

# An Investigation of Pre-service Science Teachers' Level of Efficacy in the Undergraduate Science Teacher Education Program and Pedagogical Formation Program

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## Abstract

The purpose of this research is to comparatively investigate the efficacy levels of pre-service science (Science, Biology, Physics, and Chemistry) teachers enrolled at the Undergraduate Program of Science Teacher Education and Pedagogical Formation Program. A total of 275 pre-service teachers who were studying in different programmes in the Faculty of Education, Ömer Halisdemir University composed the study group of the research in which the general survey model was used. "Teachers' Sense of Efficacy Scale" developed by Tschannen-Moran & Hoy (2001) and adapted to Turkish by Çapa, Çakıroğlu & Sarıkaya (2005) was used as the data collection tool in the research. As a result of the study, it was concluded that pre-service teachers' level of professional efficacy was high. In addition, it was determined that while pre-service teachers' level of professional efficacy did not significantly differ based on gender, their efficacy showed differences depending on the program they were studying at and their active teaching status.

**Keywords:** pre-service teachers, pedagogical formation program, teacher efficacy

## 1. Introduction

Today when information and communication technologies have dramatically developed, and besides, information has increased rapidly, individuals become aware of the events happening in different parts of the world, are influenced by each other and share their experiences with one another, cultures interact with each other, and so the process, which we call "globalisation", is experienced. In addition to that, the structure of modern society emerges. With the modern society lifestyle, large factories have been superseded by very fast computers which have become smaller enough to fit into our pockets; physical strength has been replaced by mental thinking, and the industrial products which look like metal stacks have been supplanted by smart tech products which are equipped with software. In addition, this social stage in which information is blended with technology is called information society (Güneş, 2009). At this point, there is a paradigm shift in education and training. During this shift, in formal education it is aimed for students to learn how to learn by teaching only key concepts to them, by monitoring the strategies and methods they are effective in, and by providing them with specific skills, attitudes and values (Güneş, 2009). Therefore, an observing and instructing teacher profile who guides learners in their learning, and who learns mutually with them is put forward within the framework of the changing education and teaching paradigm. According to this profile, the teacher must be the person who is able to think critically and creatively, who has advanced communication skills and is able to communicate effectively, who is a researcher and renews himself/herself constantly, who is aware of the characteristics of learners' development and personalities, who protects values and is a good model, who has a strong character, who knows how to have fun, who uses time actively and fruitfully, who is able to prepare materials to enrich learning, who thinks scientifically, who uses information technologies well, who is able to carry out assessment and evaluation aimed at the product and process, and who is able to give the right decision. When this profile is taken into consideration, teachers are required to be well trained, and to have general and specific efficacy demanded by the teaching profession (Numanoğlu & Bayır, 2009). The efficacy of a teacher affects his/her behaviours in the class, and it increases his/her struggle to attend the process, his/her approach to set a target, and his/her level of enthusiasm. In addition, teachers with high efficacy are the ones who are more open to new ideas, and who do research on new methods, which fulfil students' requirements in a better way (Tschannen-Moran & Hoy, 2001). Teacher efficacy is described as "*the knowledge, skills and attitudes to be possessed by teachers in order to carry out the teaching profession efficiently and productively*" (Ministry of National Education [MoNE], 2008: VIII). As it is understood from the description, being a teacher requires having specific knowledge, skills and attitudes in terms of professional efficacy fields, and accordingly, from another aspect, it requires to have artistic skills and features (Şişman, 2009). In the literature, teacher efficacy is classified as "*general culture*", "*field knowledge*" and "*pedagogical content knowledge (pedagogical formation)*" (Numanoğlu & Bayır, 2009; Seferoğlu, 2004; Şişman, 2009; TED, 2009: 11). In general, it is thought that field knowledge of teachers is very important. However, field knowledge of a teacher is treated as only one dimension. In addition, many research findings indicate that a teacher's knowledge of the learning-teaching process affects students' achievement in the matter of increasing it more directly and better than his/her field knowledge. While a teacher is teaching a topic, he/she simultaneously has to consider the cognitive, social and affective objectives of the subject, time

management, equipment and materials, student needs, and expectations and reactions of students (TED, 2009: 4-5). However, the efficacy of a teacher should not be limited only to effective teaching; his/her personal characteristics, communication and management skills, belief in and attitude towards the profession and his/her effectiveness in the teaching process should be considered as a whole (Süral & Sarıtaş, 2015).

