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How Do Early Childhood Education Pre-service Teachers view Science and Scientists?

Suzanne EL TAKACH
Lebanese University, Faculty of Education

Abstract: The aim of this case study was to collect and to assess students' views about their NOS understandings at the beginning and at the end of their course on teaching science. The study was conducted on 24 students, all females, in their 3rd semester (2nd year), enrolled in their initial teacher education program in early childhood education. Data were collected from 1) Draw-a-scientist-at-task tool, 2) pre- and post-questionnaires about students' views about science and scientists and 3) students' formative and summative assessment scores. To increase the validity of results, a member checking was used. Results showed that prospective teachers' views about NOS improved significantly after attending only one course and the that majority of students agreed on the importance of learning more about science for their professional development.

Keywords: Nature of science, Pre- service teachers, Early childhood, Pedagogical content knowledge, Science literacy

Introduction

Science is often sadly neglected in the early childhood classroom (Johnson, 1999). Perhaps this is because science is "perceived and presented as too formal, too abstract, and too theoretical – in short, too hard for very young children and their teachers" (Johnson, 1999, p. 19).

The Next Generation Science Standards (NGSS) (2013) aims at preparing students for college, careers and citizenship and this by designing classroom experiences that stimulate K-12 students' interests in science. Moreover, both the National Science Education Standards (National Research Council, 1996) and Benchmarks for Science Literacy (American Association for the Advancement of Science, 1993) call for an action-oriented and inquiry-based approach to science with young children.

The need to focus on science in the early childhood classroom is based on a number of factors currently affecting the early childhood community. First and foremost is the growing understanding and recognition of the power of children's early thinking and learning. Research and practice suggest that children have a much greater potential to learn than previously thought, and therefore early childhood settings should provide richer and more challenging environments for learning. In these environments, guided by skillful teachers, children's experiences in the early years can have significant impact on their later learning. In addition, science may be a particularly important domain in early childhood, serving not only to build a basis for future scientific understanding but also to build important skills and attitudes for learning.

Lately, educators recommend doing in-depth research about science in early childhood years, after the big attention to the middle and secondary schooling. Currently many studies focus on the pre-school level because it has an important influence on student choice for future careers in science or engineering than in other grade level. So, the more the teacher creates amazing experiences in science, the more the students want to learn more about science, are motivated and want to explore more! The more teachers will have a greater impact on these students that last throughout their entire school experience.

One of the primary goals of the early childhood science curriculum is the development of scientific thinking in young children. Scientific thinking differs from the learning of scientific facts in that scientific thinking involves children in the process of finding out. Instead of learning what other people have discovered, scientific thinking leads children to make their own discoveries. Scientific thinking is manifest as young children ask questions, conduct investigations, collect data, and search for answers.

Science Literacy and Nature of Science

The OECD (2007) PISA study determined scientific literacy in three dimensions: Scientific concepts, scientific processes, and scientific situations. "Scientific situations, selected mainly from people's everyday lives rather than from the practice of science in a school classroom or laboratory, or the work of professional scientists". Holbrook and Rannikmae (1997, p. 15) defined scientific literacy as: "Developing the ability to creatively utilize sound science knowledge in everyday life or in a career, to solve problems, make decisions and hence improve the quality of life".

In Year 2000, during the 2nd International IPN-symposium on Scientific Literacy, held in Kiel, Northern Germany, science educators agreed the lifelong competencies to be gained by students with regard to 3 domains: knowing, doing and assessing. These competencies were grouped under the Graeber model (Figure 1), as stated in Holbrook and Rannikmae (2009, p. 278).

Figure 1. The Graeber Model for Science Literacy (Holbrook & Rannikmae, 2009, p. 278)

Moreover, Chiapetta et al. (1991) identified the four aspects of scientific literacy: 1) the knowledge of science, 2) the investigative nature of science, 3) science as a way of thinking or knowing, and 4) the interaction of science, technology and society (STS). In the third aspect, there is emphasis on the description of how scientists experiments and emphasis on thinking, reasoning, and reflection in the construction of scientific knowledge and the work of scientists.

