

# Correlation between Kindergarten Teachers' Attitudes toward Teaching Science and Their Teaching Practices

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**Abstract** The aim of this study is four fold: (a) to reveal the attitudes of kindergarten teachers in Jordan toward teaching science; (b) to explore their teaching practices of science according to the developmentally appropriate practices approach; (c) to study the impact of their educational qualifications, years of experience, and the type of Kindergarten they work at (public/private), on their attitudes toward teaching science and their teaching practices; and (d) to explore the relationship between their attitudes toward teaching science and their teaching practices in accordance with the developmentally appropriate practices approach. The results of the study indicate that teachers' attitudes toward science were positive. Moreover, the findings indicate statistically significant differences among the mean values of the teachers' scores on the teaching practices scale in science according to the type of Kindergarten (public/private) and in favor of teachers who work in private kindergartens. The findings further indicate that teachers' attitudes toward teaching science are considered to be a significant factor in predicting developmentally appropriate teaching practices in science.

**Keywords:** *kindergarten teachers, attitudes toward teaching science, teaching practices, developmentally appropriate practices*

**Cite This Article:** Eman Gheith, and Aseel Al-Shawareb, "Correlation between Kindergarten Teachers' Attitudes toward Teaching Science and Their Teaching Practices." *American Journal of Educational Research*, vol. 4, no. 4 (2016): 320-328. doi: 10.12691/education-4-4-5.

## 1. Introduction

The educators had an increased interest in the importance of starting to teach science in the early stages of an individual's life, especially with the increasing impact of science and technology on everyday life. If education aims to prepare individuals to face life, then it is of utmost importance for us to prepare individuals for a life in which science and technology play critical roles [1]. Therefore, educational systems should not only focus on preparing qualified scientists, technicians, and engineers, but also on preparing individuals who have wide knowledge and scientific literacy, creative, and possess a general and specific skills that enable them to adapt and face the challenges of a technological society that changes rapidly [2].

Many science educators and researchers have emphasized on the importance of teaching science in the early stages of a child's life. Harlen states that there is no longer a need to justify the position of science in early stage in a child's life, nor the need to persuade principals and teachers into acknowledging the importance of science; however, it is now necessary to assist teachers in starting and continuing to teach science to children, as well as overcome any difficulties that may arise [3]. Children possess the tools necessary for learning; for they are known for their curiosity and have an intrinsic motivation and desire to possess more knowledge, as well

as a passion for learning [4]. Children tend to explore objects and events that occur in their environment using different senses, and constantly raise many questions out of curiosity [5]; in addition to that they develop their ideas about the world in their first years of their life whether they do or do not study science, and they could develop a non-scientific ideas which hinder their learning later on unless teachers intervene at the right time [1]. Children are capable of forming cognitive constructs of what they experience in their environment and using terminology to describe the concepts and cognitive constructs they have formed (6), and that all they need is rich learning environment that allows them to deal with resources, events, and ideas related to science [7,8].

Providing children with scientific activities may have a positive impact on their academic level of achievement in higher classes [9], and on their comprehension of the surrounding environment [10]. Furthermore, it helps develop their language skills [11].

Teachers play significant roles in teaching science to children, as they have the capacity to provide children with rich environment for learning science [12,13], and giving them the opportunity for inquiry. In other words, the role of the teacher is to be:

- A facilitator by providing children with appropriate opportunities to learn and practice science processes skills.
- A helper to children through assessing their learning [14].

- A consultant who observes children, listens to their discussions, and answers their questions while they are involved in exploring.
- A role model by showing an interest in exploration and discovery, persistence, and creativity through science activities [7].

Since the majority of scientific concepts taught to young children are presented through activities, teachers' attitudes toward teaching science and their ability to present scientific knowledge through activities becomes vital and important.

### 1.1. Young Children and Developmentally Appropriate Science Education

The National Association for the Education of Young Children (NAEYC) emphasizes on the importance of developmental practices when working with children in different fields, and has asserted that education practices are more effective when they fit with the way a child learns and develops. Moreover, these documents highlight how critical it is to include scientific activities in kindergarten curriculum, so that children will have the opportunity to participate in developmentally appropriate activities through learning by doing, and have underlined the desire need to find teaching strategies in the early childhood stage that are consistent with the child's developmental needs [15]. This approach (DAP) has highlighted the importance of providing children with the opportunity to learn through play and the importance of designing appropriate learning environments that help students construct knowledge by themselves, having a variety of activities, choosing science experiences that are suitable to the child's environment, and using modern technology which has become an important part of the child's literacy at home and school [12]. It is possible to present science experiences in developmentally appropriate forms using a methods and strategies; some of these methods are:

