (ten) is "the item is perfectly understandable". The teachers were also requested to make any corrections on the form, when they deemed necessary. After the language and meaning validity of the scale was ensured, validity and reliability study was made on these items.

The experts were provided with a form to ensure scope validity of the scale and requested to grade them from 1 to 10 and make any corrections, when they deemed necessary. The scores were evaluated in terms of the statistical significance of Content Validity Ratio– CVR (Content Validity Ratio/Index) values ( $p < .05$ ) (Grant and Davis, 1997).

$$CVR = \frac{Ne - N/2}{N/2}$$

Ne: means the number of experts marking “Necessary”

N: means total number of experts

In order to be able to conduct distinctiveness, structure validity and reliability analyses on the scale items whose content validity is ensured, the scale was applied to 200 science and technology teachers who are determined through scale judgment sampling method.

Total values of the items were calculated with the aim of determining whether the data obtained and the items in the scale fit for purpose. Pearson multiplication moment correlation analysis was used for determining total value of the item, independent group *t-test* was used for comparing 27% lower-upper group items scores. This way, the consistency of the items with all scale items was examined. Then, explanatory factor analysis was made in order to determine the factor structure of the scale. Factor structure of the scale was determined accordingly.

A measuring tool can be reliable only when its internal consistency is high. The most frequently used internal consistency method in the studies is determining the Cronbach Alpha coefficient. Following these procedures, the scale was finalised as applicable in schools. SPSS 18.0 was used for validity and reliability analyses of the scale.

### 2.3. Scale Developing Procedures Analysis Results

#### 2.3.1. Language Validity Analysis of the Scale

As a result of the evaluation by Turkish language experts, appropriate scores for language and meaning validity of each item in Turkish form range between 7.00 and 10.00. 34 items, out of 46 scale items, had a language and meaning appropriateness score above 9.00. 4 items were corrected while remaining 8 items were removed from the scale. Thus, the number of items in the scale was taken down to 38.

#### 2.3.2. Content (Scope) Validity Analysis (CVR) of the Scale

CVRs of the scale which is composed of 38 items received from the experts vary between -1.0 and +1.0. The items whose minimum CVR value is less than .75 were either removed from the scale or corrected. Accordingly, the data received from the experts was calculated, and 9 items which are less than .62 were removed from the scale. Moreover, some items were corrected as a result of the evaluations made. The evaluations showed that all of the items in the scale achieve content validity with regard to measuring private personal development efforts of the teachers.

#### 2.3.3. Item Total Correlation Analysis of the Scale

After content validity was completed, the scale was applied by the researcher, for pilot implementation, to 200 voluntary science and technology teachers working outside the city centre of Eskişehir. Considering the data obtained, item-total correlations were calculated. Item-total correlation coefficients are between .396 and .723 and statistically meaningful in all items.

#### 2.3.4. Item Distinctiveness Analysis of the Scale

The scores obtained from scale items were listed as 27% in upper group and 27% in lower group, and the groups were compared by conducting independent group *t-test*. Since the results of independent group *t-test* was  $p < .01$  for all items, there is a significant difference between them. This shows that the scale is distinctive.

**Table 1.** The Results of Independent Group T-test Conducted for Determining the Distinctiveness of the Items in Personal Professional Development Efforts Scale for Science and Technology Teachers Regarding Their Fields