Understanding of the nature of science, the goals, values and assumptions essential in the development and interpretation of scientific knowledge has been an objective of science instruction since at least the turn of the last century (Lederman, 1992). It is regarded in contemporary documents as a fundamental attribute of science literacy and a defense against unquestioning acceptance of pseudoscience and of reported research. Knowledge of the nature of science can enable individuals to make more informed decisions with respect to scientifically based issues; promote students' in-depth understandings of "traditional" science subject matter; and help them distinguish science from other ways of knowing.

Akerson et al (2011) found that it is clear that students as young as kindergarten are developmentally capable of conceptualizing NOS when it is taught to them. They recommend for teaching NOS to young children, and for future studies that explore learning progressions of NOS aspects as students proceed through school. Research shows also that most children have formed an opinion (positive or negative) about science by the time they reach the age of 7 (Wells, 2015). The teacher's role is critical to children's science learning, and it is a complex

one that is informed by her knowledge of children, of teaching and learning, and of pedagogical science knowledge. Finally, though an appropriate understanding of nature of science (NOS) has been recommended for all as a component of scientific literacy (DeBoer, 1991), it is clear from recent studies that students continue to graduate from high school with many misconceptions regarding NOS (Bell et al. 2003).

Lebanese students ending K-12 do not have an adequate view about NOS. BouJaoude (2002) analyzed the new Lebanese Curriculum in Science with regards to the four aspects of science. He found that Lebanese students learnt lots about scientific facts during all the schooling years but the aspect "science as a way of knowing, or science as a way of thinking" So students enrolled at the faculty in their first years, have no idea about science literacy and more specifically about the habits of minds (e.g., creativity, critical thinking and imagination…) For this reason, it is important for early childhood pre-service teachers to be prepared to learn about NOS during their initial teaching at the faculty of education and subsequently to teach to young children NOS.

Importance of the Research

Worldwide, most of educational research in science education focus on in-service /prospective science teachers, but little is done regarding ECE prospective teachers who will teach science in the preschool. In the Arab world, little attention was given to research in science for early childhood and primary classes. In fact, Ayoubi (2017) did an analysis of research in education in the Arab World between 2011 and 2015. Her study showed the scarcity of research done in Science Education: From 6545 publications, only 122 are related to science education and only 2 were addressing science in primary classes or 0.03% of the sample.

In Lebanon, based on my experience as instructor in the last 10 years at the Faculty of Education, little research was done on this group of students and especially the evaluation of the course "Teaching Science for ECE" at the Faculty of Education, Lebanese University.

In addition, I used to start the first session with a diagnostic assessment using the 12 statements on the "Myths of Science" quiz of Chiappetta and Koballa (2004), in order to know more about students' prior knowledge of science. It was striking that each year, most students answered by yes to the statement: Most scientists are men because males are better at scientific thinking.
The present study is a descriptive case study and its research questions are:

1. What are pre-service early childhood education views about NOS?
2. Did pre-service teachers change their views about science and scientists after attending the teaching science course? If yes, in what ways?
3. Did ECE pre-service teachers benefit from the course at initial education program "Teaching Science for Early childhood Education" at the Faculty of Education, Lebanese University? In case yes, in what ways?

Method

The aim of this case study was to collect and to assess students' views about their NOS understandings at the beginning and at the end of their course on teaching science. It was conducted on 24 students, all females, in their 3rd semester (2nd year), enrolled in their initial teacher education program in early childhood education during the academic year 2015-2016.

Procedure

The science teaching course covered 3 major themes: Learning theories and cognitive development theories, teaching strategies for infant and primary classes and Nature of Science and Science Literacy (Figure 2).

