

## **Jordanian Early Childhood Teachers' Perspectives Toward Science Teaching and Learning**

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### **Abstract**

*The purpose of this study was to examine Jordanian early childhood teachers' perspectives toward science teaching and learning and understand the contextual lived science experiences as realized by teachers in early childhood settings. The study has utilized mixed methods approach. An Arabic-validated version of the Early Childhood Teachers' Attitudes toward Science Teaching questionnaire was completed by 101 early childhood teachers who were randomly selected from preschools and kindergartens in Zarqa city; one of the biggest and highly populated cities in Jordan. Follow-up in-depth interviews were then conducted with 15 teachers who were randomly selected from the teachers whose permission was granted through collected questionnaires. Findings of the quantitative part of this study indicate that Jordanian early childhood teachers hold, in general, positive attitudes toward science. None of the variables (i.e., number of years of experience, qualification level of the teachers and number of science courses taken) had significant effect on the teachers' attitudes. Despite the reported positive attitudes, most teachers in this study reported that they allocate an average of less than 30 minutes per week to the teaching and learning of science in their early childhood classrooms. Qualitative data analysis helped in contextualizing the questionnaire findings. Three major themes emerged through constant comparative analysis of the interviews' transcripts: comfort and confidence in light of contextual experience, science instructional practices, and reasons behind the limited instructional time dedicated to science. This research paper ends by considering the role of the continuous professional development and pre-service teacher preparation programs in upgrading early childhood teachers' attitudes toward science teaching and learning.*

### **Introduction**

Educators and researchers advocate providing children with meaningful and relevant science experiences at a very young age since they are biologically prepared and motivated to learn about the world around them (French, 2004). According to Patrick, Mantzicopoulos, and Samarapungaven (2008), early meaningful participation in science is likely to promote children's motivation for science in subsequent stages of life. Furthermore, research has shown that a well-developed approach to science instruction that frequently engages children in developmentally appropriate science activities at the preschool and kindergarten level enhances children's scientific learning with regard to concept complexity, content knowledge of science (Tenenbaum, Schlichtmann, & Zanger, 2004), and is positively associated with higher levels of science achievement at consequent grades (Eshach & Fried, 2005; Kumtepe, Kaya, & Kumtepe, 2009). From a different angle, engaging young children in enriching science activities has been found to be beneficial in enhancing children's knowledge about the surrounding world and in developing critical areas of language and early literacy (Conezio & French, 2002; French, 2004; Peterson & French, 2008).

The growing consensus over the importance of science for young children has urged researchers and educators to scrutinize the teaching and learning of science in the early grades, especially in preschools and kindergartens. While some educators question the quantity of instructional time that is allocated to science in the earliest grades, others question the quality and appropriateness of science activities provided for children (e.g., Edington, 1996; Kumtepe et al., 2009; Patrick et al., 2008; Tilgner, 1990).

Because the teacher influence the scientific knowledge, skills, and attitudes that young children acquire at an early age, recent research have been focusing on investigating several teacher-related factors and characteristics that affect both the quality and quantity of science teaching in the classroom. One prime teacher-related factor that was found to affect both the quality of science teaching and the time dedicated to science in the classrooms is teacher's attitudes and beliefs (Spooner, 1981). Positive attitudes and beliefs define teachers' commitment to creating time for science instruction and providing children with meaningful science experiences (Gess-Newsome, 1999). According to Jones and Carter (2007), attitudes and beliefs play significant roles in shaping teacher's instructional practices and decisions in a science classroom. Considering the vital role of teachers' perspectives including their attitudes and beliefs toward science, educators continue to call for research to examine more carefully how teachers of young children perceive the teaching and learning of science (Jones & Carter, 2007).

In Jordan, the relatively recent interest on reforming the field of early childhood education was coupled with an interest in professionalizing teachers and equipping them with appropriate competencies that are needed to achieve quality instruction in all subject areas including science. While teachers are viewed as a driving force for change and renovation within the evolving context of current early childhood reform policy in Jordan, they may also be major obstacles to change due to their negative attitudes and traditional beliefs (Fullan, 1982; Plonczak, 2008). There is a lack of knowledge about how Jordanian early childhood teachers perceive the teaching and learning of science and the meanings they generate out of their lived science experiences in the classrooms. Therefore, the aim of this study was two fold. Firstly, to explore the attitudes of Jordanian early childhood teachers working with 4-5 year old children. Secondly, to provide an in-depth account of teachers' contextual and lived science experiences and the way those experiences affect both their attitudes and practices in relation to science teaching and learning. Specifically, this study attempted to answer the following research questions:

1. What are the attitudes of Jordanian early childhood teachers toward science?
2. What is the approximate instructional time dedicated to science in early childhood settings?
3. Are there significant differences between teachers' attitudes ascribed to years of teaching experience, number of science courses taken, and teacher's level of qualification?
4. What are the contextual factors that affect early childhood teachers' attitudes toward science and the instructional time they provide for science in their classroom?

In what follows, we first present a literature review that is related to science education and young children, followed by a review of literature about teachers' perspectives toward science education.

### **Science Education and Young Children**

Several development theories emerged over the past several decades. These theories, including Piaget's (e.g., 1969) and Vygotsky's (1986) theories of concept development have influenced science

education based on recognition of the way children construct scientific understanding. They have presented a shift into a new paradigm of science teaching and learning that contrasted the "fact-transmission" and teacher-centered approaches which, according to Plonczak (2008), historically dominated science classrooms.

The shift also builds on the active role of the learners in constructing their own knowledge. Hence, under the new paradigm, science is no longer viewed as a discrete body of knowledge, formulas, and facts. Rather, real science, according to Conezio and French (2002), involves content, process skills, and attitudes.