- **Active learning:** Active learning is based on the theories of Dewey, Montessori, and Piaget; as they have all asserted that children construct their own knowledge through dealing with materials and tools whether done individually or cooperatively, and where children learn concepts, form ideas and create their terms [16].
- **Learning through play:** Play is considered to be one of the most successful contexts in the field of teaching science to children for the entertainment, joy, and benefit it provides to them. A play-based curriculum works to quench children's thirst for curiosity and provide opportunity for hands-on practices in a way that responds to their questions [17].
- **Hands-on, minds-on, hearts-on:** this approach focuses on the child as a whole, as the method is most effective when a child is intellectually, physically, and emotionally involved in an activity [18].

### 1.2. Teaching Science to Children

Children begin to acquire scientific and mathematical concepts, as well as the basic skills, in the early childhood

stage; they learn science in three different learning experiences: naturalistic, informal, structured [11]. Children require being guided and encouraged by teachers in order to turn their curiosity and activities into something more scientific. In other words, they need to participate in rich scientific inquiries [8], and this obligates teachers, while teaching science to children, to focus on three main components, which are: content, science processes skills, and scientific attitudes [11,19]. Young children gain new knowledge about the surrounding world, and this knowledge is constantly changing with every new discovery [6]. Children also need to develop basic science processes skills, which include the ability to observe, compare, categorize, measure, and communicate, and which are seen necessary to handle situations they might face in everyday life, and to be able to study science and mathematics when they move up to higher school levels [11]. Children also need the chance to reflect on the results they reach, and compare them with their previous ideas and the ideas of others. This is how children are encouraged to develop scientific attitudes such as curiosity, cooperation, persistence, and open mindedness.

### 1.3. Teachers' Attitudes toward Teaching Science

Attitude is commonly defined as "a psychological tendency to evaluate an object in terms of favourable or unfavourable attribute dimensions such as good/bad or positive/negative" [20]. Attitudes develop through interaction and experiences that an individual undergoes with his/her family, teachers, and peers. They are considered important in developing thinking in individuals, as well as that they impact the decisions an individual makes [21].

Researchers have highlighted the impact of teachers' attitudes toward science on their teaching practices, their thinking, and their understanding of science [22]. They are seen as a vital component in determining teaching practices [23]. Furthermore, teacher's attitudes toward teaching science play a major role with regard to the interests and attitudes of their students toward science, as teaching science that is activity-based, the quality of teaching, and teacher's positive attitudes toward teaching science all contribute to fostering positive attitudes in their students [24]. If, however, the teacher's attitudes toward teaching science were negative, then they would tend toward avoiding teaching science or resort to traditional methods of teaching, and it is quite possible that they could transfer these negative attitudes to their students [25,26].

Therefore, teaching science effectively in the early stages of a child's life requires that educators are able to identify obstacles related to the emotional aspect of the teacher, such as being fearful, hesitant, or uncomfortable with handling science more than it focuses on their intellectual competence in science [22].

Despite the wide acceptance and acknowledgement of the importance of the role played by science in early childhood, practices in numerous kindergartens are not consistent with that, as many teachers who work in kindergartens are hesitant about teaching science in their classrooms due to their previous unpleasant experiences in

the field of science. Others view science as a type of magic tricks they can show the children when they are bored or tired which does not lead to the construction of correct knowledge and does not represent actual science [14]. They might also spend less time for teaching science compared to other subjects [27], and focus on teaching lessons related to living beings while neglecting physics [28]. Moreover, they possess low levels of knowledge, facts, and skills related to science and display feeling of being unprepared to teach science compared to other educational subjects which is negatively reflected on their practices in teaching science inside the classroom [29], and generally regard science as a difficult subject which decreases their self-confidence and increases their refusal to teach science [12].

### 1.4. Review of the Literature

Despite the importance of teaching science in kindergartens, and the importance of teachers possessing positive attitudes toward teaching science, there still exists a lack of information regarding the reality of teaching science in kindergartens, their teaching practices, and their attitudes toward teaching science. A few studies have been conducted on teaching science in early childhood; one of them is the study conducted by Erden and Sönmez (2011) which aimed to explore kindergarten teachers' attitudes toward teaching science and their impact on the activities held by teachers for the students. Furthermore, the study explored the impact of educational level, experience, and type of the kindergarten (private/public) on the teachers' attitudes toward science. The findings pointed toward a slight correlation between attitudes and the activities conducted, as well as that educational level and experience have no effect on teachers' attitudes, and that the kindergarten's sector (private/public) was the most influential factor [7].

