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An Analysis of Turkish Pre-service Preschool Teachers' Self-image on a Science Education Course

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Abstract

The purpose of the current study is to investigate the changes of self-image occurring in pre-service preschool teachers during a course of science education. The study employed the phenomenological research method within the framework of a qualitative perspective. A total number of 75 pre-service preschool teachers participated in the study on a voluntary basis and they were asked to draw a picture to reflect their state during the science education course and to explain it. The findings derived from these drawings were found to be subsumed under four categories: cognitive, implementation, affective and social. It was also found that the pre-service preschool teachers had difficulties in understanding science while emphasized a teacher-centered approach to its teaching. Moreover, inconsistent feelings and attitudes towards the subject were observed and social interaction was not depicted very much. In the light of the findings, it is suggested that preschool teacher education programs should be revised to provide effective science education. It is thought that teacher educators and mentors play an important role in pre-service preschool teachers acquiring adequate knowledge and skills and developing positive attitudes.

Keywords: Science education, preschool, phenomenology, drawing.

Türk Okul Öncesi Öğretmen Adaylarının Fen Bilgisi Eğitimi Dersine İlişkin Öz İmajlarının Analizi

Öz

Bu araştırmanın amacı, okul öncesi öğretmen adaylarında fen bilgisi eğitimi dersi sırasında meydana gelen öz imajlarındaki değişiklikleri incelemektir. Çalışmada nitel bir bakış açısı çerçevesinde fenomenolojik araştırma yöntemi kullanılmıştır. Çalışmaya gönüllü olarak toplam 75 okul öncesi öğretmen adayı katılmış ve fen eğitimi dersi süresince kendi durumlarını yansıtacak bir resim çizmeleri ve açıklamaları istenmiştir. Bu çizimlerden elde edilen bulgular bilişsel, uygulama, duyuşsal ve sosyal olmak üzere dört kategori altında toplanmıştır. Bulgular ayrıntılı incelendiğinde, okul öncesi öğretmen adaylarının bilimi anlamakta güçlük çektikleri, öğretmen merkezli bir yaklaşımı vurguladıkları görülmüştür. Ayrıca öğretmen adaylarının fen eğitim dersine yönelik tutarsız duygu ve tutumlar sergiledikleri gözlemlenmiştir. Fen eğitiminin önemli bir unsuru olan sosyal etkileşiminde çok fazla tasvir edilmediği bulunmuştur. Elde edilen bulgular ışığında okul öncesi öğretmen yetiştirme programlarının etkili fen eğitimi sağlayacak şekilde revize edilmesi önerilmektedir. Okul öncesi öğretmen adaylarının yeterli bilgi ve beceriye sahip olmalarında ve olumlu tutumlar geliştirmelerinde öğretmen yetiştiricilerinin ve danışmanların önemli rol oynadığı düşünülmektedir.

Anahtar kelimeler: Fen eğitimi, okul öncesi, fenomenoloji, çizim

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1 | INTRODUCTION

Today, contemporary education systems aim to educate scientifically literate individuals (Brown, Reveles, & Kelly, 2005; National Research Council [NRC], 1996). Among the characteristics to be possessed by the individual educated in such a system is knowing basic scientific concepts and understanding its nature, using scientific processing skills, and having positive attitudes towards the subject (Ministry of National Education [MoNE], 2018). Research has shown that the preschool period is of critical importance in developing such characteristics (e.g., Harlan & Rivkin, 2004; Watters, Diezmann, Grieshaber, & Davis, 2000). When examined in more detail, it can be seen that the science education received at an early age facilitates the ability to develop scientific knowledge in the years after (Eshach & Fried, 2005). At the same time, it is emphasized that the preschool period is an important period in developing scientific process skills. Due to the curiosity and discovery instinct that is inherent in children, it has been observed that it is easier to impart scientific processing skills to them- e.g., observation, inference, and inquiry- that are conducive to having access to scientific knowledge (Öztürk-Yılmaztekin & Erden, 2017). The early childhood period is also of vital importance in understanding the nature of science. It is generally felt that understanding the nature of science by targeting the characteristics of scientific knowledge will be thoroughly successful when its foundations are laid during preschool education (Akerson, Buck, Donnelly, Nargund-Joshi, & Weiland, 2011). Moreover, it is argued that the early childhood period is highly suitable for developing positive attitudes and beliefs towards the subject that can considerably affect children's scientific achievement in the years that follow (Saçkes, Trundle, Bell, & O'Connell, 2011). In short, science education in early years gives a direction to the lives of children by motivating them to learn about the subject, as well as imparting science-related knowledge and skills to them.