The qualifications of teachers in Turkey are under a legal provision by Article 45 of the Basic Law of National Education. This article has the following provision: "The qualifications to be sought for teachers in terms of general culture, special field education and pedagogical formation are determined by the Ministry of National Education." Therefore, as mentioned above, teacher efficacy is addressed in the dimensions of general culture, special field education and pedagogical formation, and it is assumed that teachers with the desired qualifications will be trained if courses representing all these fields are included in the curriculums of the teacher training institutions. However, when it is examined, general culture, special field education and pedagogical formation areas are handled independently from each other in theory and practice (Seferoğlu, 2004; TED, 2009).

Teacher efficacy is considered important also in science education as it is in all fields. Science teachers' beliefs about special field education knowledge and classroom activities are closely related to the efficacy fact both in pre-service and in-service teaching processes. Whereas science teachers who consider themselves competent are quite successful in using student-centred approaches, taking more time to teach science and conducting a research-based teaching, the ones who see themselves less competent prefer to use teacher-centred approaches such as just reading the textbook and delivering direct instruction. In particular, the pre-service process is a significant time period for pre-service science teachers that is devoted to improving their field knowledge and teaching skills and increasing their efficacy levels (Yaman, Koray & Altunçekiç, 2004).

Important changes have been made in the system of teacher education in Turkey from past to present. Although these changes have taken place, the debate about the method of teacher training remains the same. These discussions are maintained particularly based on the dimensions of choice of profession, vocational training, etc. (Işık, Çiltaş & Baş, 2010).

Academic education for teaching profession is given within the faculties of education in Turkey. In addition to the four-year undergraduate education programs carried out at the faculties, as of 2013-2014 academic year, pedagogical formation certificate programs have been started within many faculties of education. The 6th term pedagogical formation certificate program is being carried out in 2016-2017 academic year, too. Students who study at different faculties or graduated students gain the efficacy to become a teacher with this program. When the course contents of the pedagogical formation certificate program are examined, it is revealed that students take the following courses: *Introduction to Educational Sciences, Educational Psychology, Assessment and Evaluation in Education, Instructional Principles and Methods and Classroom Management, Counselling, Teaching Practice, Special Teaching Methods, Instructional Technologies and Materials Design*. In addition, they take elective courses like the following: *Teacher Professional Ethics, Action Research in Education, Philosophy of Education, Educational Sociology, Curriculum Development in Education, Character and Values Education, History of Turkish Education, Turkish Education System and School Management, Lifelong Learning and Use of Technology in Education*. These courses are intensively conducted during one or two semesters in the faculties of education, generally at the weekends during the times out of formal education. Sometimes, 14-week-long semester course contents are provided within 7 weeks conducting courses twice as many hours in those weeks. There are also universities that give pedagogical formation through distance education. It raises curiosity to what extent pre-service teachers who have been intensively trained in pedagogical formation for a period of only one or two semesters consider themselves professionally competent. In this context, there are many current works in the literature, too. These studies generally appear as the studies that reveal the self-efficacy or professional efficacy levels of pre-service teachers who have received pedagogical formation education. Moreover, there are also studies to compare pre-service teachers who receive formal teaching education at undergraduate level in faculties of education with those who receive pedagogical formation education (Akça, Demir & Yılmaz, 2016; Aykaç, Bilgin & Toraman; Çocuk, Yokuş & Tanrıseven, 2015; Elkatmış, Demirbaş & Ertuğrul, 2013; İpek & Demirel, 2016; Süral & Sarıtaş, 2015; Temiz, 2016; Uysal & Kösemen, 2013; Yalçın İncik & Akay, 2015).

The present study, similar to the studies given in the examples above, aimed to comparatively describe the professional efficacy levels of pre-service science teachers who were carrying out their undergraduate studies at the faculty of education and of pre-service science teachers receiving pedagogical formation education. Besides, pre-service teachers' level of professional efficacy was also compared based on whether they were actively teaching or not. In line with this purpose, the research problem was determined as follows: "Does the level of professional efficacy of the pre-service teachers who have been studying in the Faculty of Education at Ömer Halisdemir University differ in terms of various variables?" The comparison between the undergraduate teacher candidates and the ones receiving pedagogical formation education are discussed in the comparison made on the basis of the departments. The study was conducted within the framework of three sub-problems that were consistent with the above problem, and the findings were interpreted accordingly.