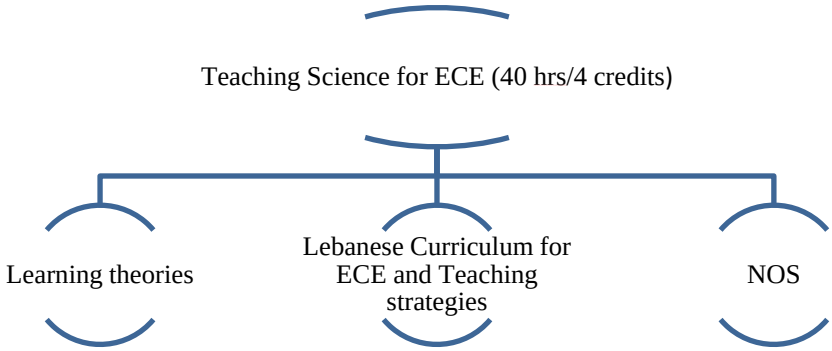


Figure 2. Components of the Science Teaching Methodology course for ECE Education

Research data collection tools and sample

The type of this study is a descriptive case study and exploratory of nature (Creswell, 2014). The validity is ensured through heavy description and the use of data multiple sources (Yin, 2014). All 24 students filled in the pre-questionnaire at the beginning of the winter semester, during the first session of the course Teaching Methodology in Science for Early Childhood Education. In the first session, 22 students made the summative exam.

Qualitative and quantitative data were collected from 1) Draw-a-scientist-at-task tool (Figure 3), 2) pre- and post-questionnaires about students' views about science and scientists, 3) students' formative and summative assessment scores and 4) analysis of ECE students' answers related to NOS in the summative test . To increase the validity of results, a member checking was used. The research study duration was 2 semesters.

The pre-questionnaire is formed of 12 open-ended questions, including 7 items related to the DAST-C test and 5 questions related to NOS. The post-questionnaire consisted of 12 items, including 4 items related to students' comments on the Teaching course, 5 items related to NOS and 3 items related to the class debriefing.

During the spring semester, a member checking session was taken place and 17 students filled in the post-questionnaire. A PowerPoint displayed the analysis of students' answers to the pre-questionnaire, in terms of; the course expectations, and Nature of science. Students then have to write their comments after watching the PowerPoint.

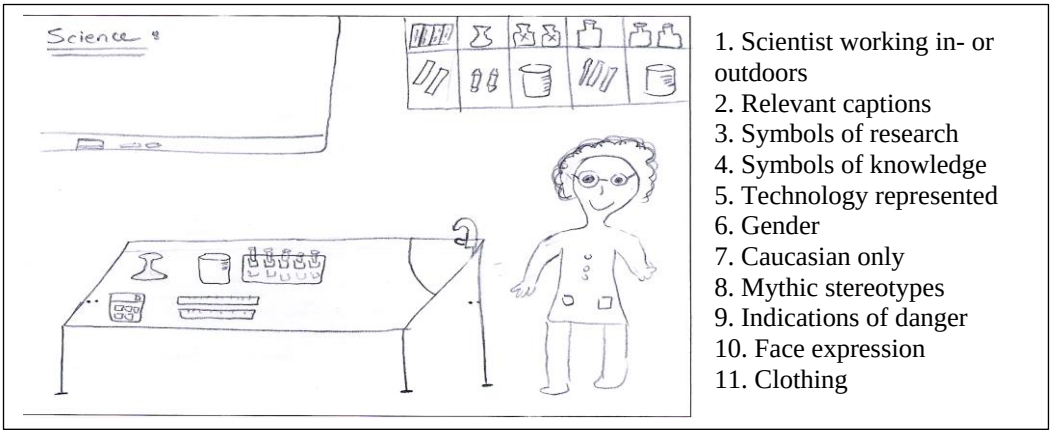


Figure 3. Draw-A-Scientist-Task indicators

Results and Discussion

Data and Results from the pre- and post-questionnaires

Results related to the research question 1: What are pre-service early childhood education views about NOS?
Pre-service teachers' views about scientists from the DAST- drawing

From the pre-questionnaire, 22 drawings were analyzed based on guidelines provided by DAST-C or Draw-A-Scientist-Test Checklist, developed by Finson, Beaver and Cramond (1995). Characteristics of stereotypical images of scientist such as lab coat, eyeglasses, symbols of research, technology, workplace and gender were considered. Teachers' and students' perceptions were analyzed not only through their drawings but also through their responses to the open-ended questions.