Although it yields such important returns, science education applied in preschool education has problems both in terms of quantity and quality (Eshach & Fried, 2005; Peferson & French, 2008). For example, Seefeldt and Galper (2007) stated that teachers do not trust themselves in science teaching and avoid engaging their students in related activities. Similarly, Pendergast, Lieberman-Betz and Vail (2017) asserted that feelings of inadequacy and anxiety influence their teaching science. On the other hand, Greenfield et al. (2009) reported that little time is devoted to science activities in preschool classes compared to other activities. It has also been reported that most of the applications conducted in the name of science activities are in fact unrelated to the subject (Tu, 2006). These conditions are thought to be caused by problems about preschool teachers' competences (Olgan, 2015). In this context, the science content knowledge of teachers is a subject that has been widely researched. Content knowledge is described as teacher's understanding concerning the structure of subjects (Shulman, 1986). Garbett (2003) stated that teachers do not have sufficient knowledge of scientific concepts to teach them during the preschool period. As a result, it is felt that they cannot provide scientific explanations to their students' questions during science activities (Kallery & Psillos, 2001). On the other hand, it has also been observed that teachers do not like doing activities related to some science subjects. Saçkes (2014) argues that while emphasis is placed on subjects such as life sciences, world and space or physical science is overlooked. Overall, the empirical findings suggest that preschool teachers have limited knowledge about scientific concepts.

Preschool teachers also have problems about another certain science-specific competence named pedagogical content knowledge of teachers. It refers to skills and knowledge for teacher to develop their teaching quality (Shulman, 1986). Concerning this topic, Kallery and Psillos (2001) explained that teachers had some difficulty in transferring scientific knowledge to students and that they had shortcomings regarding how science teaching should be conducted. In this context, Tahta and Ivrendi (2007) argued that teachers should be able to use different methods to provide rich science experiences. In the same vein, Karamustafaoğlu and Kandaz (2006) noted that teachers mostly focused on techniques such as lecturing and drama. Tunnicliffe (2016) emphasized that students can learn scientific concepts effectively through inquiry-based education including discussion, research, and active participation. In general, preschool

teachers seem to not be qualified in implementing student-centered teaching methods although they are aware of their benefits on children's learning science.

Preschool teachers' competences are shaped by their attitudes and beliefs towards science teaching. Preschool teachers may experience problems in teaching the subject because of negative attitudes and beliefs (Conezio & French, 2002). Not liking and believing that they are not successful in teaching it, they become further demotivated towards doing so (Huinker & Madison, 1997). It has been reported that these negative attitudes and beliefs find reflections in classroom practices. This is believed to lead to many negative situations such as the hindering of students' natural disposition to wonder and explore and the avoidance on the part of teachers of conducting scientific activities (Olgan, 2008). In addition, these beliefs might affect teachers' teaching style. Teachers with negative beliefs about science used more traditional methods in their classroom (Finson, Pedersen, & Thomas, 2006). As a result, preschool teacher's attitudes and beliefs have a significant influence on their behaviors and instructional preferences in the classroom.

These competences (science content knowledge, pedagogical content knowledge) were investigated in the context of pre-service preschool teachers. For example, there were some studies related to analysis of science content knowledge. S. Timur (2012) investigated the knowledge of pre-service preschool teachers concerning force and speed. It has been observed that there are certain problems in explaining and using certain concepts such as acceleration, friction force and gravity addressed within this subject. Similarly, Saçkes and Trundle (2014) revealed that pre-service preschool teachers have misconceptions about the phases of the moon. In addition to studies aimed at science content knowledge, there are also some that focus on pre-service teachers' attitudes and beliefs. B. Timur (2012) found that positive science education experiences and strong content knowledge have a significant effect on the teachers' attitudes towards the subject. In addition to such studies wherein a single factor has been addressed, there are more comprehensive studies. For example, Thulin and Redfors (2017) found that by redesigning science teaching course, pre-service preschool teachers changed negative attitudes, focused on topics within physics, chemistry, and biology equally and adopted students-centered teaching methods. Parallel to this, Eckhoff (2017) carried out a study that brought pre-service preschool teachers and preschool children together within the context of a course. Compared to the beginning of the semester, pre-service preschool teachers gained correct and valid information about the subjects taught during the semester and they developed themselves in terms of inquiry-based teaching and enhanced their self-efficacy beliefs to teach science. Overall, the pre-service preschool teachers have similar problems about teaching science as preschool teachers caused by inadequate of science content knowledge and negative attitude and beliefs. With professional development, pre-service preschool teachers seem to change their beliefs, attitudes and teaching style.