- 1<sup>st</sup> Sub-Problem: What is the distribution of the scores of pre-service teachers' level of professional efficacy?  
 2<sup>nd</sup> Sub-Problem: Are there any differences in pre-service teachers' level of professional efficacy based on their departments?  
 3<sup>rd</sup> Sub-Problem: Are there any differences in pre-service teachers' level of professional efficacy based on whether they actively teach or not?

It is believed that this topic, which has recently started to be addressed, will contribute to the literature.

## 2. Method

The survey model was used in order to describe a present situation in the study the same as it already exists, and the general survey model was used within the approaches included in this model. The study group of the research was made up with 174 pre-service science teachers who had been studying in the pedagogical formation certificate program in the Faculty of Education at Ömer Halisdemir University, and 101 pre-service science teachers who had been studying in the last year of the undergraduate program within the academic year of 2015-2016. A total of 275 participants were included in the study group. The study group was identified through convenience sampling method as non-probability (purposive) sampling. That's why it was considered appropriate to use the term study group instead of the term sample. Some demographic features of the pre-service teachers in the study group are presented in Table 1.

Table 1. Some Demographic Features of the Pre-Service Teachers in the Study Group

Features			f	%	
Gender	Women	Pedagogical Formation	101	173	62,9
		Undergraduate	72		
	Men	Pedagogical Formation	73	102	37,1
		Undergraduate	29		
Department	Biology		57		20,7
	Physics	Pedagogical Formation	59	174	21,5
	Chemistry		58		21,1
	Science	Undergraduate	101	101	36,7
Actively Teaching	Yes	Biology	42	84 (%48,3)	33,1
		Physics	26		
		Chemistry	16		
	No	Science	Undergraduate	7	7 (%6,9)
No	Biology		15	90 (%51,7)	66,9
		Physics	33		
		Chemistry	42		
	Science	Undergraduate	94	94 (%93,1)	
Total			275		100

When Table 1 was examined, it was seen that 62.9% (173 persons) of the participants were composed of women. The fact that the teaching profession is mostly preferred by women may be considered as the cause of this situation. The percentage of pre-service science teachers who were being trained in pedagogical formation was about 63.3% (174 persons). And the percentage of the pre-service teachers who were actively teaching was 33.1% (91 persons) in total. While 48.3% (84 persons) of the pre-service science teachers registered for the pedagogical formation program were actively teaching, only 6.9% (7 people) of the pre-service science teachers who had been studying in the undergraduate program were actively teaching since their student status continued. After getting the necessary permissions from the developers and adapters, the "Personal Information Form" developed by the researcher and the "Teachers' Sense of Efficacy Scale" developed by Tschannen-Moran and Hoy (2001) and adapted to Turkish by Çapa, Çakiroğlu and Sarıkaya (2005) were used as the data collection tools in the study. The relevant scale was developed by the developers using Bandura's teacher self-efficacy scale. The 9-point likert scale was graded as "1 = Incompetent; 3 = Barely competent; 5 = Somewhat competent; 7 = Quite competent; 9 = Very competent", and comprised a total of 24 items. There are three sub-dimensions on the scale, each consisting of 8 items. These dimensions were determined as "Efficacy for Student Engagement", "Efficacy for Instructional Strategies" and "Efficacy for Classroom Management". The reliability values found in the development stage of the original form of the scale were calculated as ,94 for the whole scale; ,87 for the sub-dimension of efficacy for student engagement; ,91 for the sub-dimension of efficacy for instructional strategies, and ,90 for the sub-dimension of efficacy for classroom management (Tschannen-Moran & Hoy, 2001). While being adapted to Turkish by Çapa et al. (2005), these values were calculated as ,93; ,82; ,86 and ,84 respectively. In this study, the scale was applied to a group of 102 pre-service teachers who were studying at the last year of the undergraduate program and showed similar characteristics to the

designated study group as the pilot study before the final application, and the reliability values were calculated as ,92 for the whole scale; ,78 for the sub-dimension of efficacy for student engagement; ,82 for the sub-dimension of efficacy for instructional strategies, and ,86 for the sub-dimension of efficacy for classroom management.

