**Preschool Teachers’ Attitudes towards the Implementation of Science and Technology Studies in Preschool**

**Abstract**

This study examines attitudes of Israeli preschool teachers towards the teaching of science and technology (S&T) in preschools in general, and towards the Israel Ministry of Education’s S&T program in particular. It assesses the connection between the teachers’ attitudes and their implementation of the program, and examines the difficulties they expressed and improvements they suggested regarding the implementation of the S&T program in their classes. Ninety preschool teachers responded to a questionnaire assessing their attitudes regarding teaching S&T to preschool children. Eight of these teachers were interviewed regarding the content, methods, and application of the S&T program in their preschools.

The results show that most of the teachers are engaged in teaching scientific content in the preschool, despite time constraints. All the teachers expressed positive attitudes towards teaching S&T in preschool, attributed great importance to it, and said it is appropriate for children of that age. However, they admitted that they do not fully apply the official S&T teaching program in their classes. Further, they teach mainly according to their personal knowledge, rather than the professional program. Many said they lack sufficient knowledge and are not fully familiar with the S&T program. They stated that professional development could improve utilization of time and resources, increase cooperation with other educators, and promote positive attitudes towards teaching S&T in preschool.

The main implication of this research is that a nationwide, professional training program for preschool teachers must be introduced along with the new S&T curriculum. Such training should provide teachers with in-depth knowledge of the program’s content, and methods for implementing it, and provide them with personal guidance to enable them to teach S&T with minimal difficulties or concerns.

Keywords: Preschool teachers’ attitudes; Science and technology education; Early childhood.

**Introduction**

Building an infrastructure for thinking and learning skills and life skills in general begins at an early age. Young children need to be introduced to a wide range of subjects to prepare them to function in the 21st century, which is characterized by constant change, renewal, dynamism, and openness. Science and technology are gaining momentum in today’s world and are being integrated into all areas of modern life. Decision makers in Israel’s education system recognize the growing need to give children – future citizens – knowledge about science and technology from as young an age as possible. Accordingly, the Israeli Ministry of Education has developed a program for teaching S&T in preschool.

The final version of the program for teaching science and technology (S&T) in preschools was first published by the Israeli Ministry of Education in 2016. The program details the scientific contents to be taught in preschool, and outlines the skills, competencies, attitudes, and values ​​regarding science and the environment to be developed among the children. The program aims to instill skills pertaining to scientific research and technological design.

The program is designed to be taught by the teachers who teach all the subjects in the preschool: language and literacy, mathematics, arts, environmental education, music, and more, in addition to science and technology. They must have knowledge of the topics being taught and also be proficient in the technologies and pedagogy necessary to teach the program, both verbally and through hands-on activities, in ways that are appropriate for children in preschool.

Preschool teachers encounter various difficulties in teaching S&T, including lack of scientific knowledge, lack of self-confidence in teaching science, and time constraints. As a result, they often express dissatisfaction and lack of gratification teaching S&T (Spektor-Levy, et al. 2011).

To date, there has not been a comprehensive study that assessed the reactions of preschool teachers in Israel to the implementation of this S&T program. There have been reports from the field about difficulties in implementing the program, and previous studies have indicated the nature of such difficulties (Pendergast et al., 2017; Spektor-Levy et al., 2011). Therefore, to better understand the difficulties faced by the teachers and to identify ways to improve teaching the S&T program in preschools, the current study examines attitudes of Israeli preschool teachers towards teaching science in preschool in general, and towards the official S&T program in particular. It assesses the connection between the teachers’ attitudes and their implementation of the program, and examines the difficulties they expressed and improvements they suggest regarding the implementation of the S&T program in their classes.

**1. Literature Review**

*1.1. Teaching S&T in preschool*

The importance of science and technology education for young children is widely agreed upon by educators around the world ([Furtado,](https://www.proquest.com/indexinglinkhandler/sng/au/Furtado%2C%2BLeena/%24N?accountid=41238) 2010; Spektor-Levy et al., 2011). Researchers no longer debate how early science education should begin (Gerde et al., 2013) but rather seek the most effective ways to teach it. Currently, S&T education is considered appropriate for young children (Anderson & Gulberg, 2014; Eshach, 2006; Gelman & Brenneman, 2004) and a crucial part of their learning ([Oppermann et al.,](https://www.proquest.com/indexinglinkhandler/sng/au/Oppermann%2C%2BElisa/%24N?accountid=41238" \o "Click to search for more items by this author) 2021). Exposing young children to scientific activities contributes to the development of their intelligence and abstract thinking skills (Eshach & Fried, 2005). Young children have the cognitive abilities to understand scientific concepts and can acquire and apply the skills relevant to scientific research processes, such as using research strategies, developing research questions and hypotheses, making observations, conducting experiments, predicting results, summarizing the findings, presenting the results, and drawing conclusions (Eshach, 2006; Eshach & Fried, 2005; Gelman & Brenneman, 2004; Gerde et al., 2013).