When the studies related to teacher competences of pre-service preschool teachers are reviewed, it can be seen that in general, data have been collected by questionnaires, interviews and in-class observations (e.g., Erden & Sönmez, 2011; Menon & Sadler 2016; Moran, 2007; Pendergast et al., 2017) as well as various documents such as activity plans and diaries (e.g., Brenneman & Louro, 2008; Echoff, 2017; Lippard, Tank, Walter, Krogh, & Colbert, 2018). In addition to these techniques, drawing method has been used to elicit people's ideas, feelings, and thoughts around a subject for decades. First of all, Chambers (1983) developed Draw-a-Scientist-Test to assess students' ideas about scientists through an analysis of their drawings. Research used the instrument showed that people had stereotypical images about scientists such as wearing lab coat, glasses, being male, working alone in lab, doing experiments (El Takach & Yacoubian 2020; Uçar, Eti, Demircioğlu, & Aktaş-Arnas, 2020). Then, this test has been modified and conducted to explore the participants' conception of science learning and teaching. For example, Go and Kang (2015) investigated how the pre-service preschool teachers depicted themselves during science education course. They found that thanks to the course, pre-service preschool teachers shifted towards a display of student-centered, constructivist teaching. Katz et al. (2011) examined pre-service teachers'

professional identity development in informal science education through their drawings. They found that pre-service teachers drew some images showing collaboration, inquiry and hands-on science, and enthusiasm for science and science teaching and learning. In the current study, the effect of a science education course on pre-service preschool teachers is investigated. They are asked to draw themselves in this course to reflect ideas, emotions, and knowledge. Although there is not comparison between pre- and post-drawings like studies above, it is thought that the information related to pre-service preschool teachers and science education in this course can be achieved. In this regard, the research question of this research is worded as follows:

What are the effects of the science education course on the pre-service preschool teachers while they are taking this course?

2 | Method

Research Design

The purpose of the current study is to understand the effects of the science education course the pre-service preschool teachers are taking from various perspectives. Thus, the study aims to reveal the pre-service preschool teachers' internal experiences of science education. The current study is built on the phenomenological approach included in the qualitative paradigm. Phenomenological research aims to elicit participants' opinions about a phenomenon by investigating their experiences (Larsson & Holmström, 2007). In the current study, the target phenomenon is science education. As the current research intends to make sense of the effect of the target phenomenon on pre-service preschool teachers, the purpose and the model of the research are thought to match.

Study Group

The study group of the current research comprises 75 pre-service preschool teachers enrolled at the Department of Early Childhood Education in a state university of Turkey in the spring term of 2017-2018 academic year. This university educates students with average or below-average scores taken from the centralized university entrance exam. The students in the Department of Early Childhood Education are the ones with the highest scores among the students of the faculty. However, these students are accepted to this department mainly with their Turkish-math and social science scores.

Setting

As the current study was conducted from the qualitative research perspective, it is necessary to give a detailed description of the research setting. This current study was conducted on the third-year students attending the Department of Early Childhood Education. Yet the faculty which included this department is located outside the main campus of the university. The place called 'The Education Campus' is in the city center. In the faculty, students from the departments of science and math education, social studies and Turkish education, fine arts and psychological counselling and guidance education are instructed.

The campus consists of three blocks and in these blocks, students from each department have their own classes. In the campus, however, there is only one canteen so pre-service teachers interact even if they are in different departments. There is also an indoor gym and woodland on the campus. The data of the current study were collected in the classes of the education faculty. The classes have a standard structure, and each class has a capacity of about 45 students. Pre-service teachers sit at single desks. For the current study, two different classrooms were used.

ethics

General permission was taken from the university management to conduct the study. Required permission was also taken from the faculty administration to use the classroom. Before starting, the general

purpose of the research was explained to the pre-service preschool teachers and an informed consent form was signed by each participant. It was clearly stated on the form that they should participate in this study voluntarily. No grading was performed on basis of the activities performed and their relationship with the researchers would not deteriorate. It was also stated that participants have the right to leave at any stage of the research. In addition, the e-mail addresses of the participants were collected, and they would receive a copy of the article after publication.

Data Collection Tool

In the current study, the 'draw and write' technique was used to collect data. This technique is one of the techniques that allows individuals to reflect the information they obtain from everyday life with their unique personal cognitive structure (Horstman, Aldiss, Richardson, & Gibson, 2008). Therefore, it is a very suitable data collection technique for phenomenological research. In the current study, pre-service preschool teachers were asked to draw themselves by considering all the experiences they had while they were studying science. Then they were asked to explain their drawings in detail. The technique was developed from the "draw a scientist test" (Chambers, 1983) and used as the technique of drawing oneself while giving science instruction.

Data Analysis

Analysis of the drawings

These drawings were analysed through the Science Teaching and Learning Portrayals of Professional Practices (STLP3) Scoring Rubric developed within the context of Project Nexus. The dimensions in the rubric are explained below and the rubric can be accessed via this address- (http://www.drawntoscience.org/researchers/scoring-rubric/rubric.html).