Arithmetic averages and standard deviations were calculated in the analysis of the data in the study, then the independent variables were found to have normal distributions in the comparisons according to the Levene tests, and also t-test and one-way analysis of variance (ANOVA) were performed. The Scheffe test was used to determine the difference between the groups in the variance analysis.

### 3. Findings

Findings obtained in this part of the study were handled within the framework of three sub-problems that were determined. The comparisons were made and interpreted separately for the whole scale and all the sub-dimensions of it.

#### 3.1 Findings Related to the 1<sup>st</sup> Sub-Problem

The first sub-problem of the study was determined as follows: “What is the distribution of the scores of pre-service teachers’ level of professional efficacy?” At this point, the scores of the pre-service teachers were calculated for the whole scale and all the sub-dimensions of it; and the distribution of the scores are illustrated in Table 2. In the column of the table with the title “possible scores” display the lowest and highest scores that can be taken from the scale.

Table 2. Distribution of the Scores of Pre-Service Teachers’ Level of Professional Efficacy

Dimension	n	$\bar{x}$	Mode	Median	$\sigma$	Minimum-Maximum	Possible Scores
Efficacy for Student Engagement	275	55,35	54,00	55,00	6,356	27,00-71,00	
Efficacy for Instructional Strategies	275	56,14	56,00	57,00	6,900	40,00-72,00	8,00-72,00
Efficacy for Classroom Management	275	57,06	57,00	57,00	7,677	29,00-72,00	
Whole Scale (General Efficacy)	275	168,55	184,00	170,00	18,437	97,00-212,00	24,00-216,00

When Table 2 was examined, it was seen that the scores obtained from the whole scale varied between 97 and 212. It was also observed that the highest score values were almost reached in the whole scale and the sub-dimensions. The pre-service teachers achieved very close scores to the total scores (= 168, = 56) that could be obtained from the “7 = quite competent” statement in the efficacy dimension, given the arithmetic means of the answers they had given both in the whole scale and in the sub-dimensions. This situation revealed that all of the pre-service teachers considered themselves competent in terms of general efficacy and its sub-dimensions, regardless of whether they had undergraduate education or pedagogical formation.

#### 3.2 Findings Related to 2<sup>nd</sup> Sub-Problem

The second sub-problem of the study was expressed as follows: “Are there any differences in pre-service teachers’ level of professional efficacy based on their departments?” This sub-problem which especially includes the comparison of undergraduate science teacher candidates and science teacher candidates who were receiving pedagogical formation education for the teaching profession is regarded as significant. The findings obtained from the whole scale and the sub-dimensions on the basis of the departments are given in Table 3.

Table 3. Distribution of the Scores of Pre-Service Teachers' Level of Professional Efficacy Based on their Departments

Dimension	Department	n	$\bar{X}$	$\sigma$	Minimum-Maximum	Possible Scores	
Efficacy for Student Engagement	Pedagogical Formation	Biology (1)	57	57,61	6,108	42,00-70,00	8,00-72,00
		Physics (2)	59	51,36	7,082	26,00-63,00	
	Undergraduate	Chemistry (3)	58	53,04	5,575	42,00-63,00	
		Science (4)	101	56,63	5,786	45,00-71,00	
Efficacy for Instructional Strategies	Pedagogical Formation	Biology (1)	57	57,89	6,863	44,00-69,00	8,00-72,00
		Physics (2)	59	52,72	7,156	41,00-68,00	
	Undergraduate	Chemistry (3)	58	53,54	6,724	40,00-65,00	
		Science (4)	101	57,20	6,116	40,00-72,00	
Efficacy for Classroom Management	Pedagogical Formation	Biology (1)	57	59,63	6,369	44,00-71,00	8,00-72,00
		Physics (2)	59	52,32	8,552	29,00-72,00	
	Undergraduate	Chemistry (3)	58	56,67	7,614	37,00-68,00	
		Science (4)	101	57,00	7,078	36,00-71,00	
Whole Scale (General Efficacy)	Pedagogical Formation	Biology (1)	57	175,14	17,209	135,00-208,00	24,00-216,00
		Physics (2)	59	156,40	19,199	96,00-203,00	
	Undergraduate	Chemistry (3)	58	163,25	17,464	119,00-192,00	
		Science (4)	101	170,83	16,916	121,00-212,00	

When the findings in Table 3 are examined, it can be stated that the highest mean score in the overall scale belonged to the pre-service Biology teachers ( $\bar{X}_{\text{Biology}}=175,14$ ) and pre-service Science teachers ( $\bar{X}_{\text{Science}}=170,83$ ). These two departments were followed by the pre-service teachers of Chemistry ( $\bar{X}_{\text{Chemistry}}=163,25$ ) and Physics ( $\bar{X}_{\text{Physics}}=156,40$ ) Teacher Education. Pre-service Physics teachers were the last among the departments in terms of the mean scores. This situation was parallel in the sub-dimensions of the scale as well. The results of the variance analysis indicating the significance level of the differences between the mean values are displayed in Table 4.