The following Tables 1, 2 and 3 highlighted students' answers related to DAST-C.
Overall, the scientist is a white male, working alone and doing experiments especially in chemistry. He is a normal person with no mythic stereotype (such as the crazy scientist or Frankenstein). He has good qualities such as smart, respects others' opinions, tolerant.. Students' favorite scientist are mostly from social and psychology science (Montessori, Piaget..). As for scientists like Newton, Einstein.. because they knew about them in the science textbooks in school time. Only one student mentioned an Arab scientist (Ibn-Alhaytham). The majority of the participating students gave examples of Western scientists only and only very few of them named female scientists.

Table 1. Analysis of students DAST drawings

DAST Indicators	Total	DAST Indicators	Total
1. Workplace	21	2. Relevant captions	5
Scientist working indoors	20	No captions	15
Scientist working alone indoors	19	Thoughts/big questions	2
Scientist working indoors with 2 students	1	Science- word	1
Scientist working outdoors	1	Chemical formulas	1
3. Symbols of research	21	Terms related to separation of salty water	1
lab equipment, e.g., test tube, flask, Erlenmeyer, pipette and Bunsen	18	4. Symbols of knowledge	17
		Board and chalk	2
Instruments for dissection	1	Instruments related to chemistry	12
Instruments for planting	2	Plants	2
5.Technology used	2	Poster	1
Calculator	1	Atomic model	1
Microscope	1	microscope	1
Not present	19	Not present	5
8. Mythic expression	0	6. and 7. Gender /Caucasian only	
Mythic expression	Not present	White male	20
Mother with her daughter	1	White female with a kid	1
10. Facial expression	22	9. Indications of danger	0
Young male smiling	6	Not present	13
Young female smiling	1	No, fire	8
Young male smiling with spiky hair/long hair	5/3		
Smiling young male with beard/mustache/bold	1/4/1		
Unsmiling young male	1		
11. Clothing	18		
wearing lab coat	7		
wearing eye glasses	2		
wearing lab coat and eye glasses	7		
Wearing normal clothes (dress, necktie, jeans..)	1/1		
Not drawing his body	3		

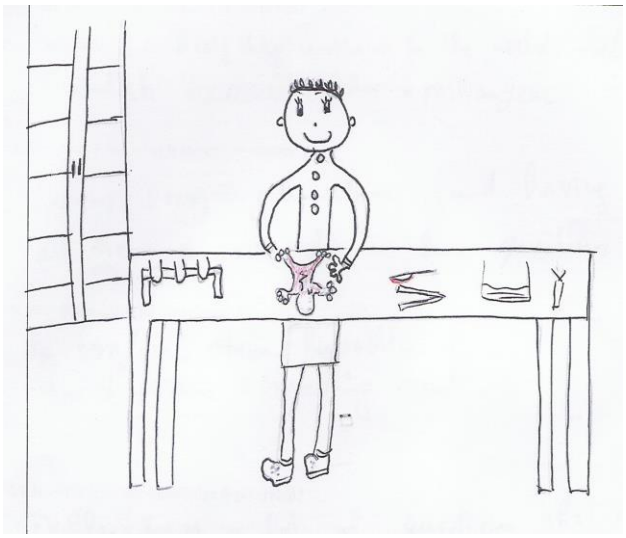
Table 2. Students' answers to DAST open-ended questions

What the scientist is doing	Total	Favorite scientist	Total
Experiment/chemistry experiment	3/10= 13	Newton	3
Dissection of a frog	1	Psychology/social scientists	3
planting	2	Montessori	2
Teaching	1	Skinner	2
Observation	3	Piaget	2
3 tasks	Total	Vygotsky	2
Doing an experiment	16	Ausubel	1
Research	1	Einstein	1
Preparing for the experiment	2	Louis Pasteur	1
Cleaning	2	Galileo	1
Observing/analyzing	10	Ibn-Alhaytham	1
Teaching	2		
Reading books	2		
Walking in nature	1		
Meet with other scientists	1		

Student 24: the scientist works on some experiments that lead him to get answers to his questions

Student 11: the scientist is doing an experiment

Student 8: the scientist is testing the hypotheses



Student 3: the scientist is dissecting a frog

Figure 4. Students' DAST-C drawings

Table 3 resumes attributes to the scientist in students' drawings; all the mentioned qualities were good ones. Students believed that the scientist is a smart person with positive values, such as, tolerance respectful and passionate about his work. In their pre-drawings, students stressed on the scientist intellectual and affective skills. In the post-drawings, the scientist affective skills increased with more emphasis on the attribute: patience.