Items Matched		X	SS	t	p	Items Matched		X	SS	t	p
1	UPPER	4.55	.50	19.54	0.00	16	UPPER	5.00	.00	17.72	0.00
	27% LOWER	2.59	.53				27% LOWER	3.12	.75		
2	UPPER	4.46	.50	18.05	0.00	17	UPPER	4.07	.63	31.13	0.00
	27% LOWER	2.42	.63				27% LOWER	1.09	.29		
3	UPPER	5.00	.00	28.31	0.00	18	UPPER	5.00	.00	21.90	0.00
	27% LOWER	1.94	.76				27% LOWER	3.12	.61		
4	UPPER	4.85	.35	25.32	0.00	19	UPPER	4.71	.45	20.24	0.00
	27% LOWER	2.51	.57				27% LOWER	2.42	.68		
5	UPPER	5.00	.00	15.54	0.00	20	UPPER	5.00	.00	13.11	0.00
	27% LOWER	3.59	.65				27% LOWER	3.42	.88		
6	UPPER	4.88	.31	28.20	0.00	21	UPPER	4.37	.62	39.73	0.00
	27% LOWER	2.81	.43				27% LOWER	1.00	.00		
7	UPPER	5.00	.00	25.65	0.00	22	UPPER	5.00	.00	14.92	0.00
	27% LOWER	2.40	.71				27% LOWER	3.74	.61		
8	UPPER	4.85	.35	23.83	0.00	23	UPPER	4.92	.26	43.60	0.00
	27% LOWER	2.16	.74				27% LOWER	1.61	.49		
9	UPPER	5.00	.00	19.13	0.00	24	UPPER	4.84	.37	24.39	0.00
	27% LOWER	3.14	.68				27% LOWER	2.31	.63		
10	UPPER	4.52	.50	30.87	0.00	25	UPPER	4.54	.50	49.77	0.00
	27% LOWER	1.51	.50				27% LOWER	1.01	.13		
11	UPPER	4.57	.49	23.80	0.00	26	UPPER	5.00	.00	20.35	0.00
	27% LOWER	2.05	.59				27% LOWER	2.92	.74		
12	UPPER	3.51	.93	19.71	0.00	27	UPPER	5.00	.00	30.61	0.00
	27% LOWER	1.00	.00				27% LOWER	2.66	.54		
13	UPPER	5.00	.00	14.61	0.00	28	UPPER	4.46	.64	39.72	0.00
	27% LOWER	3.31	.77				27% LOWER	1.00	.00		
14	UPPER	5.00	.00	13.93	0.00	29	UPPER	5.00	.00	13.55	0.00
	27% LOWER						27% LOWER				

	LOWER	3.61	.71			LOWER	3.37	.87
	27%					27%		
	UPPER	2.96	1.10					
15	27%			13.00	0.00			
	LOWER	1.00	.00					
	27%							

$\eta = 54 + 54 = 108$

### 2.3.5. Structural Validity Analysis of the Scale

KMO (Kaiser Meyer Olkin) coefficient showing applicability of the scale for factor analysis and Barlett sphericity were evaluated. A KMO value higher than .60 indicates that the study is appropriate for factor analysis.

In study, KMO coefficient was calculated .893, and Barlett test was found to be significant ( $p < .01$ ). Vertical rotation technique was used in factor analysis which aims at more easily interpretable and generalizable data.

As a result of the factor analysis, two items were removed from the scale. The factor loads obtained vary between .462 and .771. Then, the subscales which emerged as a result of the factor analysis were named by the field experts as based on field literature.

Educational and cultural knowledge which is composed of 6 items and constitutes the first subscale includes the activities carried out either by the teachers themselves individually or together with their students. Specialisation which is composed of 7 items and constitutes the second subscale include the activities and work individually carried out by the teachers with regard to teaching in a more professional way. Following scientific developments which is composed of 5 items and constitutes the third subscale includes following the current scientific developments by the teachers in their fields. Following technological developments which is composed of 3 items and constitutes the fourth subscale includes following the technology by the teachers and refreshing their knowledge. Following curriculum which is composed of 3 items and constitutes the fifth subscale include personal development of the teachers in their fields. Following media and publications which is composed of 3 items and constitutes the sixth subscale includes personal development of the teachers through television and journals.

### 2.3.6. Explained Variance Values of the Scale

Explained variance ratio enables interpreting the success of the value measured by the content of the scale dimension concerned in multi-dimensional scales. High explained variance ratio points out that the dimension concerned has been measured well (Büyüköztürk, 2012).