Table 4. Results of Analysis of Variance according to Pre-Service Teachers' Level of Professional Efficacy Based on their Departments

Dimension	Source of Variance	Sum of Squares	$\sigma$	Mean Square	F	p	Significant Difference
Efficacy for Student Engagement	Between Groups	932,685	3	310,895	8,580	,000*	1>2
	Within Groups	7355,673	203	36,235			1>3
	Total	8288,357	206				4>2
Efficacy for Instructional Strategies	Between Groups	726,183	3	242,061	5,683	,001*	1>2
	Within Groups	8646,406	203	42,593			4>2
	Total	9372,589	206				
Efficacy for Classroom Management	Between Groups	941,944	3	313,981	6,146	,001*	1>2
	Within Groups	10370,036	203	51,084			4>2
	Total	11311,981	206				
Whole Scale (General Efficacy)	Between Groups	7218,001	3	2406,000	7,999	,000*	1>2
	Within Groups	61059,516	203	300,786			1>3
	Total	68277,517	206				4>2

\* It is significant at  $p < .05$  level.

When Table 4 was examined, it was found out that the difference between the mean scores of the pre-service teachers significantly differed in the whole scale and in its sub-dimensions based on the departments in which they were studying. According to the results of the Scheffe test performed to find out in which programs the differences between the departments were, it was observed that in the overall scale, the professional efficacy mean scores of the pre-service teachers who had been studying at the Physics department ( $\bar{X}_{\text{Physics}}=156,40$ ) were lower than the efficacy for technology mean scores of the pre-service teachers who had been studying both at the Biology department ( $\bar{X}_{\text{Biology}}=175,14$ ) and at the Science department ( $\bar{X}_{\text{Science}}=170,83$ ), and this difference was significant at  $p < .05$  level. Similarly, the overall mean scores of the pre-service teachers who had been studying at the Chemistry department ( $\bar{X}_{\text{Chemistry}}=163,25$ ) were lower than the mean scores of the teacher candidates who had been studying at the Biology department ( $\bar{X}_{\text{Biology}}=175,14$ ), and this difference was significant at  $p < .05$  level. These significant differences also appeared in the sub-dimension "Efficacy for Student Engagement" in the same way. A significant difference in the scale's sub-dimensions "Efficacy for Instructional Strategies" and "Efficacy for Classroom Management" was found in favour of the Biology department teacher candidates



between the Biology and Physics departments, and in favour of the pre-service Science teachers between the Science and Physics departments. It can be assumed that this finding appeared in relation to the quality of the undergraduate education and the active-teaching variable whose information about the participants is given in Table 1 and which is handled within the framework of the next sub-problem. Pre-service teachers at the Department of Biology, which had a higher number of participants who were actively teaching, compared to other departments, had the highest mean scores in professional efficacy and their efficacy scores significantly differed from the pre-service Physics and Chemistry teachers who were receiving pedagogical formation. The fact that the difference was in favour of the Science teacher candidates who were gaining the basic knowledge of their field and the outcomes related to pedagogical formation in more class hours over a period of four years shows that four-year undergraduate program is more competent in helping students acquire knowledge and skills. The efficacy scores of the pre-service teachers in the study were also compared according to the teacher-training program in which they studied regardless of the department. The findings are illustrated in Table 5.

Table 5. Results of Analysis of t-test according to Pre-Service Teachers' Level of Professional Efficacy Based on their Teacher Training Program

Dimension	Program	n	$\bar{X}$	$\sigma$	t	df	p
Efficacy for Student Engagement	Pedagogical Formation	174	54,63	6,578	-2,511	273	,013*
	Undergraduate	101	56,60	5,776			
Efficacy for Instructional Strategies	Pedagogical Formation	174	55,57	7,286	-2,599	273	,010*
	Undergraduate	101	57,12	6,088			
Efficacy for Classroom Management	Pedagogical Formation	174	57,11	8,050	,150	273	,881
	Undergraduate	101	56,97	7,025			
Whole Scale (General Efficacy)	Pedagogical Formation	174	167,31	19,274	-1,470	273	,143
	Undergraduate	101	170,69	16,774			

\* It is significant at  $p < .05$  level.