Table 3. Students' answers about scientist attributes

	Three qualities of a Scientist	Pre-questionnaire Total (N=24)	Post-questionnaire Total (N=17)
Cognitive skills	Smart	9	6
	Intelligent	5	5
	Clever	2	3
	Genius	1	-
	Wide knowledge/Well-educated	2	-
	Has a vision	2	1
	Thinks logically	2	-
	Passionate about his work	1	3
	Objective	1	-
	Total number of answers	**25**	**18**
Psychomotor skills	Hard worker	3	3
	Active	3	-
	Takes risks	1	2
	Sharp observer	3	1
	Good-mannered	1	1
	Communication skills	1	-
	Works with technology	-	1
	Polite	-	1
	Solves problems with wisdom	-	1
	Total numbers of answers	**12**	**10**
Social-affective skills	Patient	2	4
	Does not accept failure	1	-
	Self-examination	1	-
	Helpful	1	2
	Courageous	2	-
	Self-confident	1	2
	Motivated	2	-
	Lovely	1	2
	Explorer	1	1
	Tolerant	1	3
	Respects others' opinions	1	1
	Curious	-	2
	Normal person	-	3
	Creative	-	1
	Has imagination	-	1
	Helpful	-	1
	Cooperates with others	-	1
	Total number of answers	**14**	**24**
	No answer	**4**	**2**

Results related to the research question 2: Did pre-service teachers change their views about science and scientists after attending the teaching science course? If yes, in what ways?

Tables 4 and 5 display excerpts to students' answers open-ended questions in the pre- and post- questionnaires. These questions were: 1.What does the word "science" mean to you? 2. In your opinion, what is the goal of science? 3. Why do scientists do experiments? 4. How the scientific knowledge is generated? 5. Do you think that the scientific method is the only way to do science? Why do you think so? To these questions, students'

answers were numerous and diverse. Samples of students' answers to some of these questions are tabulated in Tables 4 and 5.

Table 4. Students' answers about science

Category	ECE students' answers	Pre-Total	Post-Total
Science definition (what's science)	it is biology, physics, chemistry	4	1
	Everything related to life, humans, animals, plants, environment…	10	9
	To do experiment, to observe, to test, having results	7	2
	It is knowledge, information, laws, facts	2	-
	To discover, to explore	3	2
	Searching for answers we ask about things	1	1

When asked how scientific knowledge is generated, students emphasized, in the pre-questionnaire, e.g., on teaching and learning, from scientist to student and to other students, teaches knowledge from one generation to the other, by reading articles, books, internet and by doing experiments. In the post-questionnaire, their answers were, doing more observation and experiments and by reading.

To the question related to the scientific method, students answered by yes. Their answers changed, in the post-questionnaire, this number decreased (Table 5).

Table 5. Students responses about the scientific method as the only way to do science

	Pre-questionnaire (N= 22)	Post-questionnaire (N= 17)
Students' answers	No, you do not have to be a scientist to do science	No, you can do science at home with simple materials
	No, sometimes some people are not related to science and they can discover new methods by luck	No, it may be anyone can discover new things and use it
	No, the scientific method is not the only way to do science, lots of experiences can be made at home or in TV show and it doesn't need professional things	No, there are many ways to learn science
	No, because some hypothesis cannot be applied	No, it can be learned from our life also, by trying it
	Yes, since it give us a specific answers for our unknown questions	No, there are many methods we can do science
	Yes, since science gives us answer and information we need	No, maybe by observation
		Yes, in order to do science, you need steps to research
		Yes, because it is hard to learn new methods without a scientific method about it
		Yes, because this is the only way I know and it is good
Did not fill in the questionnaire	2	3
No	3	3
Yes	7	-
No answer	4	2

Related to the 4 aspects of Science Literacy

Students' answers related to NOS from the pre- and post-questionnaires were coded, analyzed, and categorized according to the four aspects of „Scientific Literacy" presented by Chiappetta and Koballa (2010, p.105): 1. Science as a body of knowledge, 2. Science as a way of investigating, 3. Science as a way of knowing and 4. Interaction of Science with Society and Technology (STS).