Timur (2012) has also researched teachers' attitudes toward teaching science and the influential factors, where the findings showed that teachers' attitudes were positive, and that their knowledge of the subject matter, as well as their positive science teaching experience, were the leading factors that influenced their attitudes toward teaching science [5].

At local level, Fayez and her colleagues (2011) conducted study to explore the perceptions of kindergarten teachers toward teaching science. The results showed that teachers' attitudes towards teaching science were good, the level of education, experience and the science courses taught by a teacher have no effect on their attitudes. Also, teachers allocate less than 30 minutes per week to teach science [27].

De Baz (2005), also conducted a study on the problems faced by kindergarten teachers when teaching science in classrooms in Jordan, where the findings indicated that Kindergarten teachers suffer from a lack of experience in presenting scientific activities, and face problems due to having access to only little teaching resources and the over-crowded classrooms, which all reflects negatively on their teaching practices [30].

Kalogiannakis and Violintzi (2012) conducted a study on intervention strategies for changing kindergarten children concepts about volcanos, where they investigated children's ideas about volcanos before and after the

teaching intervention by using the ancient Greek myth of Chimera. They used interviews and drawings to identify the children's ideas, the results showed that the children's ideas about volcanos became closer to the scientific model [31].

### 1.5. The Present Study

Teaching science in Kindergartens requires that there be a qualified and well-trained teacher. This poses quite a few questions regarding the efficiency of teacher education programs in Jordanian universities and community colleges in preparing trained teachers, and how effective in-service training programs really are. What are teachers' vision regarding teaching science? What are their attitudes toward teaching science? What are their teaching practices? This is critical because the teacher is the engine through which desired change may be achieved, and it is without doubt that the teacher's attitudes and beliefs about science play a major and significant role in making a change in accordance with the reform done by the Ministry of Education in Jordanian Kindergartens.

In addition, there is a lack in information regarding teaching practices in Kindergarten especially in science, whereas the majority of studies exploring teaching science to children focused on attitudes toward teaching science and the most influential factors, as well as the time allocated to science-based activities, whereas only a small these studies – especially at the local level – focused on the teaching practices of kindergarten teachers according to the developmentally appropriate practices approach, and how it relates to teachers' attitudes toward science. This study could contribute to highlighting teaching practices of Kindergarten teachers in Jordan, and their attitudes toward teaching science. It has aimed to investigate the correlation between in-service Kindergarten teachers' attitudes toward teaching science and their practice regarding science according to developmentally appropriate practices approach.

### 1.6. Operational Definitions

**Attitudes toward Teaching Science:** an emotional general disposition in which there are negative or positive feelings toward teaching science involving: Comfort-discomfort, classroom preparation, managing hands-on science, developmental appropriateness.

**Developmentally Appropriate Practice (DAP):** educational approach publicized by NAEYC in the field of early childhood education, enhance teacher to make choices about teaching children based on knowledge of how young children develop and learn while taking into consideration individual differences and needs as well as social and cultural constructs [32].

**Practice of Developmentally Appropriate in science:** science teaching practice addressing the following categories: A child-centered science environment, developmentally appropriate science activities, Assessment of children's learning of science [33]

### 1.7. Purpose of the Study

The purpose of this study is to investigate the correlation between Kindergarten teachers' attitudes

toward teaching science and their practice regarding science according to developmentally appropriate approach.

## 1.8. Study Questions

1. What are Kindergarten teachers' attitudes toward teaching science in Jordan?
2. Do the attitudes of Kindergarten teachers vary in accordance with their academic qualifications, years of experience, and the type of Kindergarten they work at (public/private)?
3. How often are developmentally appropriate teaching practices used in science by Kindergarten teachers?
4. Do the developmentally appropriate teaching practices of Kindergarten teachers in science vary in accordance with their academic qualifications, years of experience, and the type of Kindergarten they work at (public/private)?
5. Is there a correlation between the attitudes of Kindergarten teachers toward teaching science and how often they use developmentally appropriate teaching practices in science?