When the findings in Table 5 are examined, it can be seen that the mean scores that the pre-service teachers obtained according to the teacher-training program in which they studied significantly differed in the sub-dimensions "Efficacy for Student Engagement" and "Efficacy for Instructional Strategies" in favour of the teacher candidates who were studying in the Undergraduate program. And there was no significant difference in the sub-dimension "Efficacy for Classroom Management" and in the overall scale. When the findings given and interpreted in Table 3 and Table 4 are taken into consideration, this situation is regarded as an expected one. As shown in Table 1, the student status of the undergraduate pre-service Science teachers still continued, and only 6.9% (7 persons) of them were actively teaching. However, it was observed that almost half of the pre-service Science teachers who studied in the pedagogical formation program (48%, 3-84 persons) were actively teaching. Although the efficacy levels of the pre-service teachers who studied in the pedagogical formation program were significantly lower than the pre-service Science teachers who studied in the undergraduate program in terms of providing student participation and determining teaching strategies, it could be thought that the fact that almost half of them were actively teaching caused their scores to increase in the dimension of class management. This situation increased the general efficacy scores of the teacher candidates who studied in the pedagogical formation program. And no difference occurred between the groups in terms of the general efficacy scores of the pre-service teachers who studied in the undergraduate program.

### 3.3 Findings Related to 3<sup>rd</sup> Sub-Problem

The third sub-problem of the study was determined as follows: "Are there any differences in pre-service teachers' level of professional efficacy based on whether they actively teach or not?" The findings obtained from the whole scale and the sub-dimensions are presented in Table 6.

Table 6. Results of Analysis of t-test according to Pre-Service Teachers' Level of Professional Efficacy Based on Whether They Actively Teach or not

Dimension	Actively Teaching	n	$\bar{X}$	$\sigma$	t	df	p
Efficacy for Student Engagement	Yes	74	55,14	7,343	-,344	273	,731
	No	201	55,43	5,970			
Efficacy for Instructional Strategies	Yes	74	58,01	6,473	2,768	273	,005*
	No	201	55,45	6,939			
Efficacy for Classroom Management	Yes	74	58,86	7,754	2,383	273	,018*
	No	201	56,40	7,560			
Whole Scale (General Efficacy)	Yes	74	172,01	19,087	1,898	273	,046*
	No	201	167,28	18,073			

\* It is significant at  $p < .05$  level.

Findings in Table 6 appear to support the findings that were discussed and interpreted in the previous sub-problems. There were significant differences in favour of the pre-service teachers who were actively teaching and most of whom studied in the pedagogical formation program in the whole scale and its sub-dimensions other than the "Efficacy for Student Engagement". In the sub-dimension "Efficacy for Student Engagement" of the scale, there are also items like; *to reach students who are hard to work with, to enable students to think critically, to motivate students with low interest in classes, to provide students with the belief in being successful, to enable students to care for learning, to carry out quality assessment and evaluation, to ensure an unsuccessful student to understand the lesson in a better way, and to provide support for families to help their children become successful at school.* These items are far more than being based on practice; they include the skills provided to the students through the courses of educational sciences. This situation can be considered as a reason why there was no difference in the "Efficacy for Student Engagement" sub-dimension based on the state of active teaching.

#### 4. Conclusion, Discussion and Recommendations

As stated in the introduction, this study aimed to comparatively describe the efficacy levels of pre-service science teachers who were receiving undergraduate education at the faculty of education and the ones of the pre-service science teachers who were receiving pedagogical formation education for the teaching profession. According to Sharma, Loreman and Forlin (2012), whatever their individual differences are, newly-graduated teachers need to be prepared to include all students in their primary classroom activities. At this point, there is a great responsibility for teacher training programs. It is of great importance to identify pre-service teacher efficacy before they start teaching in order to determine whether they are ready for this difficulty. Therefore, it is essential to examine the efficacy levels of pre-service science teachers who have graduated from the departments other than the education faculties and who have the efficacy to teach as a result of the pedagogical formation certificate program in terms of the of the individuals receiving the education and the quality of the education that is given.