The recent approach to science education encompasses a process of exploration and active involvement with the environment (Landry & Foreman, 1999; Watts, 1997). Creating an environment where children are allowed to observe, predict and argue with the science content being learned is essential and enhances children's participation in school science discourse (Cassata-Widera, Kato-Jones, Duckles, Conezio, & French, 2008). Furthermore, it helps teachers build on students' natural curiosity and interest in the world around them (Ross, 2000).

While good science instruction in the early grades has been described differently throughout literature, some common themes are pervasive and require early childhood teachers to:

- 1- Infuse science into the daily classroom life through integrative early childhood curriculum (Bosse, Jacobs, & Anderson, 2009; Hachey & Butler, 2009).
- 2- Make science real and relevant through tapping on children's funds of knowledge and prior experiences and choosing age-appropriate activities (Hachey & Butler, 2009)
- 3- Build higher order thinking skills and positive approaches to learning through exploration and inquiry that requires children to practice process skills of predicting, observing, classifying, hypothesizing, experimenting and communicating (Cassata-Widera et al., 2008; Gallas, 2009; Gelman & Brenneman, 2004; National Research Council, 1996).
- 4- Choose science topics and content that build on children's interest, curiosity, and enthusiasm and keep activities concrete and simple (Pick, 2002).

### **Perspectives and Science Education**

Gess-Newsome (1999) has identified teachers' perspectives including their attitudes and beliefs as one attribute that is necessary to create quality science experiences in the classroom, which consequently, should be taken into account in the professional development of teachers. Cho (1997) surveyed 128 early childhood teachers from New York City and interviewed 13 teachers who were identified as having positive attitudes toward science and 11 who were identified as having negative attitudes toward science. The study results indicated that although early childhood teachers' attitudes toward science were somewhat positive, there were many teachers who felt uncomfortable with teaching science for young children. In a U.S. nationwide telephone survey conducted through Bayer Corp. (1995) with teachers of children in kindergarten through fifth grade to measure their attitudes toward science education, elementary teachers reported that they feel well qualified to teach all major subjects but less qualified to teach science. Furthermore, the majority of teachers surveyed felt that the current emphasis on science education at schools should increase and most felt that there should be an increase in the use of the hands-on approach to science instruction. Similar sentiments were expressed by primary teachers in Scotland who felt less confident teaching science than teaching English and other subject areas (Harlen, 1997).

Teachers may feel uncomfortable teaching science to children due to a lack of content and pedagogical knowledge in science which inhibit their ability and motivation to create meaningful science experiences for children (Cho, 1997; De Baz, 2005; Edington, 1996; Watters, Diezmann, Grieshaber, & Davis, 2001). Studies on teachers' perspectives and attributes indicate that teachers, especially teachers of early grades, have concerns toward teaching science and, hence, call upon teacher preparation programs to integrate the learning of science and the pedagogy necessary to enhance science education for young children (e.g., Bitner, 1990; Copley & Padron, 1998; Watters & Ginns, 1995).

For example, Garbett (2003) surveyed and tested early childhood pre-service teachers in New Zealand and found that most pre-service teachers perceived themselves less confident and competent in teaching science to children than any other subject area. Furthermore, pre-service teachers tended to overestimate their competence in science as compared to their actual tested science competence indicating that they were unaware of how little they knew and how this might affect their ability to enrich their classrooms with meaningful science experiences for young children.

While the bulk of research on teacher attributes and characteristics and their effect on science teaching and learning exist less in the field of early childhood education than in the elementary grades, there has been an emerging increased interest in exploring the effects of teacher-related factors on early childhood learning opportunities. Among the few studies that have examined the impact of teacher attributes and characteristics as they relate to the teaching of science in early childhood was the study of Faulkner-Schneider (2005). The focus of Faulkner-Schneider's study was to explore childcare teachers' attitudes, beliefs, and knowledge regarding science and the impact on early childhood learning opportunities. The researcher surveyed 778 teachers working in child care centers in Oklahoma and found that the more positive the teachers' attitudes/ beliefs about science and science teaching, the more frequently different types of science activities were provided in the classroom. The study also found that the more the teachers' knowledge of science and science teaching, the more frequently different types of science activities were provided in the classroom. In a similar line of research, Spooner (1981) found that teachers who have more positive attitudes toward science dedicate more time to instructing science than teachers with less positive attitudes.

From a different angle, Harlen (1997) pointed out that primary teachers who report less confidence in teaching science enact certain instructional practices. They may 1- avoid teaching it, 2- continue teaching topics where they feel more confident toward, 3- emphasize process outcomes rather than conceptual understanding, 4- focus on the simplest science activities, 5- rely on textbooks, and 6- emphasize direct teaching rather than directive teaching.

## **Context of the Study**

Recently, Jordan has launched policy and reform initiatives to enhance early childhood education. In 2003, the government of Jordan initiated the Education Reform for the Knowledge Economy project (ERfKE 1) that evolved into another 5-year project (ERfKE 2) in 2009 (Ministry of Education, 2010). One of the components of the ERfKE project is to expand and promote quality early childhood education to enhance children's readiness for elementary education through building the capacity of kindergarten teachers and administrators, and promoting quality in early childhood programs (Kaga, 2007).

In 2004, the Ministry of Education (MoE) prepared the National Interactive Kindergarten Curriculum as part of its larger action plan for early childhood (Abu Taleb, Al-Sayeg, & Al-Sady,

2004). The curriculum provides teachers with a wide range of science activities that allow students to explore directly the world around them. The science activities included in the curriculum offer children with the opportunity to practice some basic science process skills including observing, classifying, collecting and experimenting. Moreover, the science activities integrate into the many facets of the programs, like religion, language, math and computers.