The results of the factor analysis conducted shows that the scale items are gathered in the six subscales whose eigenvalue is higher than 1. Total variance amount explained by these six subscales is 59.545%. In social sciences, an explained variance ration between 40% and 60% is sufficient (Scherer, Wiebe Luther and Adams, 1988; Tavşancıl and Keser, 2002).

**Table 2.** Variance Percentages and Eigenvalues Explained by the Subscales of Personal Professional Development Efforts Scale for Science and Technology Teachers Regarding Their Fields

Subscale	Eigenvalue	Explained Variance
1- Educational and Cultural Knowledge	3.497	12.954
2- Specialisation	3.423	12.678
3- Following Scientific Developments	2.413	8.938
4- Following Technological Developments	2.372	8.784
5- Following Curriculum	2.324	8.607
6- Following Media and Publications	2.048	7.585
<b>Total</b>		<b>59.545</b>

### 2.3.7. Relationship between Subscales of the Scale

The factor analysis was followed by Pearson moments multiplication correlation analysis which was conducted with the aim of determining the relationship between the subscales. The correlations between the subscale points of the scale vary between .32 and .66.

**Table 3.** Pearson Multiplication Moment Correlation Analysis Conducted for Determining the Average and Standard Deviation Points of the Subscales of Personal Professional Development Efforts Scale for Science and Technology Teachers Regarding Their Fields as well as the Correlations Between the Subscales

Subscales	X	SS	1	2	3	4	5	6
1- Educational and Cultural Knowledge	3.59	.78	1	.66	.53	.46	.42	.54
2- Specialisation	2.49	.88		1	.36	.40	.32	.57
3- Following Scientific Developments	4.36	.55			1	.51	.52	.34
4- Following Technological Developments	4.10	.66				1	.37	.40
5- Following Curriculum	4.33	.69					1	.34
6- Following Media and Publications	3.22	.77						1

$\eta=200, p<.01$

### 2.3.8. Reliability Analysis of the Scale

Reliability of the scale was examined by using internal consistency method from Norm-Reference reliability. Internal consistency of the scale was determined through Cronbach Alpha coefficient. Cronbach Alpha coefficient of the scale for its subscales varies between .64 and .83. Considering the overall scale, Cronbach Alpha coefficient was determined as .82.

**Table 4.** Cronbach Alpha Coefficients of Subscales of Personal Professional Development Efforts scale for Science and Technology Teachers Regarding Their Fields

Subscales	Alpha
1- Educational and Cultural Knowledge	.83
2- Specialisation	.83
3- Following Scientific Developments	.77
4- Following Technological Developments	.67
5- Following Curriculum	.70
6- Following Media and Publications	.64
<b>General</b>	<b>.82</b>

## 3. Conclusion and Discussion

This study developed a scale for examining the personal professional development efforts of science and technology teachers regarding their fields. The scale developed for this purpose reveals in 6 sub-dimensions the personal professional development efforts of science and technology teachers regarding their fields. Moreover, the scale prepared in parallel form enables us to see the relationship between the ideal personal professional development efforts of the teachers regarding their fields and actual personal professional development efforts of them regarding their fields. With this scale, it is possible to make various evaluations and analyses considering different variables (sex, years of seniority, etc.). The factor which drove us to conduct this study is our desire to answer the question, “Do the science and technology teachers in Turkey personally and professionally develop themselves in their fields?” Given the world literature, there are a lot of studies conducted regarding professional

