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Pedagogical development level of pre-service primary school teachers for science teaching

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In this study, the pedagogical development level of pre-service primary school teachers for science teaching was examined. The participants of the study consist of 135 pre-service teachers from Primary School Teaching Department in Faculty of Education at Pamukkale University. After removing the invalid forms, a total of 128 pre-service teachers participated in the study. Data were collected with "Pre-service Teachers' Pedagogical Development Scale" developed by Hudson and Ginns and adapted by Hacıömeroğlu and Şahin-Taşkın. For data analysis, standard deviation, mean, t-test, one way ANOVA were used. Results showed that the pre-service teachers "totally agreed" they have science teaching skills in general. They "totally agreed" also with the dimensions (theory, development of children, planning, and practice) of the scale. There was no statistical difference between the pedagogical development levels of the pre-service teachers according to their gender. However, they differ according to the type of high school that they graduated from; other types of high schools (Anatolian Teacher Training High School and Science High School) perceived themselves more efficient than students from Anatolian High Schools in terms of theory and planning dimensions.

Key words: Pedagogical development, science teaching, pre-service primary school teacher.

INTRODUCTION

Human beings have been excited in exploring the world since they were created. They have put in much effort in understanding and learning the world. They have survived by adapting to what they have learned since ancient times. Indeed, humans survive by learning through their observations and experiences.

There are various types of learning today. For instance, Morgan (1995: 77) defined learning as continuous changes in behavior with experiences and repetition. On the other hand, Bower and Hilgard (1981: 21) handled learning as behavioral changing process and discriminated that learning from behavioral changes resulted from effects such as tiredness and medicine. Behaviorist approach considers learning as observable behavior changes while cognitive approach emphasizes meaning making process in learning. What the behaviorists call changing behavior is, in fact, the expression of learning which occurs in cognition. Meanwhile, learning and teaching concepts have changed due to constructivist theory. Wheatley (1991, cited in Yurdakul, 2005) indicated that learning in constructivism is a meaning making process and meaning is constructed

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not through direct instruction but by the learner himself. An individual reconstructs and interprets knowledge based on his experiences and pre-learnings. Thus learning to learn becomes important in this approach. In behaviorist approach, knowledge is transferred to the learner by an expert or a teacher. Nevertheless, in constructivism, the teacher is a guide for the learners to organize their learnings by providing a suitable environment.

What we adopt as a theory for learning affects the role of the teacher also. In behaviorist approach, the teacher is the one who transfers knowledge and is at the center of the instruction. On the other hand, in constructivism, the teacher has the role of a guide. In other words, the teacher creates suitable learning and teaching environments for the students to construct their meanings (Açıkgöz, 1996).

In Turkey, schools' curricula have been revised according to constructivist approach in 2004. The content knowledge, instructional methods, teacher and students roles were all identified based on constructivism. As Demirel (2008: 22) defines, the teacher is open-minded and innovative, considers individual differences, provides appropriate learning experiences and is the learner himself. Teacher training institutions also revised their curricula considering the constructivist approach. Brooks and Brooks (1993) emphasized that a teacher as a learner supports the autonomy of the students, encourages students' curiosity and interests, and provides environments for them to assimilate, classify and relate. In this sense, the pedagogical knowledge of a teacher becomes important. As Uşak (2005) indicated also, the purpose of the pedagogical knowledge of a teacher is to organize his knowledge based on the level and skills of his students. Pedagogical knowledge is the combination of the student, classroom, and curriculum in terms of students' level and abilities (Gudmundsdottir, 1990). As a result of rapid technological and scientific developments, curricula are revised today. Mostly in the fields of science and technology, these rapid developments lead to the increasing importance of engineering. Especially Science, Technology, Engineering, and Mathematics (STEM) has become so popular in the sense that engineering is a suitable platform for science and technology education (STEM Report, 2015). As for the learning outcomes of science courses at school, science and engineering practices were added in order to train an individual who can produce and use technological practices.