Although the MoE incorporated science in the early childhood curriculum, this curriculum has only been applied in the public kindergartens, which constitute only a small segment of the overall number of early childhood settings in Jordan. It is note worthy that most of the preschool and kindergarten educational services in Jordan are still provided by the private sector (UNESCO, 2006) which constitutes the mainstream education for most Jordanian children especially in big cities that are highly populated. Furthermore, we still lack information on early childhood teachers' capacity of and attitudes toward teaching science. Therefore, this study is expected to add to the very limited knowledge on teachers' perspectives toward science teaching and learning in early childhood.

## **Methodology**

This study employed a mixed-methodology design utilizing both quantitative and qualitative data collection methods. The use of mixed-methodology design is believed to be legitimate in this study, as according to Creswell (1998), it helps to overcome the weakness of one methodology through building on the strength of the other.

## **Study Participants**

The sample in the quantitative part of this study consisted of 101 early childhood teachers working in preschools and kindergartens of Zarqa, which is one of the largely populated cities in Jordan. Specifically, random stratification based on the three education directorates of Zarqa city was conducted to ensure representing the ratio of early childhood teachers in each directorate. One hundred and forty questionnaires were distributed and only 101 were returned back. The return rate was (72 %).

With regard to the teachers' level of education, 70 % of the teachers in this study had a secondary to diploma level of education while only 29.7 % of them had an undergraduate or graduate degree. As for the number of years of experience, 49.5 % of the teachers had 1-3 years of experience, compared to only 23.8 % who had 4-6 years of experience and to 26.7 % who had more than 6 years of teaching experience. It is note worthy that all early childhood teachers included in the sample are females since they constitute 100 % of early childhood teachers working in early childhood settings in Jordan (MoE Statistics, 2010).

For the qualitative part of this study, follow-up individual interviews were conducted with 15 teachers who were randomly selected from the overall number of participants whose permission to conduct the interviews was granted through the collected questionnaires. The 15 teachers varied in their educational levels (i.e., four of them had a bachelor degree while eleven had a secondary to diploma certificate). Furthermore, teachers varied in their majors (i.e., five of them had their educational degrees (diploma) in different majors, like Arabic literacy, math, social studies, and English, three had a diploma in science, two were certified as classroom teachers and only two had a bachelor degree in early childhood). As for the teaching experience, seven teachers had 1-3 years of experience, five had 4-6 years of experience and three had more than 6 years of experience in teaching early childhood.

### **Data collection methods**

This study implemented an Arabic-validated version of the Early Childhood Teachers' Attitudes toward Science Teaching questionnaire (Cho, Kim, & Choi, 2003). The original English questionnaire included 22 items covering four subscales: comfort/discomfort, classroom preparation, managing hands-on science, and developmental appropriateness. Translation and back translation was employed to the original English version of the questionnaire by the research team who were fluent in both Arabic and English languages. The focus during back translation (i.e., translating the Arabic version back to English) was to judge whether the content of the items was maintained. To establish content validity, the questionnaire was given to 9 judges who were experts in the field of early childhood and science education including teachers and Ph.D. holders in the Jordanian universities and the Ministry of Education. One item from the original scale (I am comfortable using any classroom materials for science activities) was deleted, some items were reworded, and four new items (marked with a star in the appendix) were added based on the judges' suggestions. To determine the internal consistency of the questionnaire, Cronbach  $\alpha$  was calculated after pilot testing the questionnaire on 30 early childhood teachers who were randomly selected from the study population. The reliability index for the scale was (.76) which is considered an acceptable level of reliability.

The final Arabic version of the questionnaire comprised of two parts. The first part contains demographic information (i.e., teachers' level of education, number of years of experience, and specialization) and a question asking teachers to identify the instructional time they provide to teaching science on a weekly basis. The second part included 25 items that measured early childhood teachers' attitudes toward science on four subscales: comfort/discomfort, classroom preparation, managing hands-on science, and developmental appropriateness. The questionnaire had a closed-response format expressed in a Likert-type scale with a scoring that ranged from "1" for "strongly disagree" to "5" for "strongly agree." All negative items were reverse coded.

For the qualitative part, the study utilized open-ended, semi-structured interviews that allowed new questions to be brought up during the interviews. An interview protocol was developed and included questions that cluster around the research questions and some items from the questionnaire that needed clarifications. For example, some of the questions were: Do you think the time you provide to teaching science is enough? What factors play in your time/planning decision? How do you feel when you teach science? All interviews were tape-recorded with the consent of the participants and then transcribed verbatim.

### **Analysis of Data**

The quantitative data in this study were analyzed through the SPSS package using descriptive statistics (i.e., means and standard deviations) to summarize the data set. Furthermore, one-way analysis of variance (ANOVA) was conducted to examine if there were significant differences among teachers' attitudes toward science ascribed to some selected independent variable (i.e., years of teaching experience (having three levels), number of science courses taken (i.e., having three levels), and teacher's level of qualification (having two levels)).

