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Preschool Teachers' Preparation Programs: The Use of Puppetry for Early Childhood Science Education

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Abstract: This paper investigated how puppetry could be used to improve the standards of early childhood science education. This study determined the effect of a puppet-making and puppetry workshop on preservice preschool teachers' beliefs and attitudes towards science education and looked into their experiences during and after puppet-making. Although participants faced some difficulties during the workshop, they developed numerous socioemotional skills. Puppetry activities can help preservice teachers learn how to deliver child-centered, stimulating, and interactive classes. Using puppets in early childhood science education can help teachers develop positive attitudes towards science and offer students high-quality, engaging, and creative activities.

Keywords: *Early childhood science education, puppets, teacher education, teaching methods.*

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Introduction

Sensory stimuli help children make sense of life and associate between things (National Association for the Education of Young Children [NAEYC], 2009; National Center for Education Statistics [NCES], 2006). Materials provide multiple learning opportunities. Most learning takes place by seeing (83%), followed by hearing (11%), smell (3.5%), taste (1.5%), and touch (1.5%). This fact suggests that multisensory learning results in more problem-solving skills and less forgetting (Science Outside the Classroom [SOtC], 2018). Therefore, teachers should be able to create dynamic learning environments where students can make use of all their senses (Saracho & Spodek, 2007; National Academies of Sciences, Engineering & Medicine, 2015). Educational materials stimulate imagination and help children enjoy exploring the world (Karademir et al., 2020). Through materials, they can learn everyday-life practices and develop 21st-century skills, such as independence, entrepreneurship, and creativity (Rotherham & Willingham, 2010).

The advantages of using puppets in the early years

Puppets allow children to put themselves in someone else's shoes and express what they feel and think. They make their puppets laugh, cry, dance, sleep, or leap for joy, which is a fun way for them to understand activities and appreciate different ways of life. In other words, children enjoy watching puppets or playing with them during class and learn while having fun (Pugh & Girod, 2007). Puppets help children develop verbal and nonverbal communication skills and express themselves better, resulting in more social and emotional support from parents and friends (Gronna et al., 1999). Children find puppets vastly enjoyable and love listening to stories told with them. Puppets help them get to know the world and get more life experience (Root-Bernstein & Root-Bernstein, 2013). Puppet characters present children with all kinds of challenges and surprises, stimulating imagination and creativity (Peck, 2005). Moreover, students who make their own puppets and put on puppet shows are more likely to demonstrate their creativity (Ocal, 2014). Children can learn new words and gain mastery over their native language and express themselves better through puppetry (Peck, 2005). Puppetry makes children happy and allows teachers to get to know their students. It is a valuable way to help students' associate emotions with facial expressions and express their own feelings. It also boosts their confidence and encourages them to develop social skills (teamwork, listening, bonding, sharing, taking responsibility, etc.) (Gronna et al., 1999).

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Preschoolers use their senses to structure information and develop skills to explore and interpret what is around them. Those who use their senses are more likely to develop cognitive skills and achieve learning (Hamre & Pianta, 2007; Piaget & Inhelder, 1928/2000). However, learning retention requires mental schematization of information (National Research Council [NRC], 2012). Rich and stimulating learning environments promote meaningful learning (Brenneman & Louro, 2008) and intellectual development (NAEYC, 2009; SOtC, 2018). Puppetry is an ideal way of transforming existing classrooms into flexible and active learning environments.

Involving early childhood preservice teachers in puppet making

Early childhood preservice teachers complete courses on theoretical and applied pedagogy and learn about numerous approaches. They should keep in mind the goals set in the preservice period and focus on achieving them in their professional lives because they will be tutoring young children aged 0-6 years (Epstein, 2007). They should have a sound grasp of different activities and teaching methods before becoming a part of the education system. During their undergraduate years, they should learn how to design rich and stimulating educational settings, workshops, and activities that meet children's needs and expectations (Goffin & Wilson, 2001). Preservice teachers should adopt cooperative strategies to use puppetry (Liang & Gabel, 2005). We aimed to promote preservice teachers' development, refresh their science education knowledge, and correct their misconceptions (Cronje et al., 2015; Gurnon et al., 2013; Kallery, 2004). To that end, this paper focused on the intersection of science and art.

Numerous studies discuss the impact of the integration of art into science education (Archilla, 2017; Braund, 2015; Butler et al., 2009; Ergazaki et al., 2015; Gurnon et al., 2013; Kallunki et al., 2017; McGregor & Precious, 2010; Odegaard, 2003). However, only a handful of studies investigate the impact of puppetry-based science education on preservice teachers and preschoolers.

Puppet-making and puppetry require specialization and promote learning more than conventional methods (Keogh et al., 2008; Ocal, 2014). Therefore, it is of paramount importance to address the potential of puppet-making and puppetry to skill development and early childhood education. Therefore, this paper focused on interviews and observations to look into the impact of a puppet-making and puppetry workshop on early childhood preservice teachers' beliefs and attitudes towards science education.