Primary school years are especially important to train individuals to become responsible for their own learnings. In this sense, having pedagogical knowledge is significantly important for a primary school teacher. In related literature, there is a lack of research assessing pedagogical knowledge. Çiltaş and Akıllı (2011) identified the pedagogical efficiencies of teachers; Öztürk and Horzum (2011) investigated the technological dimension of teachers' pedagogical knowledge, and lastly, Hacıömeroğlu and Şahin-Taşkın (2012) adopted a scale on pedagogical knowledge in Turkish. In this research, pedagogical development level of pre-service primary school teachers for science teaching was examined and three research questions were asked for this purpose:

Research Questıons

(1) What is the level of pre-service primary school teachers' pedagogical development in science teaching?
(2) Is there any significant difference between the pre-service teachers' pedagogical development level of science teaching and their gender?
(3) Is there any significant difference between the pre-service teachers' pedagogical development of science teaching and their high school type?

METHODOLOGY

Screening model was used for the study. Screening models are research approaches which aim to describe past phenomenon as it is today. The respective phenomenon is identified in its situation and as it is. In screening models, a sample is chosen from the study group or the researcher reaches whole study group in order to make generalizations (Karasar, 2007: 77).

Sample

The sample of the study consists of 135 pre-service primary school teachers from Faculty of Education at Pamukkale University. After removing the invalid forms, the study was carried out with 128 pre-service teachers. Demographics of the teachers are displayed in Table 1.

Data collection tool

Data were collected with "Pre-service Teachers' Pedagogical Development Scale" developed by Hudson and Ginns (2007) and adapted by Hacıömeroğlu and Şahin-Taşkın (2012). The scale has two parts. The first part consists of personal information, and the second part consists of items related to pedagogical development. A total of 25 items are rated from "Totally disagree" to "Totally agree". The scale is of the five-point likert type. The inter-reliability coefficient of the scale was calculated as 0.919. The scale was translated into Turkish, and three experts from English Language Teaching Department and two experts from Curriculum and Instruction Department evaluated the scale for its scope validity. It has four factors named theory, development of children, planning, and practice; its Cronbach alpha is 0.706, 0.781, 0.795 and 0.820 respectively.

Data analysis

In order to compute the pedagogical development inclination of pre-service teachers for science teaching course, total arithmetic mean scores and standard deviations, and minimum, maximum and total scores reported from the scale were calculated. While determining the median, it was supposed that the results from the scale had a homogeneous distribution. The dimensions of the 25-item pedagogical development scale are the theory (6 items),

Table 1. Demographics of pre-service primary school teachers.

Variables	f	%
Gender		
Female	85	66,4
Male	43	33,6
Total	128	100
High school type		
General high school	60	46,9
Anatolian high school	43	33,6
Others	25	19,5
Total	128	100

Table 2. Kolmogorov-Smirnov test results.

Test	Theory	Development of Children	Planning	Practice
Kolmogorov-Smirnov	1.52	2.03	0.997	2.00
p	0.019	0.011	0.273	0.011

Table 3. Pre-service teachers' pedagogical development scale.

Variables	N	X	Sd	Min	Max.	Xort	Response
Total	128	95.04	10.24	70	117	3.80	Totally agree
Theory	128	22.21	2.82	14	29	3.70	Totally agree
Development of the children	128	19.26	2.45	12	23	3.85	Totally agree
Planning	128	26.53	3.29	19	32	3.79	Totally agree
Practice	128	27.03	3.41	19	34	3.86	Totally agree

development of children (5 items), planning (7 items) and practice (7 items). The minimum score gained from the scale is 25, the median score is 91.6 and the maximum score is 125. Independent samples t-test was used to compare the mean scores and the variables. Standard deviation, arithmetic mean scores, t-test, one way ANOVA were used for data analysis. The significant value was accepted as 0.05.

Data collection

Data were collected in the spring term of 2016-2017 academic years. The scale was independently completed by the volunteer participants reminding them not to indicate their name on the scale. Data were collected by the researcher herself.