Constant comparison analysis was followed in analyzing interview transcripts. Specifically, we followed pattern coding as outlined by Miles and Huberman (1994). This approach included manual interview coding according to significant patterns and themes that were common across participants. For example, after several readings of the transcripts and the interview notes taken during the interviews' recording, the researchers color coded the individual interviews and identified patterns within and among interview transcripts. This process was done individually by each member of the

research team to validate generated themes. Attention was given to note negative cases among participants. The process of pattern coding as suggested by Miles and Huberman helped in reducing the large amount of data to smaller numbers of analytical units and facilitated more meaningful cross-case analysis by “surfacing common themes and directional processes” (p. 96) within and among participants. It is worth noting that all interviews were conducted, transcribed and analyzed using Arabic language. The emerging themes and some selected excerpts were translated into English. To establish credibility in the research analysis, the identified common themes along with the interview transcripts were given back to participants who verified the accuracy of their intended meanings and the themes generated from their interviews. Furthermore, interview transcripts and the translated excerpts were given to an external reader (i.e., a researcher expert in qualitative research) who helped establishing reliable interpretation of the data and refining the research themes.

## **Findings**

### **Quantitative Results**

To answer the first research question, we conducted a descriptive analysis to explore Jordanian early childhood teachers' attitudes on the four subscales of the questionnaire. Table 1 (see Appendix at the end of the article for all table references) presents the means and standard deviations (std.) for the items that measure teachers' comfort level toward science teaching.

A careful examination of table 1 indicates that most teachers feel a sense of comfort in doing science activities in the early childhood classroom. The item that represents this idea obtained the highest mean score of (4.54) on a scale of five. Furthermore, the majority of teachers expressed their agreement with the item that expresses their willingness to get involved in children's scientific inquiries. The mean score of that item was (4.43). The item that obtained the lowest mean score in this subscale is "I am afraid that science experiments and activities won't turn out as expected (m=3.32) indicating that teachers were less positive about their comfort level in this regard.

The second subscale of the questionnaire measured teachers' attitudes toward science classroom preparation. Table 2 presents the means and standard deviations (std.) for the items that measure this subscale.

As shown from table 2, the majority of early childhood teachers indicated that they enjoy reading resource books to obtain ideas about science (m=4.38). They further like to discuss science ideas with their colleagues (m=4.38) and are ready to learn and use scientific knowledge and skills for planning hands-on science (m=4.36). Jordanian early childhood teachers, however, were less positive about the item "preparation for science takes more time than other subject areas" which obtained the lowest means score in this particular subscale (m=3.55).

The third subscale of the questionnaire measures early childhood teachers' attitudes and willingness to manage hands-on science. Table 3 presents the means and standard deviations (std.) for the items included in this subscale.

Table 3 indicates that teachers agreed that they enjoy collecting materials and objects to use in their science teaching (m=4.31), and that they don't feel afraid of demonstrating experimental procedures in the classroom (m=3.87). However, the majority of teachers were uncertain about their interest in dealing with certain animals and insects in teaching science (m=3.3) or dealing with the messiness created when doing hands-on science in the class (m=3.11).

The fourth subscale, as shown in Table 4, represents the items that measured teachers' attitudes toward the developmental appropriateness of teaching science to young children.

As can be seen from the table, most teachers agreed that the teaching of science processes is important ( $m=4.14$ ) and that science is as important as the 3 R's ( $m= 4.19$ ). In addition, teachers believed that young children are not curious about the scientific concepts and phenomena ( $m= 3.53$ ).

Comparing the total mean of each subscale of the questionnaire provided us with a general picture of how early childhood teachers' attitudes differ toward the different areas of science teaching and learning. Table 5 presents the total means and standard deviations for each subscale as well as for the whole questionnaire.

As described in table 5, the total mean of the "managing hands-on science" subscale was the lowest (3.64), followed by the mean for the subscale "developmental appropriateness" (3.83) while the mean of the "classroom preparation" subscale was the highest (4.17) and the "comfort" subscale (4.06). This indicates that teachers' attitudes were more positive about their ability, interest and willingness to prepare for the science classroom as well as their sense of comfort in teaching science. However, teachers were less positive toward managing hands-on science in the classroom and toward the appropriateness of introducing science to children at a young age compared with the other subscales.

Regarding the second research question that aims to identify the instructional time that teachers dedicate to instructing science, we have asked teachers to indicate the approximate weekly time they actually spend on teaching science in their early childhood classrooms. Findings indicate that about 87 % of the surveyed teachers reported that they dedicate only less than half an hour per week for teaching science in their early childhood classrooms, while 9 % of the teachers indicated teaching science for one to two hours per week, and only 4 % reported providing an approximate five weekly hours for science (i.e., an hour per day).

The third research question aims to identify if there were significant differences in early childhood teachers due to some selected variables (i.e., years of teaching experience, number of science courses taken, and teacher's level of qualification). Analysis of the quantitative data through one-way analysis of variance (ANOVA) showed that none of the selected independent variables had a significant effect on teachers' attitudes toward science at ( $\alpha =.05$ ).

## **Qualitative Results**

Our initial goal behind conducting the semi-structured interviews was to delve more into understanding the attitudes of science teachers toward science through understanding the meanings they generate out of their lived science experiences in early childhood settings. Relative to the findings of our second research question which pointed out the limited instructional time early childhood teachers dedicate to instructing science, we also aimed to uncover the variables that stand behind the very limited instructional time provided to science during the week. We organized our findings around three major themes that emerged from the analysis of the qualitative data. These are: comfort and confidence in light of contextual experience, science instructional practices, and reasons behind the limited instructional time dedicated to science.