## 2. Methodology

### 2.1. Study tools

Two tools were used in this study:

- **A scale to measure Kindergarten teachers' attitudes toward teaching science.** The questionnaire developed by Cho et al. (2003) has been translated and adapted to Kindergarten teachers [19]. It consisted of 22 items, where the Cronbach Alpha was 0.92. The questionnaire was divided into four parts: comfort-discomfort (6 items), classroom preparation (6 items), managing hands-on science (5 items), and developmental appropriateness (5 items). With responses organized on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

The questionnaire was translated into Arabic and then reviewed by a group of specialists to ensure its adaptability to Jordanian environment to measure attitudes toward teaching science.

- **A scale to measure the developmentally appropriate teaching practices in Kindergarten teachers regarding science.** A literature review has been conducted in relation to developmentally appropriate teaching practices for children in the subject of teaching science to Kindergarten students. These practices were then organized into three categories, which are: a child-centered science environment (15 items), developmentally appropriate science activities (15) items, and assessment of children's learning of science (12 items).

The researchers had designed an initial questionnaire which consisted of 50 items, which was later reviewed by a group of specialists in Child Education, where a items were deleted while others were edited to that the finalized version of the questionnaire consisted of a total of 42 items that measure teachers' practices in teaching science.

With responses organized on a 3-point Likert scale ranging from 1 (never) to 3 (always).

### 2.2. Scale Reliability

The reliability coefficients of the Kindergarten teachers' attitudes toward teaching science scale and teaching practices scale have been calculated using Cronbach's Internal Consistency Alpha. The reliability value for the attitude questionnaire toward teaching science as a whole was (0.87). The reliability values for the four attitude sub-dimensions ranged from high to low: (0.65) for developmental appropriateness, (0.60) for classroom preparations, (0.55) for managing hands on science and (0.53) for comfort/discomfort.

Even though the reliability coefficients of some sub-dimensions were low, the majority of correlation values of other sub-dimensions were relatively moderate, which implies internal consistency of the overall questionnaire. The reliability value for the attitudes questionnaire was (0.87). These values are good indicators of the reliability of the scale.

The reliability coefficients of the Kindergarten teachers' developmentally appropriate teaching practices in science were calculated, where the reliability coefficient on the test as a whole reached (0.78), while the following values were calculated for each sub-dimension: a child-centered science environment (0.79); developmentally appropriate science activities (0.71); assessment of children's learning of science (0.67).

### 2.3. Study Population

The study population consisted of teachers working at both public and private Kindergartens in the city of Amman; 100 questionnaires have been distributed to Kindergarten teachers by the researchers in the second semester of the academic year 2013/2014. Of those 100 kindergarten teacher that had been contacted, 74 teachers returned the survey questionnaire to the researchers. The 74 kindergarten teachers who replied to the researchers were determined to be the sample of this study.

### 2.4. Study Sample

The study sample consisted of 74 teachers who work at Kindergartens in the city of Amman, where 28 of these teachers work at public Kindergartens governed by the Ministry of Education in Jordan (38%), and 46 who work at private Kindergartens (62%). Table 1 below demonstrates the distribution of the participants according to the variables in this study:

**Table 1. Distribution of participants in respect to academic qualification, experience, and the type of kindergarten**

	Degree	Public kindergarten N = 28	Private kindergarten N = 46	Total N = 74
Degree	Diploma	2	11	13
	Bachelors	22	34	56
	Masters	4	1	5
Experience	Less than 5 years	16	24	40
	6-10 years	10	16	26
	10 years and more	2	6	8

### 3. Data Analysis

#### First Question: What are Kindergarten teachers' attitudes toward teaching science in Jordan?

To answer this question, the mean and standard deviation values for teachers' scores on the attitudes toward teaching science scale as a whole and on all four sub-dimensions (developmental appropriateness, classroom preparation, comfort-discomfort, & managing hands-on science) have been calculated. Table 2 shows these values.

**Table 2. Means, Standard Deviations, and percentages of Kindergarten teachers' scores on Attitudes toward Teaching Science Scale as a whole and on all four sub-dimensions**

Attitudes toward teaching science sub-dimensions	No. of items	mean	SD	Percentage %
Comfort-discomfort	6	4.17	0.47	83%
Classroom preparation	6	3.98	0.46	80%
Managing hands-on science	5	3.98	0.60	80%
Developmental appropriateness	5	4.04	0.62	81%
Overall scale	22	4.05	0.41	81%

It is clear from Table 2 that Kindergarten teachers' attitudes toward science tend to be positive, as the mean scores of teachers on the scale as a whole and on all four sub-dimensions ranged between 3.98 and 4.17, with percentages ranging between 80-83%, and where the mean value of students' scores on the scale as a whole was 4.05 with a percentage of 81%.