- Dimension 1: Affective – its indicators include excitement experienced during learning and motivation to learn the subject. Humans' smiling faces and specific indicators of excitement and motivation are in speech bubbles.

- Dimension 2: Cognitive – Evidence in concepts – important scientific ideas, explanations of how events occur, the comparison of alternatives and visuals with three-dimensional models in learning experiences and arguments related to research.

- Dimension 3: Implementation – Manipulation – access to materials, the existence of test equipment, discovery – active participation, predicting, questioning and observation.

- Dimension 4: Social Interaction – Evidence of participating with others in scientific and instructional activities –the use of scientific terminology, emphasis on interaction and group work.

STLP3 evaluates these dimensions by assigning a score in the range of 0-4. When the evaluated target behaviour is not observed at all, 0 points are given and when it is observed at the highest level, 4 points are assigned. When a high score is given to the participant, it means that he/she thinks that the science education received has had a positive effect. Information about scoring and sample drawings scored can be gained at the following address (http://www.drawntoscience.org/researchers/scoring-rubric/index.html). The drawings collected in the current study were analysed according to the criteria stated in STPL3 both for each dimension separately and as a whole. A sample data analysis application is presented in Figure 1.

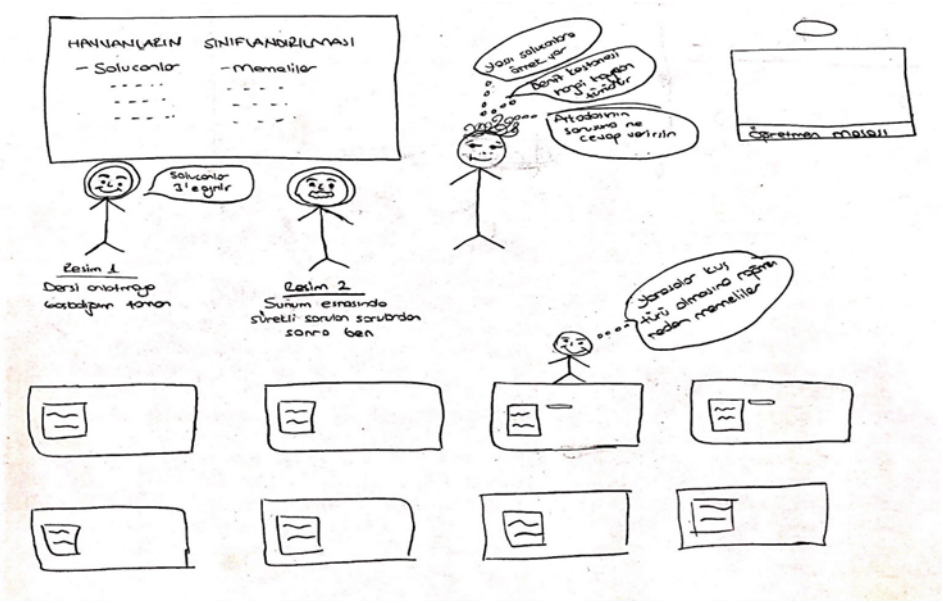

Figure 1. *STLP3 Analysis Application*

Explanation: In the Drawing 1, there are smiling and happy faces that are evaluated in the affective dimension. The affective dimension score: 3. Cognitively it is seen that the individuals in the drawing are making inquiries about science and attempting to draw conclusions. These are shown in three different speech bubbles. The cognitive dimension score: 3. In terms of the implementation dimension, it can be seen that at least one of the figures in the drawings is questioning. The implementation score: 1. In terms of social interaction, at least one figure is making a scientific inference in the speech bubble and is interacting. The social interaction score: 3. Thus, the total score taken from this drawing is: 10.

Analysis of the Written Texts

In the current study, the pre-service preschool teachers were asked to explain their drawings. They made these explanations using their own handwriting. Then the explanations made by the 75 pre-service school teachers were transferred to the computer environment. After that, the word counts were completed. As in the STLP3 rubric, the words that related to each dimension were counted one by one. For example, for the affective dimensions, words such as: 'I (don't) love', 'I (don't) like', 'I am (not) happy' etc. were searched for. For the cognitive dimension, words such as: 'I have recognized', 'I have thought' etc. were searched for. For the implementation dimension, words such as 'I do', 'experiment', 'observation' etc. were searched for and lastly for the social dimension, words such as 'friend', 'group', 'together' etc. These words were elicited by strictly following a data-oriented approach.