### *Comfort and Confidence in Light of Contextual Classroom Experience*

All 15 teachers declared that they feel comfortable teaching science to young children. The statements: "Science activities are fun," and "I love when I teach science" were repeatedly mentioned as teachers described their classroom science experiences. When asked about the

scientific content they teach to children, all teachers named topics such as "animals, plants, insects, and the four seasons". When asked if they teach any physical or chemical concepts to children, nine teachers declared that they limit scientific experiences to certain biological concepts and at a lesser degree to earth science concepts. These same nine teachers failed to name any physical or chemical concept they have taught or think is appropriate to be introduced to children at this age. At this point, most teachers expressed their apprehension toward specific science disciplines especially physics and chemistry. Some exemplary statements provided by teachers that express discomfort and low confidence in such disciplines are:

Noor: No! I don't teach physical concepts...I think they're hard for children to understand. I teach about animals, our bodies, and the seasons. Sometimes about the sun and the earth, frankly I was not good at school physics. I've never understood it

Nuha: Um...I don't understand it myself. It's like there is a wall that stand between me and understanding physics and chemistry. I teach about the senses, the seasons, and stuff like that...I think this is enough for children at this stage.

It is worth noting that five of these nine early childhood teachers explicitly expressed a belief that teaching biological concepts to young children is developmentally appropriate, while teaching other physical and chemical concepts at early grades is not. For example, Samia, who has been teaching early childhood for 16 years mentioned, "teaching five-year-old children physics! I don't know if it is appropriate...I think we should introduce information about living things that interest them like, cats, sheep, their bodies."

On the other hand, teachers who have experienced teaching some physical or chemical concepts in their early childhood classroom indicated that such experiences were the most enjoyable teaching experiences as children interacted in unique ways during them. Yet, they indicated that introducing physical and chemical concepts to young children required more time and effort on their part in comparison with the biological or earth science concepts. Lubna, who has a bachelor degree in early childhood and have two years of teaching experience, explains this idea:

Well, it is always harder to teach physical or chemical concepts than biology. You need to read more, prepare more and simplify things. In biology, even if you don't know, you just search the concept on the net or read a book but in physics or chemistry, there might be some concepts that build on others. It is harder to plan and prepare for it.

Overall most teachers reported one or two classroom incidents where they felt that their confidence in their scientific knowledge was shaken. For example, Fatin, who has a diploma degree in Arabic literacy and has been teaching early childhood for 5 years, provided an example of such classroom instructional moments:

One day, I was explaining about why certain things float and others sink and I explained to children that a heavy object always sinks and a light object floats, then a child stood up and asked about why a ship doesn't sink despite it is very heavy. I told him because of its bird-like shape, but I wasn't convinced myself.

Mariam, who is a classroom teacher with 4 years of teaching experience, also reported: "When I was teaching about wild animals to children, one student asked me if the dog is a wild animal or not and frankly (laughing) I was not able to answer him."

Interestingly, however, teachers saw those classroom moments important for their professional growth and for enhancing their scientific literacy. Nadia, who has a diploma in science explained, "with children, I come to moments where I question my basic knowledge in science. They ask questions that let me think more and ask more myself." Only three teachers (having less than three

years of experience and specialized in Arabic, English, and Social Studies) reported that they either avoid teaching the same concept in the next year or keep the topic to the minimum. The other teachers, on the other hand, reported that they resort to many resources that help them improve or modify their scientific knowledge such as the internet, library books, different school or stage textbooks, their colleagues, or ask scientists.

All 15 teachers, regardless of their level of qualification and specialization, felt unsatisfied about their professional preparation in general and in science in specific. For example, Mariam explained:

I have taken two courses in science during my study but they were more appropriate to third and fourth grades than to kindergarten....We have learned about scientific theories and laws, but we did not have a chance to practice or think of our own teaching ideas.

Furthermore, teachers, like Mariam, who have had some exposure to science content and pedagogy during their pre-service preparation felt that there should be a continuous professional support during their teaching practicum on how best to teach science to young children. According to these teachers, more science-specific workshops could help them enhance both science content and pedagogical knowledge. Teachers from other educational backgrounds (e.g., Arabic, English, and social studies), on the other hand, placed even greater emphasis on their need for continual professional development workshops that enhance their early childhood teaching in general and in science specifically.

### *Science Instructional Practices*

In this theme, we have presented results that relate to teachers' reported instructional practices in science and how they felt toward hands-on science experiences. In addition to the 20 to 30 minutes that are weekly dedicated to formal instruction in science, teachers reported that they teach science informally almost whenever a student asks a question or when a chance emerges during teaching other subject areas. "On spot teaching" as Lubna named it, was very common among teachers as they described their science instruction. Moreover, on spot science teaching was repeatedly referred to by all 15 teachers as the means through which teachers integrate science to every aspect of children's classroom experiences. For example, Nuha who finished her two years diploma in Social studies, indicated, "...like, when I teach them about the letter (ب) /b/ I tell them that a cow (بقرة) starts with (ب) and then we talk about the benefits of cows."

When asked about how they teach science to young children, some of the teachers' exemplary responses were:

Noor: We look through the textbook pictures, I ask them questions...like um... I tell them we have five senses and that we use them for different functions.....we sing songs about the senses...you know stuff like this....

Reema: I ask questions, I explain to them [children], for example, plants and why we grow them....they plant lentils at home and bring it to school ...kids love when they do that.

Lubna: well I teach them about a lot of things, like I teach them about healthy and unhealthy food and what they do to their bodies.... one time I brought them salt, sugar and lemon and children tasted them and then I taught them about sour, salty, and sweet food.

It was clear from teachers' responses that they held themselves responsible for transmitting scientific knowledge to children and that they "tell," "explain," or "teach" children about scientific phenomena by providing ready factual answers. Teachers were particularly asked if they give children

the chance to explore things on their own. "To explore" had a particular meaning for seven teachers. For instance, Hala mentioned:

Yes, I do that... I show them the magnet, and then I demonstrate to them how it attracts metal from all other materials and then they try it on their own ....they take turns...or even through groups...most of the time we don't have enough magnets.