Methods

Design

This study employed an explanatory sequential mixed methods design to collect data (scales, interviews, and observation) and provide consistent results. The design involved two stages; (1) quantitative data collection and analysis and (2) qualitative data collection and analysis (Clark & Ivankova, 2016; Creswell, 2007).

Participants

A puppet-making and puppetry workshop was developed. The experts informed preservice teachers of the workshop in the first two weeks (theoretical part). The preservice teachers first decided what kind of puppet characters to make and then made their puppets under the supervision of the experts. They worked on their puppets, sometimes alone and sometimes together with their peers. We encouraged them to cooperate with their peers to teach them how to make and implement joint decisions. We wanted them to demonstrate personal and team accountability and develop personal problem/conflict management and social/communication skills (De Beer et al., 2018). After they made their puppets, they put on shows in groups in front of their peers and the experts at the end of the workshop. The sample of the quantitative stage consisted of all preschool undergraduate students (n = 33) of the practice-based course "Toy Design" applied in the puppet-making workshop. Of those participants, six agreed to participate in the qualitative stage. Those who (1) attended the workshop, (2) put on puppet shows, and (3) agreed to participate were included in the quantitative stage. This means that participants for the qualitative stage were purposively recruited in line with the research objectives. All participants in the quantitative stage (21 women; 12 men) were third-grade undergraduate preschool education students with a mean age of 21 years. The mean age of participants in the qualitative stage (4 women; 2 men) was 22 years.

Measures

Science Teaching Efficacy Belief Instrument (STEBI) was developed by Enochs and Riggs (1990) and adapted to Turkish by Tekkaya et al. (2002). It was readapted by Tekkaya et al. (2010) for early childhood preservice teachers. The instrument consists of 23 items and two subscales: (1) personal science teaching efficacy (PSTE) and (2) science teaching outcome expectancy (STOE). The items are scored on a five-point Likert-type Scale (1 = Strongly disagree, 2 = Disagree, 3 = Neither agree nor disagree, 4 = Agree, 5= Strongly Agree) (Tekkaya et al., 2002). Ten items are reverse scored. The total scale score ranges from 23 to 115. Higher scores indicate higher self-efficacy in science teaching. Tekkaya et al. (2002) and Olgan et al. (2014) reported that the PSTE and STOE had a Cronbach's alpha (α) of 0.86 to 0.87 and 0.79 to 0.72, respectively. Fettahlıoglu et al. (2015) reported that STEBI, PSTE, and STOE had a Cronbach's alpha of 0.85, 0.84, and 0.78, respectively.

The Early Childhood Teachers' Attitudes Toward Science Teaching (TSAS) was developed by Thompson and Shrigley (1986) for primary school teachers. It was adapted to early childhood preservice teachers by Cho et al. (2003). It was adapted to Turkish by Camlibel Cakmak (2006). The TSAS-TR consists of 17 items and four subscales: comfort-discomfort, classroom preparation, managing hands-on science, and developmental appropriateness. The items are scored on a five-point Likert-type Scale (1 = Strongly disagree, 2 = Disagree, 3 = Neither agree nor disagree, 4 = Agree, 5= Strongly Agree) (Camlibel Cakmak, 2006). Three items are reverse scored. The total scale score ranges from 17 to 85. Higher scores indicate more positive attitudes towards science teaching (Guvenir, 2018). According to Camlibel Cakmak (2006) and Guvenir (2018), the TSAS had a Cronbach's alpha of 0.81, and its subscales "comfort-discomfort," "classroom preparation," "managing hands-on science," and "developmental appropriateness" had a Cronbach's alpha of 0.66-0.77, 0.75-0.75, 0.52-0.63, and 0.46-0.56, respectively. These reliability coefficients indicate that the total scale has good reliability but that its subscales have low reliability due to the low number of items (Thorndike and Thorndike-Christ, 2010). We considered two scales as dependent variables and kept the variable of "socially desirable" under control to perform MANOVA or ANCOVA. However, the data did not meet assumptions due to the sample size. The quantitative part was experimental, and therefore, the small sample size was a limitation.

Focus group interviews and observation

A mixed research design involves multiple data collection tools (scales, interview, observation, etc.) to address one or more situations (individuals, processes, activities, programs, environments, etc.) and to define situations and related themes (Creswell, 2007). A mixed research design focuses on people's experiences with a situation or phenomenon and the deep meanings they attribute to it (Patton, 2001/2014). We conducted focus group interviews and observations to investigate early childhood preservice teachers' views of the workshop. The observation method enabled us to draw a comprehensive picture of participants' behaviors, while the interviews allowed us to figure out their perceptions, views, and experiences.

Procedure

The quantitative stage focused on the impact of the workshop on participants' beliefs and attitudes towards science education. The qualitative stage involved the analysis of participants' views, observations, and experiences with the workshop. All participants attended the workshop and then prepared and put on puppet shows about preschool science education topics at the end of the semester.