Well-designed and appropriate teaching methods can help young children understand basic scientific concepts pertaining to common phenomena in nature (Eberbach & Crowley, 2009; Kambouri-Danos et al., 2019). Involving preschool children in scientific research processes develops the skills that will enable them to later understand more complex scientific ideas (Eshach & Fried, 2005; Gerde et al., 2013; Roychoudhury, 2014), improves their readiness for school, and develops their interest in and positive attitudes towards science (Eberbach & Crowley, 2009; Hastürk & Özdemir, 2021). Therefore, researchers and educators are seeking ways to improve the teaching of S&T in preschool. In the United States, for example, it has been found that despite the large number of such programs, and the abundant information and literature on teaching science in preschools, children enter elementary school with little knowledge of science and underdeveloped scientific skills. Their readiness in science is weak in comparison to other areas such as math, language and literacy, and the arts (Greenfield et al., 2009).

# One of the widely-held assumptions in education, relevant to all age levels, is that the children’s knowledge, understanding, skills, and attitudes are greatly influenced by the way they are taught (Andersson & Gullberg, 2011; Spektor-Levy et al., 2014). Many science education programs have been developed for early childhood educators worldwide (MacDonald et al., 2020). Yet many educators experience uncertainty and even fear of teaching scientific content since they lack sufficient knowledge and require support in conducting those programs (MacDonald et al., 2021). Previous studies have linked the difficulties in teaching science in preschool to the low proficiency of science educators, lack of educational resources, and programs that do not offer a wide enough variety of high-quality scientific experiences to young children (Andersson & Gullberg, 2014).

*1.2 Teachers’ attitudes towards teaching S&T in preschools*

 In recent years preschool teachers have expressed better understanding of the benefits of teaching science to young children. They also express greater confidence and comfort in incorporating scientific activities into their work. Nevertheless, they continue to indicate feelings of inadequacy and anxiety about their own scientific knowledge and their ability to transmit it to preschool children (Pendergast, et al., 2017). This led researchers to examine the links between parameters such as self-efficacy, beliefs, and preschool teachers’ perceptions regarding their educational practice of science in class (Furtado, 2010; Hastürk & Özdemir, 2021; Oppermann et al., 2021; Saçkes, 2014; Yagmur-Kolcu, & Öztuna-Kaplan, 2020). Positive attitudes towards the field of science constitute a significant factor influencing the frequency and quality of science teaching in preschool (Furtado, 2010; Greenfield et al., 2009; Hastürk & Özdemir, 2021; Saçkes, 2014; Spektor-Levy et al., 2011).

Children who study with teachers who have positive approaches and apply quality practices in teaching science have been found to receive higher scores on measures of curiosity, attitudes, knowledge, and scientific abilities, as compared to children who study with teachers who do not engage in quality science education (Spektor-Levy et al., 2011). Preschool children who completed an inquiry unit in science were able to discuss the results of their investigation with their peers, demonstrated greater knowledge of biological concepts and greater familiarity with scientific concepts such as making a hypothesis, using scientific tools, making observations and recording them, and using empirical evidence to expand and develop their knowledge (Samarapungavan et al., 2008).

Studies have found a significant positive relationship between teachers’ positive attitudes and enthusiasm for science and the extent to which they incorporate science topics in class (Spektor-Levy et al., 2011). It was also found that effective vocational training and professional development of teachers is related to the development of positive attitudes towards teaching science in preschool and consequently to a more effective engagement of scientific topics in the class (Maier et al., 2013; Pendergast et al., 2017). While characteristics of the preschool teachers, such as their level of education and experience, were found to have an insignificant impact on their attitudes towards teaching S&T, characteristics of the preschool, in contrast, were found to significantly influence their attitudes on this issue (Erden & Sönmez, 2011).

In the current research, we examined how preschool teachers perceive the link between their attitudes towards science and teaching it, as well as the impact of other parameters such as professional development, availability of science-related instructional materials in the classrooms, their perceptions of children’s capacity for learning, and their belief in their own ability to teach sciences (Saçkes, 2014).

**Background on preschool education in Israel**

Public preschools in Israel are part of the public education system and are included in the Compulsory Education Law, education is mandatory, and free, for all children in the country beginning at the age of three. There are about 21,00 public preschools in Israel (for ages 5-6), with an average of 29 children per class. The teaching staff includes a senior teacher (also called the preschool manager) and an assistant teacher. The senior teachers are responsible for everything that happens in the preschool. They teach the content for all disciplines, manage the class meetings, group projects, and all the activities of the preschool. Senior teachers must have at least a bachelor's degree in early childhood education. All the teachers who participated in this study were senior teachers (managers).

A program for teaching S&T in preschools was developed by the Ministry of Education in Israel and published in 2015-2016. Its primary goal is developing literacy in S&T, which includes knowledge of scientific concepts and development of the lower- and higher-order thinking skills, such as the synthesis and organization of concepts.