Trustworthiness

For the credible and honest analysis of the collected data in the current study, the authors adopted a researcher-centered approach. Moreover, this was planned to be conducted on the basis of the hypotheses of the postpositivist/systematic paradigm. As stated by Creswell and Miller (2000), in such cases the triangulation method is used. In the most general sense, triangulation can be defined as using more than one source to conduct qualitative research (Bogdan & Biklen, 2007). Triangulation can be performed over data sources, theories, or data collection methods (Creswell & Miller, 200). In the current study, triangulation was conducted over data collection methods. While drawings and written texts constitute two dimensions, the third is made up of various statistical tests belonging to the findings. The statistical part consists of the following: the correlation of the dimension scores within the total score and seeking expert opinions for the codes formed, a kappa measure of agreement index was found between the researchers and expert opinions as .93 for the drawings and .89 for the written texts.

3 | Findings

Findings Obtained from the Drawings

The pre-service preschool teachers' drawings were analysed on the basis of the dimensions in STLP3. As a result of these analyses, the scores for the sub-dimensions are presented in Figure 2.

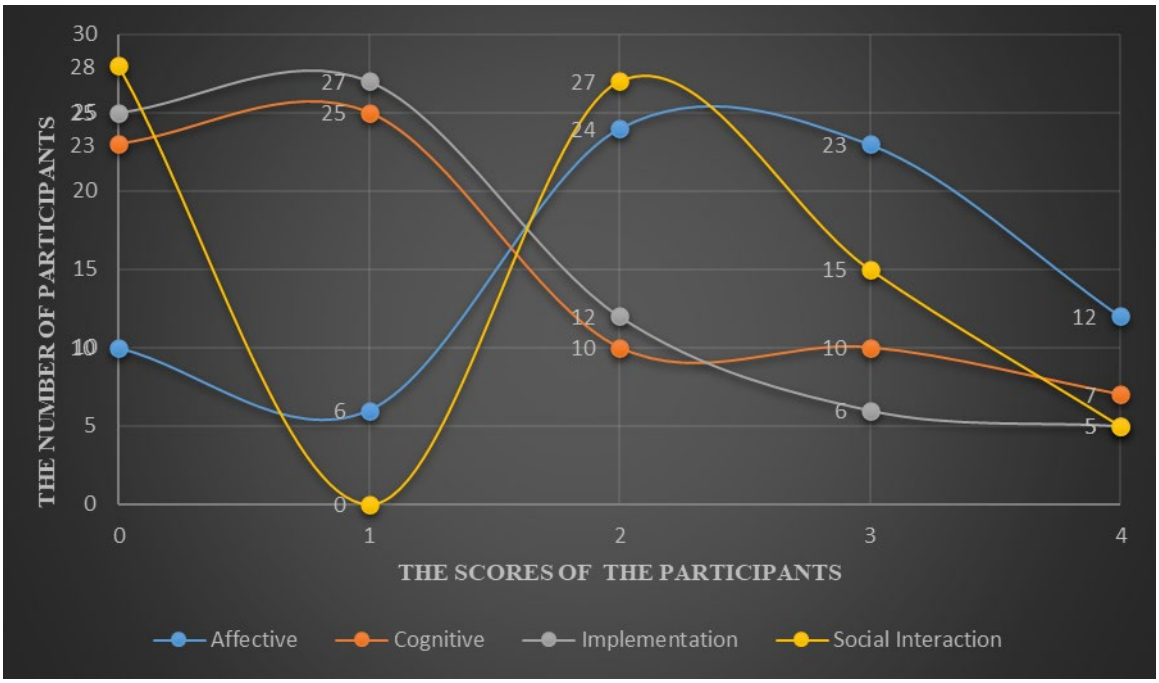

Figure 2. The Distribution of the Scores by the Participants from STLP3 Across the Sub-Dimensions

As can be seen in Figure 2, a significant number of participants (f= 86) got zero points from all the sub-dimensions. When the graph is subjected to a general analysis, it is seen that distribution is skewed to the left and thus it can be argued that the participants got low scores from the rubric in general. In the light of this finding, it is difficult to argue that the science education received by the pre-service preschool teachers had a positive effect on them. In addition, the participants taking full scores from the sub-dimensions make up a small proportion of the participants (f= 24). One of the examples from the participant having a low score is given in Figure 3.