FINDINGS

The findings of the study were presented based on the research questions. In order to comment on the responses of the pre-service teachers to the scale, the scores intervals were used. This value was "the result of dividing the difference between maximum value and the minimum value in the measurement results to the group number" (Kan, 2009: 407). So the response intervals of the pre-service teachers were obtained as totally agree (3.21 – 4.00), agree (2.41-3.20), neutral (1.61-2.40), disagree (0.81-1.61), and totally disagree (0.00-0.80). If the sample size is above 35, the Kolmogorov-Smirnov test is the one used for normality (McKillup, 2012). Kolmogorov-Smirnov test was used to determine the normal distribution criteria. As displayed in Table 2, the data were normally distributed.

Findings of the first research question

The first research question of the study was "What level is the pre-service primary school teachers' pedagogical development of science teaching?" Table 3 shows the pedagogical development levels of the pre-service teachers. The minimum score was 70, and the maximum score was 117 obtained from the scale. The mean score of the pre-service teachers was X = 95.04. This means pre-service primary school teachers have positive views about their science teaching skills. Examining the mean scores of the dimensions, the scores were X=22.21 for

Table 4. T-test for the comparison of pre-service teachers' pedagogical development level of science teaching and their gender.

Groups	N	X	Sd	t	p
Female	85	96.55	9.00	2.38	0.019*
Male	43	92.06	11.89		

*p>0.05.

Table 5. T-test for the comparison of the pre-service teachers' pedagogical development level of science teaching and their gender in terms of the dimensions.

Dimensions	Gender	N	X	Sd	t	p
Theory	Female	85	22.41	2.62	1.13	0.26
	Male	43	21.81	3.18		
Development of the children	Female	85	19.52	2.30	1.72	0.88
	Male	43	18.74	2.68		
Planning	Female	85	27.12	2.98	2.97	0.003*
	Male	43	25.34	3.57		
Practice	Female	85	27.48	3.06	2.09	0.038
	Male	43	26.16	3.90		

*p<0.05.

theory, X=19.26 for development of children, X=26.53 for planning, and X=27.03 for practice. The response of the pre-service teachers inclined to be "totally agree" and this shows that they have positive views about their science teaching skills in general. Pre-service teachers have positive perceptions that they can use their theoretical information in planning and practicing dimensions considering the development of the children.

Findings of the second research question

The second research question of the study was "Is there any significant difference between the pre-service teachers' pedagogical development level of science teaching and their gender?" Table 4 displays the findings of the analysis. As shown in Table 5, there is no difference between the gender of the pre-service teachers and their pedagogical development level of science teaching. The mean scores of the two groups are close to each other.

The only significant difference between the pre-service teachers' pedagogical development of science teaching and their gender was found in terms of planning dimension. The items of the planning are about designing an integrated and clear course structure. The difference was in favor of female students; however, it should be considered that the difference between the mean scores was low.

The findings of the third research question

The third research question of the study was: "Is there any significant difference between the pre-service teachers' pedagogical development of science teaching and their high school type?" Table 6 displays the findings. There is a significant difference between the pre-service teachers' pedagogical development of science teaching and their high school type only in terms of theory and planning dimensions. As for the dimension of theory, there is a statistical difference between the pre-service teachers who graduated from Anatolian High Schools (X= 22.16) and from other high school types (X= 24.32). Here, the other school types were categorized as Anatolian Teacher Training High Schools and Science High Schools. These high schools have a deeper and busier curriculum than the others. Moreover, students in Anatolian Teacher Training High School have courses of teacher training like planning and evaluation in instruction. This leads to the significant difference in pedagogical development of the preservice teachers who graduated from these types of high schools.

DISCUSSION

The main purpose of this study is to identify the pre-service primary school teachers' pedagogical development level of science teaching. Findings show that the

Table 6. Comparison of pre-service teachers' pedagogical development level in terms of their high school type.