Like Hala, exploration for the other six teachers meant giving the child the chance to touch or do after demonstrating the scientific concepts. On the other hand, three teachers indicated that they give their children the chance to explore things on their own and that they guide them to discover scientific concepts. Reema, for example, indicated:

One time I brought different liquids with different colors and smells including pure water. I let children taste or smell the different liquids and compare their colors, their taste, and how they smell with the water. Kids really had good time.

Early childhood teachers identified many obstacles that stand in the way of implementing hands- activities more often in early childhood settings, such as lack of resources and materials (mentioned by 15 teachers), large class sizes (mentioned by 7 teachers) and the limited weekly time devoted to science instruction (mentioned by 9 teachers). For example, Salwa who has been a preschool teacher for more than 6 years stated, "I wish we have the resources or the time needed to enable every child to try by himself or have his share of individual attention, but with 25 to 30 students in the class, I doubt this can happen." Fatin added, "Well ...there are many obstacles, like they [administration] do not provide us with materials, sometimes I have to buy them from my salary which is very humble."

Teachers were also asked about the scientific processes they tend to develop in a science activity; seven teachers requested clarification on this particular question and could only answer after I provided them with an example of a process skill. Most teachers declared that their familiarity with the science processes is very superficial and that they don't plan for them in the class. Three teachers, however, strongly capitalized on their knowledge of the science process skills. These teachers indicated that while they try to plan for children to observe, compare, or classify information and find answers on their own, they still don't know how best to incorporate them into their classroom teaching. Sameera, who has a diploma in early childhood and has been teaching kindergarten for seven years elaborated:

Well, sometimes I let children observe and then think about why things happened this way. But I don't know what to do next, I mean what the right question is and what should I introduce next...I wish we have more science-oriented workshops to give us new ideas and ways to implement the processes.

Although this study did not involve direct observation of the classroom teaching practices in science, most teachers readily acknowledged that their overall science teaching practices only minimally match the inquiry-based model of science teaching/learning.

#### *Reasons of Limited Instructional Time Dedicated to Science*

Early childhood teachers reported, through the collected questionnaire, that they dedicate less than an hour for science on a weekly basis. This finding was surprising as many studies (e.g., Spooner, 1981) indicate a positive relation between teachers' attitudes and the time teachers allot for science in the classroom. Thus, we aimed to explore what factors that might have played a role in the science instructional time decisions of science. Two major factors emerged from the results of data analysis.

The first relates to the lack of parental support and the pressure they put on teachers to teach more literacy and math.

Most teachers were extremely besieged by parents' pressure and parents' concerns with reading, writing and math. Fadia, who had more than eight years of teaching experience, illustrated:

Parents want us to teach their children how to read, write and count, they want to see worksheets and stuff at home that prove that. When I teach science, the next day, parents come and ask, why we did not teach their kids anything yesterday. When I tell them that we taught their kids science, they do not like it and they feel like we have wasted time.

Fatin adds her thoughts on this idea:

Parents were very happy when they knew I was specialized in Arabic literacy. They put pressure on the administration to place their children in my class. They want their children to read and write so quickly.

Furthermore, teachers felt that they are judged as being good teachers through their children's ability to combine sounds (i.e., oral reading) or write simple words without mistakes. Reema who has been teaching kindergartens for three years reported,

If your children do not read, write or count by the first few months in the start of the year, parents will hurry up to the administration and have their children placed with a different teacher. This really puts pressure on us as teachers.

The second factor that was salient from analysis of interview data related to the preschool or kindergarten administrators' demands. Teachers reported that the curriculum and the daily program are mostly identified and specified by the preschool administration. Teachers have slight freedom on curriculum choice or the daily program. The kindergarten and the preschool administrators specify for them what to teach, when to teach, and sometimes how to teach. The following excerpts were taken from interview transcripts to explain this idea:

Noor: the principal has to see a copy of all the worksheets and lesson plans before they are implemented. Sometimes she does some changes and requires more focus on math activities and Arabic skills.

Mariam: the classroom schedule is identified through the administration, we have to have two full days per week for teaching Arabic (reading and writing) and one day for math, one day for revision and on Thursdays we introduce religious, social studies and science activities.

Lubna: classroom time is specified by the school principal and all early childhood classrooms follow the same time divisions. We teach Arabic for one full day followed by a revision day. The same is for math. Usually we teach English, science and other topics one day a week.

When asked if they tried to increase the time given to science in the classroom, some teachers reported stress moments with their school administration as they were trying to increase science in the daily activities of the kindergarten or the preschool. According to Nadia:

One time, I planned to take children to the zoo by the end of the week. I tried to explain to the principals that I have to take them at the end of the week because they were studying about animals; the principals refused and postponed the trip. We didn't actually go.

Lubna uniquely believed that the principals' educational background affects their views about what's important to teach in the classroom. She stated, "Most early childhood principals have Arabic or English backgrounds...I think this really affects the subjects they think is of priority in early childhood."

However, other teachers believed that school principals comply to parental pressure. The following excerpt is rather lengthy, but expresses this idea efficiently:

I think there is a general understanding that science is not that important as reading and math among children. We all think that young children should learn how to read before they learn about animals and earth. Our school administration thinks that parents themselves can teach about science and social studies at home, and that parents want schools to teach skills of reading and writing. They (administrators) simply want to give parents what they want and they do not try to challenge parental and societal conceptions.

Most teachers felt that schools have an important mission, which is to change societal ideas about children that were proven wrong. For example, Lubna stated,

They [parents] just need to know that more children are failing high school physics and chemistry than Arabic literacy. If we pay more attention to science early on, we may be able to help them become real scientists.