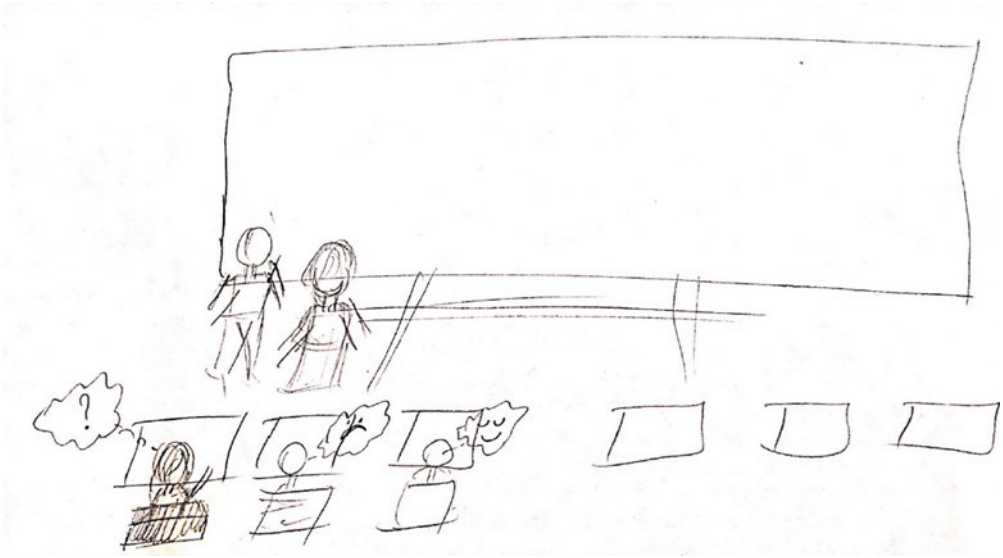

Figure 3. *A Sample Drawing from the Participant Having a Low Score from STLP3*

Explanation: In the sample drawing given above, there is no expression that can be placed into the affective dimension. There is one happy and one unhappy expression. The affective score: 2. In the cognitive dimension, only one student is depicted while questioning. The cognitive score: 1. Though in the implementation dimension there is a process conducted at the board, there is no clear statement. There is nothing like a scientific process or observation, experiment etc. The implementation score: 0. In terms of the social interaction, though a classroom setting is drawn, there is no clear evidence of interaction. Social interaction: 1. Total score: 4.

When the sub-dimensions are examined separately, it can be said that the pre-service preschool teachers perceive the effect of the science education they received as limited on the cognitive and implementation sub-dimensions. In the cognitive and implementation sub-dimensions, the numbers and scores of the students are given respectively as follows: 23 and 25 participants got 0 points; 25 and 27 participants got 1 point. More than half of the 75 participants drew the effect of science education they had received as limited on both of these sub-dimensions. It can be said that the participants find the science education they received to be most effective and meaningful in the affective sub-dimension. In a significant number of the drawings there are smiling faces or speech bubbles indicating that they are enjoying themselves (see Figure 3). In this sub-dimension, 23 students have 3 points, and 12 students have 4. In the social interaction sub-dimension, the participants show a more normal distribution. In the light of all these findings, it can be argued that the participants are of the opinion that the science education they received is not very effective in terms of cognition and implementation while they are more positive in relation to social interaction and find it most effective in terms of the affective sub-dimension. Figure 4 is an example receiving high scores from all the sub-dimensions.

When the drawings are characteristically examined, it is seen that in the majority of the drawings, happiness and pleasure come to the fore. On the other hand, there are some drawings that indicate that they are unhappy, confused and puzzled. The major shortcoming in the drawings is the lack of big scientific ideas, the lack of an explanation of how the events took place and a lack of the presentation of learning experiences. In addition, during science education, the inadequacy of the methods and techniques used to conduct experiments and observations or to gain scientific knowledge is also remarkable. Drawings in terms of social interaction generally focus on individual efforts. The presentation of activities done in groups is highly limited.

Figure 4. A Sample Drawing from the Participant Having a High Score from STLP3

Explanation: In the sample drawing, in the affective sub-dimension, the smiling faces of the figures in the drawing can be seen. The affective score: 3. In the two speech bubbles, there is scientific thinking and inferences in relation to the cognitive sub-dimension. The cognitive score: 2. In the implementation sub-dimension, there is more than one scientific tool and piece of equipment drawn. In addition, there are drawings of a rocket, planets, and an astronaut. The implementation score: 4. In the social interaction sub-dimension, the people in the drawing are working on their own yet it is seen that scientific language is used in the speech bubbles. The social interaction score: 4. Total score: 13.

Findings Obtained from the Written Texts

The 75 participants making up the study group were asked to explain their drawings in writing. In this way, it was intended to realize the process of triangulation so as to elaborate the drawings and to enhance credibility in the determination of emotions and thoughts. In the collected written texts, there are a total of 10,694 words, which means 146 words per participant. It was determined that affective expressions were frequently used in written texts such as I love (f= 3), I enjoy (f= 15), I am having a good time (f= 23), being happy (f= 11). In addition, some of the words in the affective dimension represent negative feelings such as I do not like, I became unhappy (f= 3), I do not love (f= 5).