In regards to the sub-dimensions of the scale, the highest mean scores was acquired from the items of the

first sub-dimension (comfort/discomfort), with the percentage of 83%, while the data shows that Kindergarten teachers rated lowest on the two sub-dimensions (classroom preparation) and (managing hands-on science).

Second Question: Do the attitudes of Kindergarten teachers vary in accordance with their academic qualifications, years of experience, and the type of Kindergarten they work at (public/private)?

To study the effect of the Kindergarten type (public/private), academic qualifications and years of experience on the attitudes of Kindergarten teachers in teaching science, means, standard deviations, and percentages of teachers' scores on the scale as a whole and on each one of its four sub-dimensions in relation to the three aforementioned variables have been calculated. The results are displayed in Table 3.

It can be seen from Table 3 that the mean scores of teachers working at private Kindergartens were higher on the scale as a whole and on 3 sub-dimensions: comfort-discomfort, classroom preparation, and developmental appropriateness.

The t-values have been calculated to determine whether these differences were statistically significant, which is also shown in Table 3. It can be noticed from the table that the differences among mean values were indeed statistically significant ( $\alpha=0.025$ ) on the developmental appropriateness dimension and in favor of teachers who worked in the private sector. This indicates that Kindergarten teachers' attitudes in the private sector were more positive than those of teachers in the public sector in that dimension.

**Table 3. Means, standard deviations, and percentages of the teachers' scores on the Attitudes toward Teaching Science Scale on the three variables (kindergarten type, academic qualifications and years of experience)**

Attitudes sub-dimension	Comfort-discomfort			Classroom preparation			Managing hands-on science			Developmental appropriateness			Total		
	M	SD	%	M	SD	%	M	SD	%	M	SD	%	M	SD	%
kindergarten type															
Public (N=28)	4.04	0.46	81	3.90	0.42	78	4.02	0.69	80	3.84	0.55	77	3.95	0.40	79
Private (N=46)	4.25	0.47	85	4.02	0.48	80	3.96	0.57	79	4.17	0.64	83	4.10	0.41	82
t	-1.843			-1.063			0.419			-2.293			-1.524		
sig	0.069			0.291			0.676			0.025			0.132		
educational qualification															
Intermediate Diploma (N=13)	4.08	0.54	82	3.82	0.71	76	3.75	0.58	75	3.88	0.73	78	3.89	0.52	78
B.A (N=56)	4.18	0.47	84	4.01	0.39	80	3.99	0.59	80	4.08	0.61	82	4.07	0.39	81
M.A (N=5)	4.33	0.33	87	4.00	0.35	80	4.48	0.46	90	4.12	0.54	82	4.23	0.31	85
F	0.55			0.92			2.81			0.56			1.52		
Sig	0.58			0.40			0.07			0.57			0.23		
years of experience															
Less than 5 years (N=40)	4.03	0.52	81	3.88	0.51	78	3.88	0.61	78	3.86	0.70	77	3.91	0.46	78
6-10 years (N=26)	4.35	0.33	87	4.14	0.34	83	4.16	0.61	83	4.28	0.44	86	4.23	0.28	85
More than 10 years (N=8)	4.29	0.39	86	3.92	0.45	78	3.95	0.45	79	4.20	0.41	84	4.09	0.34	83
F	4.214			2.675			1.858			4.378			5.309		
Sig	0.019			0.076			0.164			0.016			0.007		

Furthermore, data in the table indicates that the attitudes toward teaching science of those Kindergarten teachers who had obtained an M.A were more positive on the scale as a whole and on its 4 sub-dimensions, as the mean of teachers who had obtained an M.A on the scale as a whole was 4.23 (with a percentage of 85%); whereas the mean of teachers who had obtained a B.A only reached

4.07 (with a percentage of 81%); teachers who hold a Diploma degree only had less positive attitudes toward teaching, with a mean of 3.87 (and a percentage of 78%).

ANOVA analysis of variance was used to pinpoint any existing statistically significant differences among the mean scores of Kindergarten teachers respect to the academic qualification variable.

Table 3 demonstrates the F-values; the findings indicate that the differences in mean with respect to the academic qualification variable were not statistically significant.