The quantitative stage employed a group pretest-posttest design. Participants completed the STEBI (Enochs & Riggs, 1990) and TSAS (Cho et al., 2003) prior to the workshop (pretest). The experimental group attended the workshop and then completed the same two scales (posttest). The researchers first conducted in-depth interviews and then carried out observations to support the interview data. They developed an interview form based on the feedback of three experts (two in preschool education and one in measurement) and then conducted the interviews. After checking the recording device, asking general introductory questions, and briefing on interview rules, the researchers posed questions to elicit information on the 1) effects of the workshop on participants, 2) their experiences with the workshop, 3) strengths and weaknesses of the workshop, 4) impact of puppetry on preschool education, 5) relationship between puppetry and early childhood science education. The researchers carried out nonparticipant observations during the workshop once a week for 12 weeks. They videotaped the observations and took field notes. They reviewed the records over and over again to enrich the field notes.

Data analysis

Quantitative

The data were analyzed using the Statistical Package for Social Sciences (SPSS, v 24.0) at a significance level of 0.05. Table 1 shows the descriptive statistics. Descriptive statistics, histograms, and the Shapiro-Wilk test (sample < 35) were used to analyze participants' STEBI and TSAS pretest and posttest scores.

Table 1. Descriptive statistics

	STEBI Pretest	**STEBI Posttest**	**STEBI Difference**	**TSAS Pretest**	**TSAS Posttest**	**TSAS Difference**
Mean	89.575	94.666	5.090	65.484	73.393	7.909
Median	91.000	96.000	5.000	66.000	75.000	8.000
Mode	79.000	100.000	17.000	75.000	77.000	9.000
SD	9.430	12.095	10.675	7.620	8.594	11.119
Skewness	-.280	-.220	-.254	-.366	-.926	-.046
Kurtosis	.485	-.591	-.976	-.808	.991	.156

Table 1. Continued

	STEBI Pretest	STEBI Posttest	STEBI Difference	TSAS Pretest	TSAS Posttest	TSAS Difference
Minimum	65.000	69.000	-14.000	50.000	51.000	-19.000
Maximum	111.000	114.000	23.000	77.000	85.000	31.000
Shapiro-Wilk Statistic	.978	.971	.960	.951	.927	.988
Shapiro-Wilk p-value	.716	.503	.252	.146	.028	.965

A p-value greater than .01 (Shapiro-Wilk test) indicates normal distribution at that significance level. Participants' STEBI and TSAS pretest and posttest scores had similar mean, mode, and median values. The kurtosis and skewness coefficients ranged from +1 to -1. Moreover, the skewness and kurtosis indices ranged from -2 to +2, suggesting that the data were normally distributed. Therefore, a parametric test (paired sample t-test) was used for analysis (McKillup, 2012; Mertler & Vannatta, 2005).

The result showed a significant difference between STEBI and TSAS pretest and posttest scores. Cohen's d effect size was calculated to determine the magnitude of the effect of the workshop on participants' self-efficacy beliefs and attitudes towards science teaching (Ellis & Steyn, 2003; Field, 2009). Cohen (1988) suggested that an effect size of 0.2, 0.5, and 0.8 is small, moderate, and large, respectively (Cohen, 1988).

A numerical value calculated for a reliability coefficient varies from sample to sample (Nitko & Brookhart, 2010). Therefore, Cronbach's alpha was used to determine the internal consistency of STEBI and TSAS for our sample (Nitko & Brookhart, 2010; Taber, 2018). The Cronbach's alpha values were assessed using George and Mallery's rules of thumb (2019): $0.70 < \alpha < 0.79$ = acceptable, $0.80 < \alpha < 0.89$ = good, and $0.90 < \alpha < 1.00$ = excellent. The STEBI pretest ($\alpha_{pretest}$=.82) and posttest ($\alpha_{posttest}$=.89) scores indicated good reliability. The TSAS pretest ($\alpha_{pretest}$=.73) score indicated acceptable reliability, while the TSAS posttest ($\alpha_{posttest}$=.88) indicated good reliability.

Qualitative

The interviews were analyzed to determine participants' workshop experiences and its effect on early childhood science education (Krippendorff, 2013). The data were analyzed using inductive content analysis and qualitative second-cycle coding (Miles et al., 2014). The researchers first read all the transcripts and field notes several times and reviewed the video recordings over and over again to get a general idea about how to code the data. They then coded the interview and observation data, taking into account their sub-goals. In the first cycle, they coded some of the data separately and then compared them to develop themes and categories. They discussed the codes and developed new themes and categories to make them conceptually dense and free from biases and assumptions. In the second cycle, they used the constant comparison to code the remaining data (Corbin & Strauss, 2008). They used the QSR N-Vivo 8 to develop themes and subthemes and then interpreted and explained the findings. They asked an expert to check the codes and themes for reliability. They discussed the codes and themes based on expert feedback until they reached a consensus.