The cognitive and implementation sub-dimensions are the dimensions for which the lowest scores were taken from the drawings. The same holds true for the written texts. In the cognitive dimension, the participants used expressions such as understand (f=23), recognize (f=13) and learn (f=11) to indicate that they are cognitively active. However, there are also large number of negative expressions such as I don't understand (f= 17), I cannot recognize (f= 9), I cannot learn (f= 8). The same holds true for the implementation dimension. It was found that words related to skills or operations needed to conduct educational and instructional activities were scarcely included. Words such as experiment or conducting an experiment (f= 3), observation or making an observation (f= 1), explaining (f= 6) and asking questions (f= 11) are the words detected in the implementation dimension. In light of all these findings, it can be maintained that the participants felt cognitively challenged while undertaking the science education and that they were able to produce a very limited number of words in the implementation process. Moreover, the fact that "asking a question" are the words most frequently repeated in the application sub-dimension offers some insight into how the science education given to them was conducted.

Although there is a balance between the low and high score drawings in the social interaction dimension, in the written texts, words such as me (f= 13), myself (f= 28), on my own (f= 9) are seen. Words connotating social interaction such as together (f= 6), group (f= 4), team (f= 3) and squad (f= 1) were used relatively less. Samples from the written explanations of the participants are presented in Table 1.

Table 1. Samples from the Written Texts

Text 1.
In the science education course, I have learned how to deliver the lesson to my students in the future and by dreaming of delivering such lessons, I have felt really happy.
Text 2.
I have realized the mistakes which I had considered correct. I learned by doing experiments. Experiments were very interesting and amazing for me.
Text 3.
Learning science is a lot of fun. But I had some difficulties in understanding.

Findings related to Statistical Tests

Within the context of the current research, statistical operations were carried out to support the triangulation process. Thus, as the researchers did, another field expert scored the drawings and analyzed the written texts. Both results were subjected to a kappa fit index test and for the drawings, it was calculated to be .92 and for the written text, it was calculated to be .83. Moreover, by calculating the correlation between the sub-dimensions of the rubric and the total score, it was proven that the rubric is valid and reliable. In this connection, the correlation values obtained with the Pearson product-moment correlation analysis (r) are presented in Table 2.

Table 2. Total Score and Between Sub-dimensions Pearson PM Correlation Coefficients

	Affective	Cognitive	Implementation	Social Interaction	Total Score
Affective	-	.281*	.365*	.218*	.577*
Cognitive	-	-	.867*	.644*	.881*
Implementation	-	-	-	.660*	.909*
Social Interaction	-	-	-	-	.806*

* *p< 0.05*

As can be seen in Table 2, the sub-dimensions of the STLP3 rubric correlate significantly with each other and with the total score. According to Cohen (1988), the value between .1 and .29 means a low correlation, between .3 and .49 means a medium correlation and between .5 and 1.0 means a high correlation. The correlation of the total score with the affective dimension is medium and with all the other dimensions, it is high. Thus, the findings obtained from the rubric statistically overlap with the results obtained from the written texts. All the sub-dimensions refer to the changes experienced by the pre-service teachers during the science education they have received. Thus, it can be said that all the sub-dimensions had some effects on the pre-service teachers' perception of the science course (total score) they took to some extent.

4 | Discussion & Conclusion

The purpose of the current study was to investigate the changes occurring in pre-service preschool teachers during the science education course through the 'draw and write' technique. The findings derived from both the drawings and the written texts are parallel to each other and they were gathered under four dimensions -cognitive, implementation, social and affective. First, it was found that the pre-service teachers were unable to develop themselves cognitively well within the context of this course. In this respect, it is thought that they have some shortcomings in their knowledge about scientific concepts, in explaining scientific events and in developing arguments. B. Timur (2012) and Saçkes and Trundle (2014) stated that pre-service preschool teachers use information that is not scientifically correct in explaining scientific events due to their limited knowledge of science. Thus, the pre-service preschool teachers' being weak in the cognitive dimension might be related to their weak science content knowledge. Their primary and secondary education could offer low quality and frequent science learning opportunities. Considering that especially secondary school curricula are important to transfer contents of science into the courses in pre-service teacher education (Barenthien, Oppermann, Anders, & Steffensky, 2020) it is evident that they can have difficulty in cognitive activities such as understanding science concepts, giving explanations and forming arguments. To avoid such situations, the number of science-related courses in preschool teacher education programs could be increased. Given that the higher the number of science courses taken at undergraduate level, the higher the number of science activities conducted in preschool classes (Saçkes, 2014), it can be predicted that the integration of courses directed to the development of science content knowledge into undergraduate teacher education programs will yield important gains. On the other hand, it can be seen that science courses recommended for preschool undergraduate level do not sufficiently emphasize the scientific content. In the science courses of this education programs, subjects such as the importance of science education at early ages, scientific thinking skills, the nature of science, things to be considered in planning science activities, methods used in science education and example activities are included (Turkish Council of Higher Education, 2018). Though these subjects are important, science subjects that are generally subsumed under the three headings of physics, chemistry and biology are avoided to a large extent. Therefore, it is argued that the reorganization of preschool teacher education programs could help overcome this problem.