The S&T subjects to be taught at such a young age must be carefully chosen, as the knowledge base must be built layer by layer, using appropriate pedagogical methods, so that the children can experience and understand the basic and primary ideas of science. The topics chosen for inclusion in this program are ones that are familiar in young children’s world and everyday lives (Roychoudhury, 2013). The S&T program discussed in this study focuses on three topics: the weather and celestial objects, the human body, and human-made products in their environment.

This study is significant in that it is the first to examine Israeli preschool teachers' attitudes towards teaching S&T in preschools in general, this program and their implementation of it in specific, the difficulties they face, and their recommendations for improving attitudes towards S&T studies in preschools and the implementation of the program.

The research questions were:

A. What are the attitudes of teachers towards teaching S&T in preschool in terms of a. the importance of the program, b. their confidence in applying it, and c. the actual implementation?

B. What do the teachers report regarding the extent to which they are familiar with the S&T program and how they implement it?

 C. What are the difficulties and the ways to overcome them in implementing the S&T program as expressed by the teachers?

**2. Methodology**

*2.1. Research method, population, tools and procedure*

The study combined quantitative and qualitative methodologies.

The population sample included 90 senior preschool teachers who teach in and manage 90 different preschools in the southern region of Israel who volunteered to participate in the study. All the teachers were female. All the teachers have a degree in early childhood education: 63% have a bachelor's degree (63%) and the other 37% have a master's degree. They all serve as the primary teachers in the preschool. The nature of the research was explained to all participants, and no further ethical approval was required.

About 74% worked in the country’s geo-social peripheral regions, and about a quarter (26%) in central urban areas. Their years of experience ranged from five to over twenty years. The internal reliability of the questionnaire was very good (Cronbach’s alpha **=** 0.91).

The attitudes of these 90 teachers were examined in two stages. First, they answered an online questionnaire (Table 1) with 31 statements regarding teaching S&T in the preschool. They assessed each statement according to a 4-point Likert scale ranging from "strongly disagree (1) to "strongly agree" (4). The questionnaire, developed by Maier et al. (2013) was translated into Hebrew and the wording of the statements was adapted to be relevant to preschool teachers implementing the S&T program in Israel. The questionnaire with the 31 statements in the questionnaire and the means and standard deviations of the teachers' responses are shown in Table 1.

In the second phase, we conducted semi-structured personal interviews with eight of the teachers. The interviews lasted about 30-45 minutes. The interview, developed by Spektor-Levy et al. (2011), examined the teachers’ attitudes regarding their implementation of the official S&T program, including scientific content, teaching methods, and activities. We added questions regarding the frequency of scientific activities in the preschool, the learning environment, scientific equipment used, familiarity with the scientific educational materials used, familiarity with the program goals, difficulties arising while teaching the program and their suggestions to improve its implementation.

*2.2 Analysis of the Findings*

2.2.1. Quantitative Analysis

The 31 statements were grouped into four categories, which were found to be reliable via a factor analysis using the varimax method with orthogonal rotation, as shown in Table 2.

We conducted a mapping analysis that revealed links between the categories. After the mapping analysis, a new order of categories was created that are shown in Table 2:

a. Preschool teachers’ attitudes towards the importance of the S&T education program in preschools.

b. The teachers’ level of confidence in teaching science in preschool.

c. The teachers’ description of their implementation of science-based activities and the S&T program in preschools.

d. Difficulties the teachers described regarding implementation of the S&T program.

The quantitative analysis examined the link between the teachers’ reported attitudes towards teaching science and their attitudes regarding the practical implementation of the S&T program. A Pearson test was conducted to examine the relationship between the four categories of the questionnaire.

2.2.2. Qualitative Analysis

The data obtained from the semi-structured personal interviews were processed through content analysis. We performed a categorical analysis using a sorting process in which data belonging to the same phenomenon were combined to create content units, which are statements from the analyzed content. The product of the analysis is thematic categories. In the first stage, a preliminary analysis was conducted by selecting statements by the teachers that relate to the research questions. Subsequently, the data were divided accordingly into initial categories that were reduced to core categories.

עזרה, מה ניתן להוסיף?

**3. Results**

*3.1. Preschool Teachers’ Attitudes towards Teaching S&T in Preschool*

The questionnaire with the 31 statements regarding teaching S&T in the preschool and the mean scores and standard deviations of the teachers' responses are shown in Table 1. A summary of the preschool teachers’ attitudes towards engaging in science in the preschool appears in Table 2.