According to Bandura (1986: 25), people's thoughts, beliefs and feelings affect how they behave. And teacher efficacy is defined as the belief or opinion that teachers have about how to teach troublesome students or students with low motivation best (Han, 2014: 47). Therefore, there is a strong relationship between student achievement and teacher efficacy. Teacher candidates who define themselves as competent are thought to be more successful when they start to serve. Studies revealing this situation are frequently encountered in the literature. For example, in a study conducted by Nie, Tan, Liau, Lau and Chua (2013) with 2139 teachers working at different levels of schools throughout Singapore, it is seen that there is a high correlation between teaching efficacy and constructivist teaching. Furthermore, it is stated that efficacy of a teacher enhances teaching adaptation. Similarly, in a doctoral thesis carried out qualitatively with three different branch (Physics, Chemistry and Biology) teachers who have been teaching in the field of science for more than eight years, Han (2014) has reached the conclusion that teacher efficacy plays a primary role for the level of teachers' pedagogical content knowledge. In his study conducted in Canada with 1065 foreign language teachers on self-efficacy, Swanson (2012) has come to the conclusion that teachers are inclined to leave the profession as a consequence of lack of self-confidence in teaching cultural knowledge as well as classroom management problems that may arise. In another study carried out with 100 Chemistry teacher candidates taking the course Analytical Chemistry I, Tenaw (2013) examines the relationship between the self-efficacy of teacher candidates and their academic achievements, and concludes that there is a significant and high positive correlation between the level of self-efficacy and academic achievement. In a similar way, in their study with 188 elementary school teacher candidates, Brigido, Borrachero, Bermejo and Mellado (2013) study the relationship between self-efficacy beliefs of pre-service teachers and their emotions they foresee for themselves in conducting science lessons in the future. As a result of the study, the pre-service teachers who consider themselves less competent

have lower feelings for science lessons related to Physics and Chemistry, which are thought to be stricter.

In the light of the studies mentioned above, it can be stated that it is necessary for teacher candidates to see themselves competent when they start to work in order to attain success. It was concluded in the study that the pre-service science teachers who were studying at undergraduate level as well as the pre-service science teachers who were studying in the pedagogical formation certificate program considered themselves competent at the level of “quite competent” (Table 2). This situation was revealed in the same way in the studies of Çocuk et al. (2015); İpek and Demirel (2016); Uysal and Kösemen (2013); Yalçın İncik and Akay (2015), who carried out similar studies. At this point, it is expected that pre-service teachers should be successful in the process of starting the profession.

The comparison of the efficacy level of pre-service science teachers having undergraduate education and pre-service science teachers receiving pedagogical formation education for the teaching profession, which reflects the actual starting point of the study was first carried out on the basis of departments and then on the basis of programs. In the comparisons made on the basis of the departments, it was concluded that in the whole scale and its sub-dimensions, the mean scores of the Biology teacher candidates who were studying in the pedagogical formation program and the Science teacher candidates who were studying in the undergraduate program were higher than those of the Physics and Chemistry teacher candidates studying in the pedagogical formation program, and the differences between the mean scores were meaningful (Tables 3 and 4). In the comparisons made between the programs (undergraduate education and pedagogical formation), it was found out that the efficacy scores significantly differed in the sub-dimensions of the scale titled as “Efficacy for Student Engagement” and “Efficacy for Instructional Strategies” in favour of the pre-service Science teachers who were receiving undergraduate education. There was no significant difference in the sub-dimension “Efficacy for Classroom Management” and in the overall scale depending on the increasing average in this dimension (Table 5). When the demographic features of the participants were examined (Table 1), it was seen that almost half of the pre-service Science teachers who were receiving pedagogical formation education, and especially the majority of the Biology teacher candidates receiving this education were actively teaching. Undergraduate pre-service Science teachers were actively teaching at a very low rate due to their on-going student status. The increase in the scores of pre-service science teachers studying in the pedagogical formation program in the sub-dimension “Efficacy for Classroom Management” is considered to be the reason for this situation. Pre-service Science teachers who acquire basic knowledge with respect to their fields and the skills related to pedagogical formation over a period of four years, and also who find more practice opportunities with the activities like micro teaching, presentation, observation, etc. consider themselves more competent in general terms in the sub-dimensions “Efficacy for Student Engagement” and “Efficacy for Instructional Strategies” which require more skills theoretically than pre-service Science teachers who receive pedagogical formation education.