Dimensions	High school type	N	X	Sd	df	F	p	Sig.
Theory	General High School	60	91.85	9.40	2/125	11.18	0.000	1-3
	Anatolian High School	43	96.60	8.61				
	Other	25	100.04	12.31				
	General High School	60	21.36	2.48				2-3
	Anatolian High School	43	22.16	2.75				
	Other	25	24.32	2.73				
Development of the children	General High School	60	18.75	2.64	2/125	2.68	0.072	-
	Anatolian High School	43	19.60	2.15				
	Other	25	19.92	2.30				
Planning	General High School	60	25.36	3.10	2/125	8.19	0.000	1-2
	Anatolian High School	43	27.32	2.81				1-3
	Other	25	27.96	3.61				
Practice	General High School	60	26.36	3.05	2/125	2.31	0.103	
	Anatolian High School	43	27.51	2.74				
	Other	25	27.84	4.81				

pre-service teachers totally agreed they have science teaching skills generally. They "totally agree" with the dimensions of the scale (theory, development of children, planning, and practice) also. It is a good finding that the pre-service primary school teachers perceived themselves as efficient in teaching science and making students have positive attitudes towards science course. MEB (2017) identified 6 main efficiencies in "teaching proficiency main efficiencies guide" and the participants of the current study have the efficiencies such as recognizing students and curriculum-content knowledge. Hudson and Ginns (2007) also reached the same results in their study that pre-service teachers had a high level of awareness in planning their course. In another study, Kurtuluş and Çavdar (2010) compared the self-efficiency of pre-service primary school teachers and pre-service science teachers in science teaching. Results showed that pre-service primary school teachers had a high level of self-efficiency but not more than pre-service science teachers. Wenner (2001) found that pre-service teachers considered themselves efficient in the development of children and practicing of the curriculum. Savran (2002) made a research with pre-service science teachers also, and found that they have a high level of self-efficiency. Andersen et al. (2004) stated that novice teachers saw themselves as efficient but their self-efficiency beliefs were based on their workplaces. Altunçekiç et al. (2005) found that pre-service teachers considered themselves efficient in terms of science education. There was no significant difference in the pedagogical development of the teacher candidates' science lesson compared to their genders. This finding is in consistent with some of the studies in related literature (Hacıömeroğlu and Şahin-Taşkın, 2012; Altunçekiç et al., 2005; Savran, 2002; Wenner, 2001). However, some others found a significant difference in terms of gender variable (Akkoyunlu and Orhan, 2003; Yaman et al., 2004; Çakıroğlu et al., 2005; Yılmaz et al., 2006; Gencer and Çakıroğlu, 2007). It is striking that there was a difference in planning dimension for female students. Özdemir (2008), Başer et al. (2005) and Kiremit (2006) also got the same result. This may be because of the common belief that girls consider planning and programming in their daily life more. After all, the items in planning dimension are about effective designing of the course.

There was a significant difference in the pedagogical development of pre-service primary school teachers according to high school type in the theory and planning dimensions. As for the theory, pre-service teachers who graduated from other high school types – which are Anatolian Teacher Training High Schools and Science High Schools – had higher scores than the students who graduated from Anatolian high schools. Kiremit (2006) and Akkoyunlu and Orhan (2003) also found a significant difference in terms of Anatolian Teacher Training High School graduates. In Anatolian Teacher Training and Science High Schools, students have a more intense curriculum. Moreover, students in Anatolian Teacher Training High Schools have the courses of planning and evaluation in instruction. This may lead to a significant

difference in pedagogical development.

Conclusion

Below are some suggestions given based on the results of the current study:

(i) Pedagogical development levels of the pre-service teachers should be periodically investigated, and based on the results teacher training programs should be revised. Specifically, boys have a low level of awareness in terms of planning so there should be various activities to acknowledge male students.
(ii) The current study was conducted with pre-service primary school teachers at Pamukkale University. Similar studies should be conducted in different universities and different branches. Furthermore, future qualitative studies should be conducted to investigate whether pre-service students' pedagogical development level is affected by various variables.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

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