**Table 1**

 *Mean score and deviation of S&T Education Questionnaire Statements (N=90)*

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Statement | MeanScore | StandardDeviation |
| 1 | Science activities in early childhood stimulate children’s interest in science at a later age. | 3.69 | 0.512 |
| 2 | I feel confident planning and demonstrating in-class activities related to the physical sciences and energy, such as gravity and physical states (solid, liquid and gas). | 3.09 | 0.944 |
| 3 | Scientific topics should be introduced at an early age. | 3.80 | 0.429 |
| 4 | The time devoted to studying science is inadequate, due to other requirements. | 2.84 | 0.947 |
| 5 | Children learn best through practical experience with physical objects and materials. | 3.91 | 0.286 |
| 6 | Science-related activities improve approaches to learning in early childhood learning. | 3.51 | 0.640 |
| 7 | I discuss ideas and topics related to studying science with other teachers. | 2.43 | 0.960 |
| 8 | I use all types of materials in scientific activities, for example toys and containers. | 3.20 | 0.864 |
| 9 | Preparing to teach science takes longer than preparing to teach other fields. | 2.57 | 0.912 |
| 10 | I use books to get ideas for science activities for young children. | 2.92 | 0.951 |
| 11 | I feel confident doing scientific activities in my preschool. | 3.29 | 0.811 |
| 12 | I feel confident planning and demonstrating in-class activities related to biology (e.g., living things, plants, animals). | 3.07 | 0.946 |
| 13 | Science-related activities in early childhood improve children’s math skills. | 3.23 | 0.875 |
| 14 | Early childhood science-related activities improve children’s language skills. | 3.48 | 0.674 |
| 15 | I do not have enough scientific knowledge to teach science to young children. | 2.89 | 0.953 |
| 16 | I do not feel confident talking to children about scientific methods (e.g., hypothesizing, predicting test results, conducting an experiment). | 3.58 | 0.793 |
| 17 | I use the internet to find ideas for science activities for young children. | 3.47 | 0.810 |
| 18 | Young children cannot learn science until they learn to read. | 1.07 | 0.361 |
| 19 | I get ideas for science activities from what the children do, say, and want. | 3.21 | 0.786 |
| 20 | Science-related activities are too difficult for children in preschool. | 3.67 | 0.636 |
| 21 | I include sections from science books during story time in preschool. | 2.07 | 0.922 |
| 22 | Science-related activities in early childhood improve children’s social skills. | 2.97 | 0.841 |
| 23 | I enjoy doing science-based activities with the preschool children. | 3.32 | 0.805 |
| 24 | I’m afraid that children might ask a question about scientific phenomena or principles that I cannot answer. | 3.28 | 0.948 |
| 25 | I demonstrate scientific processes (e.g., comparing objects to see if they will float or sink in water). | 3.61 | 0.575 |
| 26 | Designing and conducting scientific activities is a difficult task. | 3.02 | 0.874 |
| 27 | Young children are curious about scientific principles and phenomena. | 3.73 | 0.536 |
| 28 | I do not have enough materials for teaching science. | 3.01 | 1.011 |
| 29 | I try to incorporate scientific activities every day. | 2.31 | 1.013 |
| 30 | I feel confident planning and presenting to the class activities related to Earth sciences (e.g., Sun, Moon, stars and weather). | 2.97 | 0.965 |
| 31 | I collect materials and objects to use in teaching science.  | 3.03 | 0.880 |

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**Table 2**

*Reliability and Distribution of Continuous Variables in the Sample Population (N = 90)*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variable | Statements number and list  | M | SD | Cronbach’s α |
| General mean score in the questionnaire | 31 | 3.07 | 0.35 | 0.88 |
| Importance of teaching S&T in preschools | 7(3,6,7,13,14,22,27) | 3.49 | 0.41 | 0.74 |
| Teachers’ level of confidence in teaching science in preschool | 14(2,7,8,10,11,12,17,19,21,23,25,29,30,31) | 3.14 | 0.60 | 0.82 |
| Teachers’ implementation of science-based activities in preschool | 9(7,8,10,17,19,21,25,33,31) | 2.99 | 0.53 | 0.77 |
| Teachers’ difficulties in teaching science in preschool | 7(4,9,15,16,24,26,28) | 2.77 | 0.24 | 0.46 |

The highest mean score (from the Likert-scale ratings) was for the category “Importance of teaching S&T in preschool”. This indicates that the teachers find science teaching to be important and appropriate for young children, and that it can also improve their mathematical and language skills. All the teachers agreed that they should start addressing scientific topics from an early age, that studying science in preschool is extremely important, and that it contributes to the children’s long-term development. The category “Teachers’ level of confidence teaching science in preschool” assessed the assumption that teachers’ confidence in teaching science impacts their implementation of science-based activities in preschool; that is, that teachers who feel more confident teaching science will be more likely to implement activities in this field, leading their students to be more interested and develop greater curiosity in the field of science. In this category, most preschool teachers said they feel confident teaching science. Over 80% of the surveyed teachers reported that they enjoy engaging in science education and feel confident conducting various scientific activities in the preschool. Over 70% said they feel confident planning and demonstrating activities and processes related to the fields of physics and biology. The mean scores for the items related to using science books and sharing science education practices with other teachers were relatively low (close to 2.00), indicating that the teachers less frequently engage in these activities.