When the current pedagogical formation education process in Turkey is examined, it is seen that this education is provided in the faculties of education, usually during evening hours or at weekends when it is extracurricular time in the faculty and with very intense class hours successively. And in some faculties, these courses are conducted through distance education. The short duration of the program, the program’s being compressed, unsuitable time and conditions, teachers’ lack of efficiency from time to time, and not planning practical lessons make this education inadequate. For example, in their study in which Süral and Sarıtaş (2015) examined the efficacy of the students participating in the pedagogical formation program for the teaching profession, they stated that 73.3% (220 people) of the 300 students included in the study expressed the view that the formation education should be taken within a four-year undergraduate program. There are different studies in the literature that support the above-mentioned negative sides of pedagogical formation education and examine their characteristics (Demirtaş & Kırbaç, 2016; Kiraz & Dursun, 2015; Önder & Tagay, 2015; Taneri, 2016; Tepeli & Caner, 2014). In a comparative study conducted by Yalçın İncik and Akay (2015) with 500 teacher candidates attending the faculty of education and pedagogical formation certificate programs, they found out that prospective teachers studying at the faculty of education stated that the education they received was sufficient to meet teachers’ efficacy while teacher candidates receiving pedagogical formation training stated that formation education was insufficient to meet teachers’ efficacy. According to the results of the study, the formation education is compressed in a very short time, which negatively affects the fulfilment of the efficacy. When the negative aspects of the pedagogical formation education program supported by the related studies are eliminated, it is believed that the teacher candidates who receive this education will develop themselves and see themselves more competent in the dimensions of “Efficacy for Student Engagement” and “Efficacy for Instructional Strategies” discussed in the study. It is therefore recommended to extend the program duration, to make the time and conditions more appropriate, and to plan the course activities in such a way that the teacher candidates gain more pedagogical skills.

In the study, within the framework of a different sub-problem and in order to investigate the findings of the previous sub-problems, the efficacy of the pre-service teachers who were carrying on with their undergraduate and pedagogical formation education for the teaching profession were compared according to



whether they actively taught or not, without making a distinction between the programs. It was concluded that the efficacy levels of the pre-service teachers composed by the participants who were actively teaching and most of whom were studying in the pedagogical formation program, were significantly higher in the overall scale and in the other dimensions except the “Efficacy for Student Engagement” (Table 6). This result supports the fact that the active teaching variable discussed in the previous section increases the efficacy levels of pre-service teachers. At this point, it can be argued that teacher efficacy is related to the teaching experience. In a study on teacher self-efficacy conducted by comparing prospective teachers with teachers who actively teach, Putman (2012) used the scale used in this study and found out that the efficacy of the teachers with more experience were significantly higher in the overall scale and in all its sub-dimensions than the efficacy of the teachers with less experience and that of the prospective teachers still studying. Similarly, Ipek and Demirel (2016) comparatively examined the self-efficacy beliefs of pre-service primary school teaching and pedagogical formation program teacher candidates, and they put forward that self-efficacy beliefs of the teacher candidates who attended the pedagogical formation program as an alumni were significantly higher than those of the primary school teacher candidates who still continued in the program and the teacher candidates attending the pedagogical formation program from the faculty of arts and sciences. And they attributed this result to the fact that many of the teacher candidates who graduated were actively teaching at various private institutions even though they had not been appointed as teachers for many years since they did not have certificates for teaching. Devine, Fahie, and McGillicuddy (2013), in their study carried out in 12 different schools in Ireland, found out that the beliefs and practices of experienced teachers in their teaching activities were higher. Also, the study conducted by Bedir (2015) on teacher efficacy has significance in favour of experienced teachers. In this case, environments should be established to provide active teaching opportunities for teacher candidates both in undergraduate programs and in pedagogical formation programs. In this context, the effectiveness and supervision of “Teaching Practice” lessons in both programs should be increased and more opportunities for teacher candidates to work on the field should be provided.

In this study, the efficacy of the pre-service teachers who study in two different teacher education programs which are currently present in Turkey for the time being are examined. Comparative studies that address efficacy and effectiveness of these pre-service teachers, especially those who have been appointed to Science teaching after receiving pedagogical formation and still continue to work should be conducted.

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