Findings

A paired sample t-test was used to determine significant differences between participants' STEBI pretest and posttest scores.

Table 2. T-test results for mean STEBI pretest and posttest scores

	N	x̄	SD	df	t	p
Total Pretest	33	89.57	9.43	32	2.740	.010*
Total Posttest	33	94.66	12.09			
Subscale						
PSTE Pretest	33	48.93	6.75	32	2.856	.007**
PSTE Posttest	33	52.72	8.23			
Subscale						
STOE Pretest	33	40.63	5.88	32	1.305	.201
STOE Posttest	33	41.93	5.84			

*p<.05, **p<.01

Participants' mean STEBI posttest score ($M_{posttest}$=94.66, S.E=2.10) was significantly higher than their pretest score ($M_{pretest}$=89.57, S.E=1.64) [t(32)= -2.740, p<.05, r=.43]. Their PSTE posttest score ($M_{posttest}$=52.72, S.E=1.43) was significantly higher than their pretest score ($M_{pretest}$=48.93, S.E=1.17) [t(32)= -2.856, p<.05, r=.45]. These results indicated that the workshop moderately increased participants' total and personal science teaching efficacy beliefs. However, there was no significant difference between the mean STOE pretest ($M_{pretest}$=40.63, S.E=1.02) and posttest scores ($M_{posttest}$=41.93, S.E=1.01) scores [t(32)= -1.305, p>.05]. A paired sample t-test was used to determine significant differences between participants' TSAS pretest and posttest scores.

Table 3. T-test results for mean TSAS pretest and posttest scores

	N	x̄	SD	df	t	p
Total Pretest	33	65.48	7.62	32	4.086	.000**
Total Posttest Subscale	33	73.39	8.59			
Comfort-Discomfort Pretest	33	15.69	1.64	32	6.29	.000**
Comfort-Discomfort Posttest Subscale	33	17.93	1.67			
Classroom Preparation Pretest	33	16.00	2.12	32	.464	.646
Classroom Preparation Posttest Subscale	33	16.36	3.44			
Managing Hands-on Science Pretest	33	16.18	2.74	32	2.728	.010*
Managing Hands-on Science Posttest Subscale	33	17.63	2.27			
Developmental Appropriateness Pretest	33	17.60	4.93	32	3.760	.001**
Developmental Appropriateness Posttest	33	21.45	3.15			

*p<.05, ** p<.01

Participants' mean total posttest TSAS score ($M_{posttest}$=73.39, S.E=1.49, S.E=1.49; t(32)= -4.086, p<.05, r=.58) was significantly higher than their pretest score ($M_{pretest}$=65.48, S.E=1.32). Their "comfort-discomfort" posttest score ($M_{posttest}$=17.93, S.E=0.29, t(32)= -6.294, p<.05, r=.74) was significantly higher than their pretest score ($M_{pretest}$=15.69, S.E=0.28). Their managing hands-on science posttest score ($M_{posttest}$=17.63, S.E=0.39, t(32)= -2.728, p<.05, r=.43) was significantly higher than their pretest score ($M_{pretest}$=16.18, S.E=0.47). Their developmental appropriateness posttest score ($M_{posttest}$=21.45, S.E=0.54, t(32)= -3.760, p<.05, r=.55) was significantly higher than their pretest score ($M_{pretest}$=17.60, S.E=0.85). These results indicated that the workshop significantly improved participants' attitudes toward science teaching. However, there was no significant difference between participants' mean TSAS "classroom preparation" pretest ($M_{pretest}$=16.00, S.E=0.36) and posttest scores ($M_{posttest}$=16.36, S.E=0.59) [t(32)= -0.464, p>.05].

The themes, subthemes, categories, codes, and quotes are presented in Tables. The comments section focused on the observations to provide an accurate picture of participants' views and help readers analyze and interpret the findings. Table 4 presents the participants' workshop experiences.

Table 4: Participants' Puppet Workshop Experiences (Period: During Puppet Workshop)

Theme	Category	Subcategory	Code	Quotations
Positive	Cognitive		Development of creativity/originality (N=5)	*You have to use your creativity; you have to solve the problems you face. I mean, that's what we've learned. (TC4)*
			Making use of experience (N=5)	*Using the experiences at the next stage made it much easier for us. (TC5)*
			Development of problem-solving skills (N=4)	*I had a hard time sewing, but then I got an idea, using gloves or socks. I mean, you try and find a way to solve the problems. (TC1)*
			Alternative solutions (N=3)	*You need to find alternative solutions to be efficient because there is little time. (TC2)*
			Fast decision making (N=1)	*I was able to make quick decisions when I needed to save the puppet and myself. (TC6)*
	Motor skills		Developing new motor skills (N=5)	*We developed new skills and used them at each stage. For example, some of us knew nothing about sawing. (TC3)*
			Becoming experienced /mastering/becoming advanced (N=5)	*The workshop helped us develop many skills, especially fine motor skills. (TC4)*
			Producing (N=4)	*We finished making the products, I mean, the puppets, and put on shows at the end of the course.*
			Time- and labor-intensive (N=2)	*Making the puppet took longer than I thought it would. I mean, we worked hard to finish them with all other classes and whatnot. We tried really hard and finished them. (TC3)*