For the group of statements included in the category “Teachers’ implementation of science-based activities in preschool,” a mean score of 2.99 was obtained, indicating most of the surveyed teachers said they are engaged in scientific activities in the preschool. Most (79%) said they receive ideas for practical activities either from the children’s own actions and words, or from online resources. The vast majority (97%) said they demonstrate physical scientific processes to children.

At the same time, the scientific activity in the preschool is limited. Over half of the teachers (58%) said they do not make an effort to include scientific activities every day. The majority (80%) do not integrate science-themed books during story time in the classroom.

The category “Teachers’ difficulties in teaching science in preschool” shows a relatively low mean score of2.77, indicating that the teachers do not think they face major difficulties in teaching science in preschool. However, closer inspection of each statement individually reveals significant heterogeneity in attitudes towards difficulties in dealing with challenges, and the Cronbach’s alpha for this category is low. While some teachers said they are able to overcome the challenges, others said they find it difficult to cope with the challenges of teaching science in preschool. For example, a significant proportion of the surveyed teachers (61.5%) agreed that the time devoted to studying science is insufficient due to other teaching requirements. In fact, the main problem that the preschool teachers repeatedly raised was the lack of time resources; most said they cannot devote adequate time to teaching science in preschool. About 44.2% said that preparing for science teaching takes longer than for other fields. About two-thirds (67.4%) said that they have sufficient scientific knowledge, but the remaining third (32.6%) said the opposite. Moreover, although more than half of the surveyed teachers reported confidence that they would be able to answer the children’s questions about phenomena or scientific principles, over a quarter (28%) said they definitely faced the fear that they could not.

In the comparison test using a t-test between the background variables of the preschool teachers (their years of experience, education, their age, age of their students, and the type of locality in which the preschool where they teach is located), and the preschool teachers’ attitudes, we found no significant differences.

In the Pearson test (Table 3) that examined correlation between categories, significant positive correlations of low to high intensity were found between each of the categories of the questionnaire items, and all the other categories. A positive correlation was found between the importance that teachers attribute to teaching science in preschool and their confidence in teaching sciences (0.470). An even stronger correlation was found between the perceived importance of teaching science and teachers’ implementation of science-based activities (0.608). The more importance that teachers attribute to science education, the more likely they are to say that they feel confident doing so, and to in fact implement this type of learning. A relatively high positive correlation was found between the teachers’ level of confidence in teaching science in preschool and their actual implementation of science-based activities (0.730).

A negative correlation was found between the teachers’ level of confidence and perceived difficulties in teaching science in preschool (greater difficulty is associated with a lower feeling of confidence in teaching science). Negative correlations were found between the teachers’ difficulty in dealing with the challenges of teaching science and the importance that they attribute to teaching this subject. The implementation of science-based activities and the importance that the teacher attributes to the subject both decreased as the teachers’ perceived difficulties in teaching science in preschool increased.

**Table 3**

*Pearson’s Correlations Between the Study Variables*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Importance of teaching science in preschool | Teachers’ level of confidence teaching science in preschool | Implementation of science-based activities in preschool | Teachers’ difficulties in teaching science in preschool  |
| Importance of teaching science in preschool | 1 | 0.470\*\* | 0.608\*\* | -0.237\* |
| Teachers’ level of confidence teaching science in preschool |  | 1 | 0.730\*\* | -0.366\*\* |
| Implementation of science-based activities in preschool |  |  | 1 | -0.273\*\* |
| Teachers’ difficulties in teaching science in preschool |  |  |  | 1 |

\* p < 0.05, \*\* p < 0.01 (two-tailed)

*3.2 The Teachers’ Familiarity with the S&T Program and its Goals*

In the second part of the study, we interviewed eight preschool teachers in order to examine their attitudes and experiences regarding the S&T program, as expressed in their own words. The questionnaire used in the first part of the study did not address the official program specifically. The first five interview questions dealt with the general teaching of S&T in preschool, followed by five questions pertaining to the official program and the preschool teachers’ implementation of it. When asked about the extent of familiarity with the official S&T program, all teachers responded that they knew about it, but only a minority said they were familiar with it to a great extent and used it to plan their teaching curriculum.

The teachers’ primary use of the S&T program pertained to the selection of the designated learning contents and skills. Most of the interviewed teachers reported a low degree of familiarity with the program, saying, for example: “I read the program…long time ago” (2), “I know less about the program itself” “I know it somewhat” (5), “Yes, more or less” and “I do not really know the program, I have not seen it yet” (4). Most said they use the program little or not at all. In their opinion, working with the program document does not help them because “The program is not clear and not detailed enough” and “If I knew the plan better, I would probably use it more” (8). The teachers stated that they were not familiar with the goals of the program. One teacher said: “Some (parts) I do not apply, or not enough. For example, I do not know what should be taught according to the astronomy curriculum” (7).