Moreover, the data shows that the means of the overall scale and on each of its sub-dimensions were higher in teachers who had a moderate years of experience (with a mean of 4.23, and a percentage of 85%), followed by teachers with a high years of experience, where the mean value of teachers who had more than 10 years of experience was 4.09 (with a percentage of 82%); whereas teachers who had less than 5 years of experience had the lowest mean value of all (3.91, with a percentage of 78%).

To determine whether these differences were statistically significant on the years of experience variable, an ANOVA analysis of variance test has been conducted. Table 3 shows the F-values and how significant they were. It can be noticed that the differences were indeed statistically significant for the means of teachers on the years of experience variables, in favor of teachers who had a moderate experience years in teaching on the scale as a whole ( $\alpha=0.007$ ). Significant differences also existed on the first and fourth sub-dimension with a significance level ( $\alpha$ ) below 0.02.

In addition to, Post Hoc Comparisons were conducted using Scheffe' Test. The results indicated significant differences between the mean scores of teachers on the overall scale in favor of teachers who had moderate experience compared to those who had less than 5 years of teaching experience with a significance level of  $\alpha = 0.025$ , and on the first (comfort-discomfort) and fourth (developmental appropriateness) sub-dimensions at a significance level ( $\alpha$ ) below 0.03.

**Third Question:** How often are developmentally appropriate teaching practices used in science by Kindergarten teachers?

To answer the third question, the means, standard deviations, and percentages of the Kindergarten teachers' scale on each item on the scale have been conducted. Appendix 1 shows the results obtained.

Means, standard deviations, and percentages of the participants' scores on the teaching practices scale as a

whole and on each of its sub-dimensions have been conducted also. Table 4 shows the results.

**Table 4. Means, standard deviations, and percentages of the teachers' scores on the Teaching Practices Scale**

Teaching Practices sub - dimension	No. of items	Mean	SD	percentage
A child –centered science environment	15	2.59	0.26	86%
Developmentally appropriate science activities	15	2.24	0.28	75%
Authentic science assessment	12	2.56	0.26	85%
Overall scale	42	2.46	0.23	82%

As illustrated in Table 4, the mean scores of the study sample on the scale as a whole reached 2.46 (with a percentage of 82%); as for the sub-dimensions of the scale, the participants obtained the highest mean value on the first sub-dimension (a child-centered science environment) with a percentage of 86%; whereas the participants obtained lower means on the second sub-dimension (developmentally appropriate science activities) with a mean of 2.24 (and a percentage of 75%), which implies that the extent to which teachers use developmentally appropriate science activities was of a moderate degree.

**Fourth Question:** Do the developmentally appropriate teaching practices of Kindergarten teachers in science vary in accordance with their academic qualifications, years of experience, and the type of Kindergarten they work at (public/private)?

To study the effect of the Kindergarten type (public/private), academic qualifications and years of experience on the extent of developmentally appropriate teaching practices in Kindergarten teachers when teaching science, the means, standard deviations, and percentages of the their scores on the scale as a whole, as well as on its three sub-dimensions, on the three variables have been calculated. Table 5 shows the results.

Table 5 points out that the mean scores of teachers who work in private kindergartens on developmentally appropriate teaching practices scale as a whole, as well as on each of its sub-dimensions were higher than those of teachers who worked in public Kindergartens.

**Table 5. Means, standard deviations, and percentages of teacher's scores on the Teaching Practices Scale on the Kindergarten type, educational qualification, and experience variables**

Teaching Practices Sub-dimension	A child–centered science environment			Developmentally appropriate science activities			Authentic science assessment			Overall scale		
	M	SD	%	M	SD	%	M	SD	%	M	SD	%
Kindergarten type												
public (N=28)	2.56	0.32	85	2.06	0.23	69	2.45	0.27	82	2.35	0.24	78
Private(N=46)	2.61	0.22	87	2.34	0.26	78	2.62	0.23	87	2.52	0.20	84
t	-0.842			-4.702			-2.899			-3.204		
sig	0.402			0.000			0.005			0.002		
educational qualification												
Intermediate Diploma (N=13)	2.53	0.30	84	2.21	0.32	74	2.54	0.22	85	2.42	0.25	81
B.A (N=56)	2.60	0.26	87	2.25	0.28	75	2.57	0.27	86	2.47	0.23	82
M.A (N=5)	2.63	0.29	88	2.19	0.17	73	2.45	0.21	82	2.42	0.18	81
F	0.409			0.158			0.524			0.261		
Sig	0.666			0.854			0.595			0.771		
years of experience												
Less than 5 years (N=40)	2.55	0.31	85	2.21	0.32	74	2.55	0.25	85	2.43	0.26	81
6-10 years (N=26)	2.64	0.19	88	2.27	0.26	76	2.56	0.29	85	2.49	0.20	83
More than 10 years (N=8)	2.65	0.21	88	2.25	0.14	75	2.56	0.25	85	2.48	0.15	83
F	1.147			0.464			0.012			0.575		
Sig	0.323			0.631			0.988			0.566		