development of science and technology teachers (Klieger and Bar-Yossef, 2011; Darling-Hammond, 1998; Glenn, 2000; Hoban, 2002). The mentioned studies mostly focus on enhancing the quality of teachers, learning success of the students, learning and teaching activities, content information, long-lasting impact of time, and other learning (Kennedy, 1999; Garet et al., 2001; Loucks-Horsley et al., 2003). Mentioned studies served as a guide for us in developing this scale. The literature research conducted in Turkey regarding personal professional development of science and technology teachers regarding their fields resulted in no adequate information. The information obtained is limited with professional development (Çelikten, 2005). It was deemed that developing such a scale was highly essential for revealing the current situation of personal professional development of science and technology teachers in Turkey regarding their fields and for taking remedial measures for the sake of next generations. No scale similar to this one prepared for science and technology teachers was found as a result of literature researches. This scale will reveal, in 6 sub-dimensions, how science and technology teachers develop themselves in their fields while performing their jobs. The contribution to be made by the research data obtained by applying this scale developed in this study: we believe that, depending on the results of the research to be conducted, undesirable situations may be eliminated by introducing concrete activities or arrangements aiming at increasing personal professional development efforts of science and technology teachers in Turkey regarding their fields. Furthermore, the scale developed in this study for science and technology teachers may be adapted to other disciplines (mathematics, physics, chemistry, biology, etc.).

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### Note

This study has been generated by Ayşegül Bilgin from Master’s Thesis “Personal Professional Development Efforts of Science and Technology Teachers Regarding Their Fields” submitted at “Institute of Educational Sciences, Eskişehir Osmangazi University” in 2014.

## Appendix

### Scale: “Personal Professional Development Efforts Scale for Science and Technology Teachers Regarding Their Fields”

While answering the questions, please add to the beginning of the sentence, “A good Science and Technology Teacher”. Please mark only one of the choices; “Always”, “Often”, “Sometimes”, “Rarely”, “Never”. \*This scale was translate to English into Turkish by the Authors

IDEALLY (What should be ideal answer in your opinion?)					PERSONALLY (How often do you do?)										
Always	Often	Sometimes	Rarely	Never	A good Science and Technology Teacher					Always	Often	Sometimes	Rarely	Never	
<b>Educational and cultural knowledge:</b>															
					1. should go / goes to exhibitions, museums, science centres etc. related to his/her field.										
					2. should read / reads books related to his/her field.										
					3. should participate / participates in in-service training programmes related to his/her field.										
					4. should participate / participates in knowledge contests related to his/her field together with his/her students.										
					5. should participate / participates in scientific meetings (congress, seminar, conference etc.) related to his/her field as audience.										
					6. should go / goes to field trips (exhibitions, museums, science centres etc.) related to his/her field together with his/her students.										
<b>Following scientific developments:</b>															
					7. should subscribe / subscribes to web sites where she/he can follow field-related innovations.										
					8. should obtain and solve / obtains and solves field-related tests.										
					9. should follow / follows on the internet up-to-date information related to his/her field.										
					10. should follow / follows the news on media related to his/her field.										
					11. should research / researches field-related issues that he/she is unfamiliar with.										
<b>Following technological developments:</b>															
					12. should obtain / obtains animations related to his/her field.										
					13. should closely follow / closely follows technological developments.										
					14. should be / is familiar with the recently-developed technological products.										
<b>Following curriculum:</b>															
					15. should exchange / exchanges information in his/her field with the other teachers working in the same field.										
					16. should exchange / exchanges views in his/her field with the teachers working in other fields.										
					17. should make effort / makes effort to be well-informed regarding the acquisitions included in the curriculum.										
<b>Following media and publications:</b>															
					18. should follow / follows scientific journals in his/her field.										
					19. should follow / follows domestic TV shows in his/her field.										
					20. should follow / follows foreign TV shows in his/her field.										
<b>Specialisation:</b>															
					21. should exchange / exchanges views with the academics about the developments in his/her field.										
					22. should design / designs different experiments in parallel with the experiments made in his/her field.										

					23. should invite / invites domestic experts related to his/her field to the school.					
					24. should invite / invites foreign experts related to his/her field to the school.					
					25. should participate / participates in scientific meetings (congress, seminar, conference etc.) related to his/her field as speaker.					
					26. should participate / participates in competitions among the teachers (i.e. "Teachers are Producing") in his/her field.					
					27. should participate / participates in Lifelong Learning programmes (i.e. Comenius, Leonardo da Vinci).					