Yet, as schools continue to meet the very low expectations of parents and society without trying to boost them up; early childhood teachers believe that they are sending a message to young children and their parents that science is not important in their children's lives. For instance, Reema mentioned:

Even parents who are doctors and pharmacists care more about reading and writing than they care about their children's scientific knowledge... it may be a good idea to start with these parents who value science. They could help us change other parents' beliefs.

## **Discussion**

This research was an attempt to explore Jordanian early childhood teachers' attitudes toward different aspects of science teaching and learning and understand their contextualized science experiences in early childhood settings. Quantitative findings indicate that Jordanian early childhood teachers feel comfortable toward science and toward their ability and willingness to prepare for science class. This finding is consistent with the findings reported by Cho's (1997) and Faulkner-Schneider's (2005) studies despite the different contexts where the studies were implemented. Contextualized data, however, revealed that some teachers may have equated science only with biology and not with all scientific disciplines. Jordanian early childhood teachers restricted the science content they introduce in their early childhood classroom to biological and earth science topics and reported greater comfort toward biological concepts than physical and chemical concepts. This may have been the case due to a higher perceived knowledge and understanding of biology and earth science concepts than of physical and chemical ones. Teachers in this study referred to biological topics as easier to understand on their own than physical concepts. This is expected as most early childhood teachers teaching in Jordanian kindergartens and preschools come from different educational backgrounds with minimal exposure to scientific and pedagogical content knowledge. A similar finding was reported by Harlen (1997) who found that early childhood teachers in Scotland were more confident toward biological concepts than toward energy/forces concepts. Subsequently, according to Harlen, teachers introduce content where confidence is greater more frequently which explains the dominance of biological concepts in early childhood science teaching in Jordan. Introducing biological concepts more often than other scientific concepts in early childhood settings may also be interpreted in light of what Jordanian early childhood teachers think is more appropriate to be introduced to children at this very young age.

Moreover, despite the overall positive comfort level that Jordanian early childhood teachers hold toward science as indicated in the quantitative results, they reported moments of tension and discomfort during science instruction as indicated through analysis of the interview transcripts. This discrepancy could be due to the tendency of early childhood teachers to provide socially desirable answers on the questionnaire items. Only few teachers reported that they resort to avoiding concepts where they faced difficulty or discomfort while teaching. Surprisingly, most teachers who were interviewed reported that these moments provoked their motivation to exploit different resources for science content knowledge and that they utilized these moments in their future planning and preparation for science activities.

Jordanian early childhood teachers' attitudes towards "hands-on science" were less positive than their attitudes toward the other three sub-scales of the questionnaire. This finding indicates that there is a significant number of Jordanian teachers who have negative attitudes toward hands-on instruction of science. Early childhood teachers identified many obstacles that stand in the way of implementing hands-on activities in early childhood settings. Among these are: lack of resources and materials, large class sizes, and the limited weekly time devoted to science instruction. Although most of the barriers that early childhood teachers identified are external, questionnaire results show that there is a significant number of teachers who are uncertain about their willingness to handle insects and animals or even the messiness created by the hands-on activities.

In addition, most teachers' clearly lack knowledge of the science processes or the pedagogical knowledge about how best to incorporate them into their teaching. Planning for children to develop the science process skills form the basis of the inquiry –based model of science instruction that is supported by the worldwide science education reform (Levitt, 2001). Early childhood Jordanian teachers admittedly described their science instruction as traditional and only minimally approach the inquiry-based models of learning. According to Garbett (2003), pedagogical content knowledge of the teachers and their abilities to make science understood to children is influenced by their content knowledge. Most early childhood teachers in this study lack content knowledge of science and therefore, it may have affected their pedagogical knowledge.

On spot science teaching characterized how early childhood teachers integrate science with other classroom daily experiences, which subsequently compensated for the low instructional time dedicated to it in the classroom, as they believed. On spot science teaching that early childhood Jordanian teachers use parallels what Kaplan-Sanoff and Yablans-Magid (1981) termed "Incidental Sciencing" through which science is taught occasionally following an unpredictable classroom incident that provokes children's questions. Incidental science instruction was described by Kaplan-Sanoff and Yablans-Magid as more typical than formal science instruction in early childhood settings.

From a different angle, the finding concerning the limited time that Jordanian early childhood teachers devote to science in the classroom was surprising. Many researchers (e.g., Cowan, 1999; Faulkner-Schneider, 2005; Spooner, 1981) pointed out that the positive attitudes toward science can be a strong indicator for a more instructional time allotted to science in the classroom. This may be due to the possibility that early childhood teachers overestimated their comfort level in the questionnaire to provide socially desirable answers. The qualitative results further helped in contextualizing the results obtained through the questionnaire. Lack of support from the parents and the administrators' demands were among the major factors behind the limited time provided for science in the early childhood classrooms. Clark (2003) pointed out that the relative importance given to science by authorities could be an important factor that affects the amount and nature of science teaching. This finding is of particular interest as administrators and parents constitute the

authorities that gauge early childhood teachers' actions and practices, as it is the case in most private early childhood settings.

Finally, unlike the findings of many studies (e.g., Lederman, 1992; Tilgner, 1990), neither the number of years of experience nor the qualification level of the teachers had a significant effect on the teachers' attitudes toward science. This may be attributed to the general poor preparation in science regardless of teachers' varied educational backgrounds and teaching experiences. It is worth noting that similar to Shrigley (1973), this study finds little support to the conjecture that teachers' attitudes might be affected or related to their science knowledge which is usually measured through the number of science courses taken during their professional preparation. Analysis of qualitative study indicate that even those teachers who studied a number of science content courses during their pre-service teacher programs felt that their professional preparation is unsatisfactory and needed more support in science content and pedagogy and required more in-service science oriented workshops. This may imply the similarities in quantity and quality of field experiences in science despite their variation on factors of experience, qualification and number of science courses.