Table 4: Continued

Theme	Category	Subcategory	Code	Quotations
	Social-emotional		Increase in curiosity/interest/Increase in motivation (N=6)	*We got more and more curious with each stage and enjoying producing something made us more and more motivated. (TC1)*
			Self-exploration/ self-knowledge (N=6)	*I had no such skill before, so it's made me realize that I have a knack for it. (TC5)*
			Enjoying/taking pleasure/satisfaction (N=6)	*I made two puppets in the workshop. I would do it again; it was very nice; I had a lot of fun at every stage. (TC2)*
			Feeling/joy of success (N=5)	*It's very nice when a product comes out and when you overcome difficulties and finish a puppet. It shows that you can accomplish things. (TC3)*
			Emotional relief/letting go of stress (N=5)	*Some days just don't feel right. I felt like I was getting away from all stress while working on the puppet in the workshop; it did me good. (TC4)*
			Development of self-confidence (N=5)	*... I had had no self-confidence before. That kind of activity boosted my confidence. I can now make a puppet by myself. (TC5)*
			Being acclaimed (N=4)	*Our classmates liked our puppets too, which made us sure that we did it right. We set an example for them and helped them develop different thoughts. (TC6)*
			Pride (N=3)	*I felt like I achieved something and took pride in it. I was proud that I started something and finished it and that others liked it. (TC4)*
			Increase in the sense of ownership/attachment (N=3)	*Puppets are like assistants for us teachers. It feels like your child once you finish it. I mean, you bond with it. (TC2)*
		Prosocial behaviors	Teamwork (N=5)	*The workshop is not like other classes. There, you work with others, so you get to learn about teamwork. (TC1)*
			Socializing (N=5)	*Another comforting aspect of puppet-making is that it gives you a chance to socialize. It helps with group coherence. (TC6)*
			Cooperation / solidarity (N=5)	*... We helped each other to figure out the difficult parts of puppet making*. (TC4)
			Exchange of ideas (N=4)	*You get to communicate and socialize with your classmates when you work with them, and this encourages team spirit, but you need to exchange ideas with one another. (TC3)*
			Development of empathy skills (N=4)	*When you are with your classmates with different skills, you try to understand each other, which promotes your empathic perspective. (TC5)*
			Development of sense of responsibility (N=3)	*The teacher gave us a task that we needed to complete in a certain time, so we were encouraged to finish it. (TC1)*
Negative	Motor skills		Failure to adjust symmetry (N=3)	*I had a hard time nailing the face proportion. Its eyebrows were too high, the mouth too small, the ears uneven, etc. I had a hard time making it symmetrical. (TC5)*
			Tearing up a tissue (N=2)	*I had difficulty tearing up a tissue because it was pretty frustrating, I mean, tearing it into small pieces. (TC3)*
	Time management		Missing the deadline/ lack of enough time (N=4)	*We had limited time. If we had had more time, we would have learned some parts of the process better. (TC2)*

Participants' responses focused on three periods: before, during, and after the workshop (Tables 4 and 5). The themes were classified as positive and negative. Participants mostly made statements on social, emotional, and motor skills. They stated that they were excited and curious about the workshop but believed they needed to prepare. However, some were afraid of the workshop before it was held because they knew almost nothing about how to make puppets. Almost all participants lacked experience, but some were prejudiced against the workshop. Participants learned new things, gained new experiences, and developed creativity and decision-making skills throughout the workshop. During the gradually progressing sessions, they became more skilled and were able to find alternative solutions to their problems. They devoted a lot of time and effort to make their puppets and developed motor, social, and emotional skills. They were curious and motivated about the workshop, and therefore, they discovered themselves and became more satisfied as they completed the tasks.

Participants took pride in their work because their puppets appealed to other people. The whole process boosted their confidence. Those who were prejudiced or nervous about the workshop were relieved during the process. Participants had the opportunity to socialize and work together, which made them more responsible and capable of exchanging ideas and empathizing with others. The workshop helped them develop problem-solving skills and creativity and positive attitudes towards science education. They faced problems in almost all areas of development and exerted effort to solve them by using their problem-solving skills. They also had difficulty making a connection between subjects, themes, and concepts, coming up with scenarios and learning them by heart, and reducing abstract concepts to the level of children. To solve those problems, they rehearsed and came up with everyday life activities and content that required more creativity. They sometimes improvised and sometimes learned the texts by heart. They were excited or stressed during their puppet shows. Some participants had difficulty finding suitable melodies and songs for their shows. They were careful about using child-appropriate and simple language, while some had difficulty adjusting and toning audio during their shows. Participants rehearsed often and tried to pay attention to time management. However, some had difficulty in motor activities and time management. They had a hard time making their puppets symmetrical and/or proportional and tearing up tissues into pieces. Some participants were concerned about missing the deadline.