Another important finding of the study relates to the implementation process of the science education course. The participants showed that the science education course was mostly given by a teacher-centered approach such as asking questions. It is thought that young children can learn science effectively with active participation in science activities (French, 2004). In this respect, the inquiry-based science instruction in which scientific process skills such as making observations and inferences can be developed is emphasized to be an important teaching approach for children to learn science (NRC, 2007, 2012). It is suggested that effective use of this approach by teachers in their classrooms depends on their receiving an education and gaining experience in this subject (Petersen and Treagust, 2014). In the current study, what has been understood from the drawings and written explanations of the pre-service teachers is that this approach is not usually emphasized in their training. In this respect, Eckhoff (2017) argues that teacher educators can influence pre-service preschool teachers in a positive way by creating various opportunities that involve this approach. On the other hand, it is considered that it will be important for teacher educators to apply this approach in their own practices. According to Bandura's (1997) social learning theory, people learn behaviors by taking other people demonstrating the same behavior as a role model. From this point of view, it is possible to say that pre-service preschool teachers who have the opportunity to observe a course in which the inquiry-based science learning is used adopt this approach more easily. In addition, the use of this approach by mentor teachers in their classes where pre-service teachers carry out their internship is important (Landry, 2009; Onchwari & Keengwe, 2008). Observing how this approach

is applied in a real preschool classroom environment and what is taken into consideration during this application will increase the experience of pre-service preschool teachers in this subject.

The pre-service preschool teachers reflected an environment in which social interaction was not emphasized in the context of the science education course they took. Inquiry-based science teaching also requires an interaction between people. In the light of this, creating environments where various scientific process skills can be used and discussion of the learned information can be conducted in small groups is suggested (Echoff, 2017). In the current study, it is thought that social interaction was observed very little by the pre-service preschool teachers as they had not really experienced this teaching approach. Science is the product of a joint effort and progresses with the contribution of many people (Knorr-Cetina, 1999). Therefore, it is a fact that it is important to educate pre-service preschool teachers about working in cooperation and collaboration so that they can teach this to their students in the future. In addition, it is argued that rather than assigning specific tasks to each group member so that each group member only deals with his/her own task, group members' doing everything together will be more effective (Chiriac, 2014). In this way, it is believed that the group's self-confidence will increase and more successful results will be achieved (Atasoy & Çakıroğlu, 2018). Science teaching classes integrated with such group work is thought to affect the structure of the science activities to be implemented by pre-service preschool teachers.

One of the important findings of the current study is that drawings were produced by the pre-service preschool teachers including the indicators of their interest in and enthusiasm about the science education course and also positive feelings towards it. On the other hand, it was observed that while explaining their drawings, besides positive feelings, they also expressed a considerable number of negative ones. Thus, it is difficult to conclude that pre-service preschool teachers developed positive attitudes towards science. The quality of science education is affected by teachers' attitudes towards science (Cobem & Loving, 2002). Hence, in addition to increasing pre-service teachers' science content and pedagogical content knowledge, their attitudes towards science should be developed (Pendergast et al., 2017). At this point, it should be noted that teacher educators and mentor teachers' positive attitudes reinforced with interest and enthusiasm during science teaching can affect pre-service preschool teachers.

As a conclusion, in the current study, pre-service preschool teachers tried to explain themselves through drawings within the context of a science education course. The obtained data have revealed that the science education course has a limited contribution to their cognitive, affective and social development and implementations in classroom. It was also discovered that the pre-service teachers experience difficulties in understanding scientific concepts and are instructed through a teacher-centered approach. In addition, it was also concluded that the science education course is not effective in terms of developing positive attitudes towards science and does not emphasize social interaction- something that is important for science applications. In the light of these findings, revision of preschool teacher education program is of particular importance. Furthermore, implementation of effective science instruction by teacher educators and mentor teachers in their classrooms can make positive contributions to the development of pre-service preschool teachers. Finally, in order to obtain more profound and detailed information, the drawing technique used in the current study can be supported with other data collection tools such as classroom observations and interviews. Considering the findings of the current study, it is clear that further research to investigate the science education course effectively integrated with the four dimensions would make important contributions to the literature.This section may include the discussion of your findings, and conclusions with comparison to the literature, implications, and recommendations. In addition, there are three sub-sections every manuscript must include:

Statements of publication ethics

Ethical issues were taken into consideration in the study. Participants took part in the study voluntarily. In addition, it was paid attention that there was no physical or psychological harm for the participants. They also were assured that the research data would be kept in confidence.

Researchers' contribution rate

This study was done with equal collaboration of the researchers. Therefore, they participated in every part of the research such as data collection, data analysis and writing this document.

Conflict of interest

There is no conflict of interest in the study.

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