The interviewed teachers attributed great importance to the application of the program in preschools stating that it should definitely be implemented, defining it as “an important program, a good program that can help the teacher in her work.” Others said: “The program addresses important topics like scientific language, phenomena,” “It’s good to have a plan. The program gives ideas and can help. Obviously, it needs to be implemented” (7).

This is in line with the results from the first part of the study, where all the participants expressed a positive attitude in favor of teaching science in preschool. Even if a minority of teachers expressed some doubts about the program, they still considered it important and added that “The program is good. The program should be implemented intelligently and regularly,” “The program should be well known and implemented.”

Analysis of the interviews shows that all the teachers were engaged in teaching scientific content in the preschool, even if not according to the program. Four reported that they deal with scientific content on all three topics of the program, while the four other teachers reported that they address only two of them, leaving out the topic of astronomy.

*3.3. Frequency of Science-based Activities in Preschool*

Four of the interviewed teachers reported that they engage every day in some science-based activity in the preschool. Science-based activities are done in the classroom, the school courtyard, on field trips, and even at home. As one preschool teacher proudly said, "…each and every day. The children bring from home things that are related to the teaching” (7). Several said that the parents share with them the children’s interest in science and continued learning at home. The teachers reported that they combine science education with mathematics, literacy, and sustainability/environmental education. Some teachers had difficulty defining the frequency of science-based educational activities in their class. Two said they conduct science-based activities twice a week, two others said twice a month. Some said they think they do not spend enough time teaching science: “It’s not enough, not to the extent I would like” (5) “Not the frequency I would like it to be” (8) and “No time. I have birthdays and other parties, there is not time for everything,” (4).

*3.4 Methods of Teaching Science in Preschool*

All of the interviewed teachers said that they use various methods for teaching science, such as learning by doing practical science-based activities, problem-solving, and research activities. For example: “Extraction of olive oil was a very interesting experience. I brought olives, they crushed them, felt the oil” (7). Or: “Snails: That’s something that really interests them. We gave the snails food. We cleaned their container. The children were involved in the whole process. We checked what they did or did not eat” (5). “Sometimes we do group experiments as well. This is how we did the evaporation experiment using a kettle” (1).

Most said they often teach science to the whole class, even though they agree that this method is sometimes less appropriate for preschool children. As one teacher described: “There are a lot of activities I have to do during the day. I do not have enough time to do much in groups” (2). Another teacher expressed concern and frustration that she could not always use appropriate methods for science-based activities: “I have about an hour each day that I can teach science. I try to work in small groups ... If I teach the whole class ... the science activity loses ... all its value... especially where there are two age groups. The younger ones are ... not sitting still. On the other hand, the older students, it is clear that they understand. I should do the scientific activity only with them. In the end everything is squandered and it’s a pity ... every time I try, but that’s the way it is” (6). “In the sciences, I do not know how to build it gradually. Where do I start? How should I continue? I do use tools, but what is better to start with? What is the order? Maybe it is not worth it at all” (8).

*3.5. Teachers’ Difficulties in Implementing the Science Curriculum*

An analysis of the interviews found that the interviewed teachers reported five main factors that make it difficult for them to implement the S&T program: a) workload and time constraints, b) lack of staff and assistance for teaching science, c) lack of knowledge and skills to teach science to young children, d) lack of teaching materials adapted to and appropriate for the level of a preschool child, e) lack of familiarity with the program.

Quotes for each category include:

a) Workload and time constraints: The teachers said that they cannot devote enough time to teaching science: “I do not always have time ... there are many activities I have to do during the day” (2). “I do engage in science, but not enough, not to the extent I would like. There are a lot of plans, a lot of demands. Not enough time to do everything” (5). “I am so busy” (7).

b) Lack of staff and assistance for teaching science. The teachers complained that they do not receive sufficient assistance in teaching S&T: “Who will help me? An assistant would help” (2). “Sometimes parents cooperate .... Besides, my assistant helps me in the process ... otherwise I have no help” (4). “Lack of staff” (7). “We have no one, no related classes, nothing” (5). “Every day I am alone” (8).

c) Lack of knowledge and skills to teach science to young children: “I have never undergone advanced training. In mathematics yes, but in science - no. The truth is, I really want … practical training” (2). “In science I do not know how to build [the program]. Where to start? How to proceed? What is the order? … What process does the child go through in building this knowledge? I do not know where to start, what comes next” (8). “I lack knowledge and tools. I use my intuition” (5). “I don’t know, mostly what comes up. It’s not planned” (1).

d) Lack of teaching materials adapted to and appropriate for the level of a preschool child: “We have test tubes that I brought from some factory. I have a magnifying glass, a terrarium, an aquarium. What else do I have? That’s it” (3). “I have nothing. A magnifying glass. (Laughs). I really have nothing” (8). “The truth is I don’t have that much scientific equipment. I don’t have any kit. I try to improvise every time. I don’t have scales. I have magnifying glasses. I don’t have binoculars ... I don’t have a budget” (7).

e) Lack of familiarity with the program: “I am less familiar with the program itself. I have been exposed to many programs, apart from the formal one” (3).