Table 5: Effect of Workshop on Participants (Period: After Puppet Workshop)

Category	Subcategory	Code	Quotations
Personal development		Contribution to self-expression skills (N=4)	*Making puppets is mentally relaxing. It's a way of expressing yourself. You can reflect what is on your mind to the puppet. (TC6)*
		Development of empathy skills (N=4)	*Puppet-making also taught us to put ourselves in the shoes of others at every stage of the task. (TC1)*
		Development of creativity (N=4)	*I saw how different each puppet was. Each of us made something different. So, it means that the whole thing made us more creative. (TC3)*
		Improvement in problem-solving skills (N=4)	*We found solutions to the problems that we faced. Sometimes we tried to do something different, even if it did not work well either for the puppet or for us. (TC4)*
		Developing self-discipline (N=3)	*You should try harder to fulfill a task you are assigned to, there is something you need to finish on time, so you have to push yourself to finish it (TC2)*
Social-emotional		Improvement in social relationships (N=6)	*Some of our classmates were shy, but we ended up getting along well with them towards the end of the workshop. (TC5)*
		Self-knowledge (N=5)	*There were some things I could and some things I couldn't do during the workshop, but it helped me get to know myself better. I can now make puppets by myself. (TC5)*
		Suppressing negative emotions (N=4)	*We faced many problems through the workshop, but we learned how to overcome them and even how to suppress our emotions. (TC1)*
		Positive jealousy (N=2)	*We were sometimes jealous of each other. Some of our classmates were really talented, so we just copied what they did. (TC6)*
		Cute spirit of competition (N=1)	*We were also in some sort of a friendly competition with one another, which motivated us more. (TC3)*
	Prosocial behaviors	Collaboration-cooperation-solidarity (N=6)	*Some made the hair better; some made the hands better. For example, I was good at painting, but not at making the hands. So, for example, Buşra helped me. All students helped one another. (TC3)*
		Forming team spirit (N=5)	*We learned something new every day. We discovered our own weaknesses and made up for each other's shortcomings. (TC6)*
		Respect for differences (N=3)	*Everyone discovered their strengths and weaknesses. We resolved our differences and developed skills by helping each other based on mutual respect. (TC1)*
Motor skills		Developing new motor skills (N=6)	*I can say that everyone has developed manual skills that they had never used before and had no idea that existed. (TC5)*
		Improving fine motor skills (N=5)	*We all made significant progress by the end of the workshop. It helped us develop different types of skills, but most of all, manual skills. (TC4)*
		Painting skills / achieving symmetry (N=3)	*Most of us developed symmetry skills. It was really a challenge to make both the face and the body proportional. (TC2)*

Participants' post-workshop views were classified under the categories of "personal development," "social-emotional," and "motor skills." Those who stated that the workshop helped them develop empathy exerted great effort and discipline to fulfill the assigned tasks. They went through a developmental process after the workshop and got to know themselves better thanks to socialization. Those who explored different ways to cope with negative emotions sometimes enjoyed a friendly competition as they were positively jealous of each other. According to their views, it was a collaboration-intensive workshop which taught them to respect others. Therefore, we can conclude that the workshop helped participants develop fine motor skills and made them fairly advanced in executing those tasks.

Table 6 provides information on the role of puppetry in early childhood science education. Participants' views were collected under the subthemes of "concept teaching," "method-technique," and "activities." The first subtheme focused mostly on life science, earth science, and space. Participants noted that science teachers could use puppets to teach health and hygiene, basic characteristics of humans and animals, lifecycle, seasons, and natural disasters. They also stated that puppetry was an effective way of presenting basic information about the earth and planets. They considered puppetry to be a flexible method that could be incorporated into all teaching techniques (drama, experimentation, presentation, performance, etc.) and activities (exercise, animation, rhythm, etc.).