### **Conclusion and Research Implications**

This research aimed at: first, exploring Jordanian early childhood teachers' attitudes toward science and second, understanding their contextualized science experiences.. Study findings indicated that early childhood teachers hold different attitudes toward different aspects of science teaching and learning. Furthermore, science teaching and learning remains problematic within the context of Jordanian early childhood classrooms as less than half an hour is currently dedicated to science. Qualitative data on the other hand suggests that early childhood teachers in Jordan teach biological and earth science concept more than they teach physical or chemical concepts and that they desire more content and pedagogical knowledge in science through sustainable professional development opportunities.

In light of the study findings, teachers' competence and confidence toward science should be further enhanced and promoted through paying more attention to the professional preparation programs of early childhood teachers in Jordan. Copley and Padron (1998) indicated that these programs should help early childhood teachers acquire the necessary skills and competencies in order to help children understand and like science. They need to: 1- develop good dispositions toward science, 2- experience good science teaching, 3- focus on how children learn science, 4- participate in a variety of professional development, 5- shows an ability to integrate science within classroom learning experiences, and finally 6- to apply appropriate strategies to achieve meaningful home-school relationships.

In-service teachers should also be able to maintain their professional growth through attending workshops that specifically support their content and pedagogical knowledge of science. This was a desire of most early childhood teachers interviewed in this study. The foci of such workshops can vary. They can aim at introducing varied and developmentally appropriate science activities for young children. They can also provide teachers with specific strategies to overcome barriers and frustration they face during science instruction. From a different angle, schools and administrators should be educated about how best to capitalize on their teachers' strengths and qualities through recognizing their expertise and professional preparation and through offering more opportunities for early childhood teachers to continue and sustain their professional development. There is also an urgent need to widen and increase societal awareness of the importance of science in children's lives. Schools can arrange for periodical parental workshops through which they can promote parental support for science in early childhood settings. If policy makers in Jordan do not

attend to the specific needs of early childhood teachers and to the teachers' levels of competence, confidence, and pedagogical knowledge in science, Jordanian children will continue to experience narrow and poor science learning experiences.

Because of the paucity of research on early childhood teachers' attitudes toward science in Jordan, similar studies may need to be conducted to explore the perspectives of teachers from other cities in Jordan. Specific research problems that tackle the issue of the professional preparation of pre-service early childhood teachers in science can widen our knowledge of issues and concerns associated with such programs. Furthermore, studies that explore parents' and principals attitudes toward science are strongly encouraged.

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## Appendix

**Table 1. Means and standard deviations of early childhood teachers' responses on the comfort/discomfort subscale**

Attitudes	Mean	Std.
1- I feel comfortable doing science activities in my early childhood classroom	4.54	.74
2- I fear that I am unable to teach science to young children adequately	3.89	.94
3- I feel comfortable with the level of scientific knowledge necessary for teaching young children	4.22	.61
4- I am afraid that children may ask me a question about Scientific principles or phenomena that I cannot answer	3.95	1
5- I hope to excite children about science in my classroom	4.41	.64
6- I am willing to get involved in children's scientific inquiries	4.43	.62
7- I am afraid that science experiments and activities won't turn out as expected	3.32	.98

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**Table 2. Means and standard deviations of early childhood teachers' responses on the classroom preparation subscale**

Attitudes	Mean	Std.
1. I enjoy reading resource books to obtain ideas about science activities for young children	4.38	.66
2. I am willing to spend time setting up materials for scientific exploration	4.12	.73
3. I am ready to learn and use scientific knowledge and skills for planning hand-on science	4.36	.58
4. I like to discuss ideas of science teaching with my colleagues	4.38	.68
5. I plan to integrate science into other subject areas	4.17	.87
6. I am familiar with raising open-ended questions to encourage children's scientific exploration	4.23	.72
7. preparation for science teaching generally takes more time than other subject areas	3.55	1.11

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**Table 3. Means and standard deviations of early childhood teachers' responses on the managing hands-on science subscale**

Attitudes	Mean	Std.
1- I am not afraid of demonstrating experimental procedures in the classroom	3.87	.86
2- I enjoy collecting materials and objects to use in my science teaching	4.31	.63
3- I am interested in handling certain animals and insects to teach science	3.3	1.08
4- I do not mind the messiness created when doing hands-on science in my classroom	3.11	1.13

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**Table 4. Means and standard deviations of early childhood teachers' responses on the developmental Appropriateness subscale**

Attitudes	Mean	Std.
1- I do not believe it is appropriate to introduce science to children at an early age	3.63	.98
2- I am comfortable with determining science curriculum that is developmentally appropriate for young children	3.82	.78
3- I do not feel that young children are curious about scientific concepts and phenomena	3.53	1.01
4- I am familiar with the processes and ways that young children learn science	3.76	.74
5- I feel that young children can not learn science until they are able to read	3.71	.91
6- The teaching of science processes (observation, classification) is important	4.14	.71
7- Science is as important as the 3 R's	4.19	.69

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**Table 5. Subscale Means and Standard Deviations**

Subscales	Number of Items	Mean	Std.
Comfort/discomfort	7	4.06	.42
Classroom preparation	7	4.17	.44
Managing hands-on science	4	3.64	.58
Developmental appropriateness	7	3.83	.39
Total	25	3.96	.297

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