None of eight of the teachers said they had undergone any training in science education in the last five years.

*3.6 Preschool Teachers’ Attitudes towards Teaching Science and Implementation of the Program.*

The preschool teachers who showed positive attitudes towards science also expressed enthusiasm and desire for conducting science-based educational activities in their classes. Yet their words indicated a gap between the desire to teach science and their actual implementation of the S&T educational program.

The positive attitudes towards science were expressed as follows: “Science is one of my favorite fields. Through science you can teach a whole world and impart knowledge to children in all fields. It is a really deep experience because children deal with something real, tangible. I introduce science in almost each of my educational activities... through connecting to the animal and plant world, the children develop. Both in terms of cognition and of sensitivity to nature. They learn important things, perhaps the most important things to know” (7). “I strongly believe that science education should be practiced ... I saw how happy they are to do all the processes. To experience it. It is very important. I know how significant it is for children” (6).

The quantitative analysis shows that there is a correlation between the teachers’ positive attitudes towards teaching science in preschool and frequent application of scientific activities. Expressing confidence teaching science was strongly linked to implementing some sort of science activity, but not necessarily the official program itself. Five of the interviewed teachers expressed a positive attitude towards the implementation of the S&T curriculum in preschools. The other three teachers expressed a positive attitude but with some reservations, adding that “The plan is good. The plan should be implemented intelligently” (1), “One should be familiar with the plan. It is worth incorporating in class” (7), or “We probably need to apply it” (5). The teachers explained that “The plan is too general, not clear and detailed enough” (8).

Even teachers with strongly positive attitudes toward science education said that they do not implement the program to the extent that they wished. They teach science in their classes at least several times a week, but not according to the S&T program. For examples: “I do not know exactly, but certainly implement something” (4), “I do not know. Maybe yes, intuitively” (8), “I still try to bring in the matter of the sciences, because I think it’s very important.... If it was up to me, I would be more engaged ... I would do it all the time” (6). “I include science in every subject ... it’s in my head all the time ... I was not really able to teach according to what was written in the booklets ... but I am aware of things” (7).

1. **Discussion and Recommendations**

In this study, we have examined the attitudes of preschool teachers in relation to the importance of teaching science in preschool, the application of Israeli official S&T program in their class. The teachers’ difficulties in implementing science teaching in general and the S&T program in particular, and the what may promote that implementation in their classes were also studied.

Regarding the first research question, the results indicate that the basic attitude of preschool teachers towards teaching science in preschool is positive, and the teachers recognize the importance of teaching science in early childhood. These results are consistent with the results of previous studies examining teachers’ attitudes toward teaching science in preschool, which also found that most preschool teachers say that science education should begin in early childhood, that young children can perform science-based activities, and that science education has a long-term positive impact on children’s later access to the field of science (Hastürk & Özdemir, 2021; Spektor-Levy et al., 2011).

The results were not uniform regarding preschool teachers’ self-confidence or the level of assimilation of S&T studies in preschool.

However, this study found positive correlations between the teachers’ attitudes regarding the importance of teaching science to young children and their confidence in engaging in this teaching, as well as their implementation of science-based activities. This means that the more positive attitudes teachers have about the importance of teaching science in preschool, the more comfortable and confident they are in doing so, and the more likely they were to actually implement the teaching of science in preschool.

At the same time, having a positive attitude towards teaching S&T in preschool was not the only factor that affected teachers’ confidence and the implementation of the program. In addition, we found negative correlations between the level of difficulty the teachers said they have in dealing with the challenges of science teaching in preschool and the importance they attribute to teaching science and the actual classroom teaching. That is, the more difficult teachers find the challenges of science teaching, the less important they consider it, and the less likely they are to implement science-based activities in their lessons. Although teachers feel a great responsibility to meet the children’s needs (Maier, Greenfield, & Bulotsky-Shearer, 2013), and say it is important to teach science in preschool, the extent to which teachers act on these attitudes is influenced by their personal level of confidence in teaching this subject and the difficulties they face in teaching science (Saçkes, 2014).

Regarding the second research question, the results reveal a complex picture regarding the actual implementation of science teaching in preschool. Most teachers include science activities in theirteaching and say that they must have adequate knowledge of the chosen field and the pedagogical skills necessary to teach scientific content and ideas to young children (Andersson & Gullberg, 2014; Thulin & Redfors, 2017). However, about a quarter of them said they worry that they will not know how to answer children’s questions about scientific phenomena or principles, and about a third of them do not feel confident in planning and presenting science-related activities in class. These teachers said they lack training or sufficient knowledge in science teaching and as a result, they experience a lack of confidence, discomfort, stress, or fear in teaching certain science content. These results are also consistent with previous studies (Greenfield et al., 2009; Spektor-Levy et al., 2011; Yagmur-Kolcu & Öztuna-Kaplan, 2020) showing that even teachers who are strongly supportive of early childhood science education may feel they have insufficient scientific and pedagogic knowledge. The result is that children finish preschool with a lower level of knowledge about scientific subjects than desired.