Table 6: Relationship between Puppetry and Early Childhood Science Education

Theme	Sub-theme	Category	Codes	Quotations
Science Education	Concept Teaching	Life Science	Health-hygiene (N=3)	*Teachers can use them to instruct kids about hygiene and health rules. For instance, we can make a germ puppet to talk about germs or a puppet about any topic we have to cover. (TC5)*
			People (N=2)	*Almost all puppets for kids are human figures. We can use puppets to talk about people and their lifestyles. We can make a puppet of any character, like, a scientist for example, and we can get her to do experiments. (TC3)*
			Lifecycle (N=2)	*The teacher can address the topic of the lifecycle, which is in a Turkish activity, and use puppets to explain the characteristics of animate and inanimate things. (TC1)*
			Animals (N=2)	*Students can use workshop methods to make animal puppets and use them in class to learn the characteristics of animals. (TC2).*
		Earth Science	Weather condition/ seasons (N=4)	*Science education includes weather conditions. The teacher can dress up a puppet and explain the weather conditions and their characteristics. (TC6)*
			Earthquake (N=2)	*We could use puppets to instruct children about first aid and to tell them about the things they should do in an emergency, like earthquake, flood, fire, etc. (TC4)*
		Space	Our world (N=2)	*Imagine using puppets to teach about our world and its resources and how we should use them. It would be great to have puppets in different colors and clothes and use them to address themes of respect for differences. (TC1)*
			Planets (N=1)	*It would be interesting to use mock-ups and puppets to teach about astronomy and planets. (TC2)*
	Method-Technique	Drama	Preparation-warm-up (N=4)	*We can use puppets to teach instructions for warm-up exercises at the beginning of drama practices integrated with science education. (TC5)*
			Animation (N=1)	*We can use puppets as the main characters of stories, or we can make simple puppets and use them for stories. (TC4)*
			Relief (N=1)	*As with warm-up exercises, we can use puppets to teach instructions for relief and relaxation so that students can get some time to rest. (TC3)*
		Experiment	Show (N=3)	*I can use puppets to explain non-risky experiments to children. (TC1)*
			Before lecture (N=2)	*When we go over a topic, we can have puppet activities to give information to kids. I think that teachers should use puppets to inform students before an experiment. (TC6)*
			After lecture(N=2)	*Let's say you did an experiment, and then you are doing some explaining about it, there you can use puppets to make sure that the students learn it well. (TC5)*
		Game	Unstructured games (N=4)	*The teacher can introduce the game as the kids play on their own, or they pick up the puppet and come up with a scenario and start playing it. (TC1)*
			Fictional games (N=3)	*Puppets help improve imagination. They help kids develop new ideas; both puppet-making and puppet shows do that. Kids can come up with games and plays. (TC6)*
		Narration	Warnings/verbal instructions (N=5)	*Puppets can be used to teach and remind children of in-class rules and to communicate verbal commands to them. The best method for this is actually to use the mascot puppet of the class. (TC2)*
			Feedback (N=2)	*I prefer to use puppets in science activities to explain abstract concepts or to turn them into concrete. (TC6)*

Participants thought of puppetry as an alternative method to turn abstract concepts into concrete visual representations and develop social-emotional and communication skills. They regarded puppetry as more of a child-centered educational approach in early childhood education. They remarked that puppets could boost teachers' confidence, attract students' attention, make teacher-student communication more effective, and promote readiness to learn. They also stated that puppetry could help teachers provide fun learning environments promoting productivity, development, and positive attitudes.

Discussion

The results showed that the puppet-making and puppetry workshop designed for early childhood science education improved preservice teachers' self-efficacy beliefs and attitudes. Research in the last decade has shown that affective components for engagement and achievement in science activities are becoming more and more important (Ballen et al., 2017; Greenfield et al., 2009; Robnett et al., 2015). McBride et al. (2020) argue that pedagogical approaches based on conventional methods negatively affect self-efficacy, beliefs, and attitudes towards undergraduate science education. Therefore, they recommend that schools take the necessary steps to improve students' attitudes and beliefs towards science.

Participants who knew little about puppet workshops were prejudiced and nervous about the workshop. We designed a hands-on workshop focusing on students' needs and facilitating individual or group work. As in McBride et al. (2020) and Oliveira (2010), our participants learned new things, discovered their own skills, built self-confidence, demonstrated more prosocial behavior, and experienced less anxiety as time went on. They faced different challenges at different stages, but the workshop helped them develop empathy skills and encouraged them to collaborate and make joint decisions to find creative solutions to complete the tasks (Ballen et al., 2017). The workshop made sure that they experienced different feelings and went through a process of maturation and learning at each stage. This experience changed their mindset and made them more open to cooperation and appreciative of differences (Akerson, 2004). They developed and displayed numerous skills throughout the workshop (Robnett et al., 2015).

Misperceptions and lack of material and content knowledge are some of the major obstacles teachers face when teaching science to young children (Kallery, 2004). They even cause teachers to avoid doing science activities (Cho et al., 2003; Karademir et al., 2020; Nayfeld et al., 2011). Our results showed that incorporating arts into early childhood science education had an impact on participants in various ways. Science education integrated with arts engages students in activities and allows them to associate science concepts with everyday life (De Beer et al., 2018; Pugh & Girod, 2007). Teachers incorporating arts into lectures tend to be more confident and friendly to their students and use more straightforward language. Children show great interest in puppets and enjoy watching them. Puppets enable them to establish more healthy relationships and communicate better with their peers. Scientific and exploratory rehearsals based on puppetry and adult support have positive effects on both students and teachers (Garbett, 2003). They teach students how to communicate more horizontally and allow teachers to get to know and evaluate their students better (Fulton & Simpson-Steele, 2016). This promotes the development of social-emotional skills, which is one of the goals of early childhood education. Educational environments facilitating socialization help teachers develop more child-centered and better classroom management skills (Turk et al., 2019). Teachers using puppets can build strong relationships with their students and provide an affective classroom atmosphere (Karademir & Oren, 2020).