To investigate whether these differences had a statistical significance, the t-values, which can also be seen in Table 5 have been calculated. The table reveals

that these differences were indeed statistically significant with a significance level ( $\alpha$ ) below 0.005, and in favor of teachers who worked in private Kindergartens on the scale

as whole, and on the two sub-dimensions (developmentally appropriate science activities & authentic science assessment), which mean that the extent to which developmentally appropriate teaching practices are used among Kindergarten teachers in the private sector were higher than those in the public sector.

As for the variable of education qualification, the results shown in the table indicate small differences among the means of the participants on the test as a whole as well as on its sub-dimensions.

The F-values have been calculated, and the results indicated that there were no statistically significant differences with respect to the educational qualifications of the teachers on their use of developmentally appropriate teaching practices when teaching science to children.

Furthermore, in regard to the variable of experience years, Table 5 indicates that teachers with moderate and high experience had slightly higher mean scores than those with low experience.

After calculating F-values, the results indicate that no statistically significant differences exist for the years of experience variable on the extent to which Kindergarten teachers use developmentally appropriate teaching practices when teaching science to children.

**Fifth Question:** Is there a correlation between the attitudes of Kindergarten teachers toward teaching science and how often they use developmentally appropriate teaching practices in science?

To test the correlation between Kindergarten teachers' attitudes toward science and the extent to which they use developmentally appropriate practices, the researchers have conducted the simple linear regression method. The results are shown in Table 6.

**Table 6. Regression analysis (dependent variable: Developmentally Appropriate Teaching Practices)**

	Estimated Coefficient	Standard error	t	p-value
constant	0.932	0.198	4.702	0.00
Attitudes toward science teaching	0.376	0.049	7.718	0.00
Determination coef.R2	0.45			
F (p-value)	59.57 (0.00)			

Table 6 shows that teachers' attitudes toward teaching science are of a statistical significance in predicting the use of developmentally appropriate practices. As shown in the table, 45% of the variability in developmentally appropriate practices is predictable through the relationship with attitudes toward science, and the  $R^2$  value that has been calculated 0.45, and this is considered to be moderate variability in predicting the developmentally appropriate practice in science with attitudes toward teaching science.

## 4. Discussion

This study aimed to explore the correlation between Kindergarten teachers' attitudes toward teaching science, and their teaching practices, in Jordan through the Developmentally Appropriate Teaching Practices Approach, and the effect of the Kindergarten type (private/public), the academic qualification, years of experience on teachers' attitudes toward teaching science and on their developmentally appropriate practices.

The findings indicate that Kindergarten teachers possess positive attitudes toward teaching science. These findings are in accordance with the findings of several studies [5,7,27].

The study also showed that the level of developmentally appropriate teaching practices of science in kindergarten teachers on the scale as a whole and on the two dimensions: a child – centered science environment and authentic science assessment was high, while the lowest level was in developmentally appropriate science activities dimension.

The high level of developmentally appropriate practices of science in Kindergarten teachers could be due to how much more emphasis teacher preparation programs in Jordanian universities and the Ministry of Education have lately put on the developmentally appropriate practices approach in Kindergartens, as it has been included in courses taught within the Kindergarten teacher preparation programs at universities as well as in in-service teachers training programs.

As for the dimension of "developmentally appropriate science activities", low levels may be due to insufficient courses on methods of teaching science in teacher training programs. This reflects negatively on teachers' abilities to choose and introduce appropriate activities for the children. Also the implementation of such activities requires teachers to coordinate with kindergarten administrations and other institutions in order to arrange for outdoor experiences. Moreover, a few kindergarten teachers are not sufficiently qualified, and the implementation of some activities requires the use of modern technology tools that may not be available in some kindergartens. Another point worth mentioning is that teachers may have traditional beliefs about teaching science which affects their teaching practices.

Furthermore, the study did not find statistically significance differences in teachers' attitudes toward teaching science on the Kindergarten type variable. This is not consistent with [7], as they asserts that private kindergarten teachers had more positive attitudes toward teaching science compared to teachers working in the public type.