 The teachers said they implement scientific activities such as demonstrating experiments and research activities, similar to what was described by Spektor-Levy (2013). At the same time, teachers choose the content and methods of teaching science intuitively, based on their knowledge and personal experience, not based on the program or its goals. In fact, only a small part of the official program is actually implemented in the preschools. All the surveyed teachers said that they teach scientific content, and most said they follow the spirit of the S&T program and sometimes use the teaching methods described in it. However, they are aware that they sometimes use less appropriate teaching methods due to lack of time and inability to reach each child individually. This is due to the low self-efficacy of the preschool teachers (Greenfield et al., 2009; Oppermann et al., 2021) and the multiple requirements placed on them.

Regarding the third research question, the personal interviews gave the teachers the opportunity to describe in detail the difficulties that may prevent them from applying the official S&T program. One of these is lack of familiarity with the program. Even if the teachers know about it, they do not know its goals and content, so they do not implement it as they do with curricula for mathematics, language, arts, and current events. The lack of knowledge of the S&T program indicates that teachers consider it a lower priority and have an ambivalent attitude towards it. In order for preschool teachers to be familiar with the program, the supervisory bodies must increase awareness of it, and ensure appropriate training and professional development for teachers to promote its implementation.

Another notable difficulty is the lack of time allocated by the teachers to science lessons. Similar results have been shown previously (Greenfield et al., 2009), indicating that a work overload is a consistent challenge. Teachers need to integrate children’s everyday activities as part of the preschool curriculum to enable them to learn science (Kambouri-Danos et al., 2019).

It has been found that in order to develop research skills and problem-solving abilities among young children, a long-term time investment is required (Visone, 2009). Teachers must adapt the activities to the age and developmental level of all the children in their classes. Teachers often have difficulty achieving all the required goals. Similarly, preschool teachers in the U.S. (Greenfield et al., 2009) reported low self-efficacy in science teaching and difficulty finding time to teach science, due to the burden placed on them in all subject areas. The S&T program does not refer to the amount of time or frequency required for teaching science in preschool and the teacher must determine both. It is possible that a dictated minimum time and frequency of activities could help teachers in planning the overall curriculum for the preschool, and the teaching of the sciences in particular.

The surveyed preschool teachers reported having little knowledge of content in the science field, and feel they lack skills for teaching science to young children. The results are consistent with the findings of others (Spektor-Levy et al., 2011; Yagmur-Kolcu & Öztuna-Kaplan, 2020) which indicate that only a minority of teachers feel confident about their personal knowledge in the sciences. The teachers said they did not receive proper training during their studies, or afterwards. They asserted that effective professional development would lead to a significant improvement in their sense of confidence in teaching science, reflecting the findings of previous research indicating that professional training in science greatly advanced science teaching in preschools (Furtado, 2010; Greenfield et al., 2009; Piasta et al., 2015; Visone, 2009). Such advanced training provides teachers with the confidence, knowledge, and principles that are necessary for them to teach science and perform science experiments in preschools in a way that is appropriate to children of that age (Andersson & Gullberg, 2014). Professional training can also promote cooperation with other educators and thus overcome another difficulty noted by the surveyed teachers.

Another problem expressed by the surveyed teachers is the lack of teaching materials and equipment for scientific research. They said that they often use non-scientific tools to teach these lessons. Strengthening teachers’ positive attitudes toward science teaching, as part of their training process, may encourage them to devote more resources to purchasing scientific aids and equipment. The teachers asked for greater exposure to the Department of Education’s national publications and to work with professional trainers for scientific work in the preschool, in order to establish a more positive attitude towards teaching science.

The primary limitations of this study are its small sample size and the fact that all teachers came from the public Jewish educational system. Obviously, more extensive studies are required, especially in preschools of different types, such as private schools, and in other regions of Israel and in other countries.

The main implication of this study is the vital need to strengthen preschool teachers’ scientific knowledge and their confidence in teaching this subject. This, in turn, can increase the importance that the teachers attribute to teaching S&T in the preschools. The practical and operational recommendations for promoting S&T in preschools and improving implementation of the program, which are derived from this finding, are detailed below.

First, extensive training should be conducted for preschool teachers in order to explain the contents and goals of the official S&T program in particular and the field of science in general. Second, preschool teachers should be provided with appropriate teaching materials and equipment for conducting scientific research activities, according to the program. Third, networks for professional advancement and social support of preschool teachers should be established, through which professional training will be held on scientific education. Such networks will strongly promote the science teaching in preschools, and highly benefit the young children - the next generation.

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