Puppet-making and puppetry are different from ordinary methods because they have an aesthetic structure that stimulates curiosity. Teachers are expected to use methods that allow them to turn abstract concepts into concrete representations and encourage students to question (Sackes et al., 2011). Fulton and Simpson-Steele (2016) also argue that art activities help people use inquiry, observation, discovery, communication, everyday life skills to transform their thought into concrete forms. During rehearsals for scenario production and animation, most students prefer to work together and focus on the right content (Odegaard, 2003). However, art is integrated into education differently than convention educational approaches. For example, preparing puppets and putting on shows require a series of steps involving creativity and rigorous work (Archilla, 2017). Those steps are a) preparing scenarios, b) developing characters, c) making sound adjustments, and d) transferring gestures and facial expressions to the puppet (Kallunki et al., 2017). Teachers interested in using puppets should hold animation and sound rehearsals. Puppets should be made of materials that children would not be afraid to look at or touch (Ocal, 2014). We took heed of this warning and used inexpensive classroom materials and made the puppets of cute characters from children's tales.

Early childhood teachers incorporate art into education to have more quality time with students. This is the main reason why this study took a constructivist education approach. In other words, the study adopted the goals of Braund (2015), who held a workshop to help preservice teachers gain pedagogical experiences and develop engaging child-centered activities in their professional lives. Our results show that puppet-making and puppetry is a stimulating and appealing activity than can be integrated into science education. This result agrees well with the suggestions of Odegaard (2003). Another result is that art activities appeal to students, making it possible for teachers to convey the messages they want their students to receive. McGregor (2014) also asserts that teachers should set the stage for child-centered and concrete activities that promote aesthetic perspectives.

Conclusion

Undergraduate programs of education faculties in many countries have invisible barriers that prevent preservice teachers from demonstrating their judgment skills and creativity. Therefore, it would not be wrong to assume that academics use ordinary methods and strategies to teach the undergraduate curricula (Oliveira, 2010). Curricula rich in learning outcomes allow students to take part in discussions and gain experience (Archilla, 2017; Kallunki et al., 2017), whereas exam-based and result-oriented curricula are too conventional to achieve that. Conventional methods prevent teachers from using effective methods to design education and training (Ro, 2020). Therefore, researchers recommend that preservice teachers keep up with the growth of knowledge in their own fields and learn how to integrate pedagogical tools into education (Kallery, 2004; McBride et al., 2020; Sackes et al., 2012).

Most early childhood students are not provided with sufficient materials and practices on science education (Karademir et al., 2020; Nayfeld et al., 2011; Sackes et al., 2011). Therefore, teachers could turn to art activities to make science topics more interesting for their students. They should incorporate science activities into their lectures to promote inquiry and interaction and help students establish cause-and-effect relationships (NAEYC, 2009; NRC, 2012). Numerous researchers recommend that teachers prefer novel methods to teach young children science topics (Braund, 2015; Eshach & Fried, 2005; McGregor, 2014; Odegaard, 2003; Partnership for 21st Century Learning, 2011). Teaching methods in early childhood education should at least be interesting and rich in visual variety. Puppetry helps children comprehend science concepts more quickly and concretely than conventional methods. According to the NRC and the NAEYC, games facilitate learning in preschoolers. Puppetry also involves games and theatrical techniques. Therefore, early childhood students who learn science through puppetry are more likely to build confidence and develop positive attitudes towards science.

Recommendations

We should inform teachers of science-teaching pedagogy and help them build confidence and make educational environments rich in material. Policies on early childhood education should be reformed. Experts should deliver undergraduate science education courses. These measures can help us revise undergraduate education policies and reduce preservice teachers' fear of science. Moreover, integrating puppetry into early childhood education can significantly help students and teachers interact better and develop social-emotional skills. In this way, teachers can get to know their students better and evaluate them from different perspectives. Puppets can help students build team spirit, bond with their peers, and empathize and cooperate with others. Moreover, puppet shows allow both teachers and students to develop creative thinking skills and go through active learning and teaching processes. Teachers who do not know how to make puppets can use ready-made puppets or masks designed for art activities.

Limitations

This study had two limitations. The results are sample-specific, and therefore, cannot be generalized to all preservice teachers. Second, the qualitative in-depth and observational data provided only tentative information on the implementation of assessment practices within the workshop. Therefore, more information is warranted to make conclusive claims. Proactive and play-based pedagogy becomes more and more critical in early childhood education. Therefore, future studies should investigate teachers' views of teaching and learning science with puppets.

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Authorship Contribution Statement

Erdinç Öcal: Validation, review & editing, project administration, funding acquisition. Abdulhamit Karademir: Methodology, validation, formal analysis, investigation, writing - original draft, Writing - review & editing, visualization. Özkan Saatçioğlu: Methodology, analysis, conceptualization, validation. Beyza Demirel: Investigation, resources.

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