As for developmentally appropriate teaching practices in science, the findings indicate statistically significant differences on the Kindergarten type variable and in favor of teachers in the private Kindergarten. This could be due to the fact that public Kindergartens in Jordan have only been established recently, and might not be able to provide all material and tools necessary to conduct science-based activities based on the developmentally appropriate teaching practices approach [30], while private Kindergartens are more interested in providing all necessary resources and equipment for science experiences, and tend to provide a more suitable classroom environment. Additionally, many private Kindergartens give their teachers the opportunity in attending training courses and seminars to keep up with new pedagogical practices, as well as providing professional supervisors who follow up with teachers' performance on, and teachers' contracts are renewed annually based on their performance throughout the year, which is done to as a form of quality control, and to help teachers improve their performance, professional development, and interest in their students.

The findings regarding educational qualifications have shown unexpected results, as the study indicate that there are no statistically significant differences on the educational qualification variable on teachers' attitudes toward science. These findings are consistent with [7,27]. The findings also indicate that there are no statistically significant differences on the educational qualification variable on their developmentally appropriate teaching practices in teaching science.

This may be due to the fact that teachers who had obtained an M.A degree did not exceed 7%, or due to the fact that teacher preparation programs— whether B.A or M.A – do not put enough emphasis on teaching science, nor do they provide an appropriate courses on science or teaching methods, which would have been helpful to teachers in teaching science through the Developmentally Appropriate Teaching Practices Approach, and would develop their attitudes toward teaching science. Additionally, these programs do not focus on hands-on activities when teaching science to the pre-service teachers.

As for years of experience, the findings showed that teachers who had moderate experience had more positive attitudes toward teaching science on the scale as a whole, and on the two sub-dimensions: Comfort and Development.

These findings differ from those shown in a other studies, as a research papers indicate that years of experience had no influence on teachers' attitudes toward science [27], whereas some studies indicate that years of experience have an impact, in favor of teachers with the least experience [7].

## 5. Recommendations

- Conducting a Qualitative study to explore how teachers may present developmentally appropriate practices through observing teaching practices in Kindergarten teachers in classrooms, or through conducting interviews with them to study their pedagogical skills in teaching.
- Conducting a Qualitative study focused on observation and interviews to identify the factors that impact teachers' attitudes toward teaching science.
- Teacher preparation institutions should test pre-service teachers' attitudes toward teaching, and provide the necessary assistance to them on the hands of university professors or teachers from cooperative schools in case their attitudes were negative.
- Introducing courses for in-service teachers in teaching methods in the field of science, where teachers are given the opportunity to participate in hands-on activities, seminars, and workshops to increase their self-confidence and expand the knowledge they already have.
- Focusing on more practice-based courses in the teacher preparation programs prior to service, so that students would have the opportunity to try out what they have learned in theoretical courses, and increase the science courses in university course plans.
- Conducting studies to explore appropriate teaching methods to improve teachers' attitudes toward teaching science.
- Providing pre-service and in-service teachers with more activities related to science, familiarize them with science teaching methods, and enrich their scientific knowledge, which leads to more developmentally appropriate attitudes toward teaching science to children.

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#### Appendix 1. Mean and standard deviation of the study sample grades on a scale of Developmentally Appropriate Teaching Practices

Item	Mean	S.D
1	2.89	0.31
2	2.85	0.36
3	1.54	0.73
4	2.20	0.68
5	1.85	0.84
6	1.72	0.69
7	2.51	0.65
8	2.78	0.45
9	2.66	0.56
10	2.77	0.45
11	2.84	0.37
12	2.61	0.54
13	2.81	0.39
14	2.69	0.49
15	2.74	0.44
16	2.74	0.44
17	2.57	0.58
18	2.66	0.53
19	2.88	0.40
20*	1.65	0.77
21	2.66	0.50
*22	1.68	0.76
23	2.18	0.75
*24	1.38	0.61
25	1.55	0.72
26	2.26	0.78
27	2.65	0.53
28	2.84	0.37
29	2.53	0.53
30	2.80	0.40
31	2.00	0.81
32	2.39	0.70
33	2.68	0.53
34	2.66	0.58
35	2.66	0.50
36	2.77	0.45
37	2.77	0.42
38	2.76	0.43
39	2.66	0.48
40	2.72	0.48
*41	2.09	0.81
42	2.47	0.58

\*statements were built negatively