Table 6. Percentage of students' answers related to "what's science"

What's science?	Aspect 1 (Science as a body of knowledge)	Aspect 2 (Science as a way of investigating)	Aspect 3 (science as a way of knowing)	Aspect4 (Science, Technology and society)	Aspect 1&2	Aspect 1 & 4
Before Total= 24	4 16.66%	5 20.83%	0 0%	4 16.66%	7 29.16%	0 0%
After Total= 17	6 35.29%	1 5.88%	1 5.88%	1 5.88%	2 11.76%	3 17.64%

Table 7. Percentage of students' answers related to "why do scientists experiments?"

Why do scientists experiments?	Aspect 1 (Science as a body of knowledge)	Aspect 2 (Science as a way of investigating)	Aspect 3 (science as a way of knowing)	Aspect 4 (Science, Technology and society)	Aspect 1&2	Aspect 1 & 4
Before Total= 24	1 4.16%	15 62.5%	1 4.16%	4 16.66%	0 0%	0 0%
After Total= 17	1 5.88%	4 23.52%	0 0%	0 0%	3 17.64%	7 41.17%

Table 8. Percentage of students' answers related to "what's the goal of science?

What's the goal of science?	Aspect 1 (Science as a body of knowledge)	Aspect 2 (Science as a way of investigating)	Aspect 3 (science as a way of knowing)	Aspect4 (Science, Technology and society)	Aspect 1&2	Aspect 1 & 4
Before Total= 24	2 8.33%	3 12.5%	6 25%	8 33.3%	2 8.33%	-
After Total= 17	0	4 23.5%	0	0	1 5.8%	2 11.7%

Table 9. Percentage of students' answers related to "how the scientific knowledge generated?"

How the scientific knowledge generated?	Aspect 1 (Science as a body of knowledge)	Aspect 2 (Science as a way of investigating)	Aspect 3 (science as a way of knowing)	Aspect 4 (Science, Technology and society)	Aspect 1&2	Aspect 1 & 4
Before Total= 24	0	7 29.1%	6 25%	0	0	5 20.8%
After Total= 17	0	5 29.4%	8 47%	3 17.6%	1 5.8%	1 5.8%

In sum, students view about science changed as well as their perception about the scientific method. Their view about Aspect 2 remain unchanged (empirical science), but they link science with socio-scientific issues (to cure disease, to find solutions to our environmental problems..).

Data from the students' formative and summative tests
Pre-service ECE Teachers scores

Many questions of the formative and summative tests were taken from online quizzes and Chiappetta and Koballa (2004, 2010).

Table 10 shows the content of the summative exam and the number of students whose answers were correct to the items related to the test three main parts: Learning theories, Nature of Science and Lesson plan.
For instance, in the summative exam, to the question II.11: Astrology (predicting your future from the arrangement of stars and planets) is a science (True or False), 11 students answered by true.

Question II. 8: Science can be influenced by race, gender, and nationality or religion of the scientist: 14 out of 22 gave wrong answers.
To the question II.12: Science requires a lot of creativity (True/False), only 9 students answered correctly.
To Question II. 14: Science requires a lot of creativity: 10 out 22 gave wrong answers.

Table 10: Students' scores details in the summative exam

(N=22)/ Total score= 50	Range	Frequency
Learning theories (Question no I/14)	[1-6]	5
	[7-11]	17
	[12-14]	0
Nature of Science (Question no II/16)	[1-5]	0
	[6-11]	17
	[12-16]	5
Lesson plan (Question no III/20)	[0-5]	0
	[6-10]	7
	[11-15]	9
	[16-20]	6

Table 11 displays the students' scores and frequency for both formative and summative tests. In their formative assessment, 16 students took a mark ranged between 61 and 70, while 11 students took a mark ranged between 51 and 60.

Table 11. Students' scores

Students tests	Range	Frequency
Formative assessment/100	[30-40]	1
(N=24)	[41-50]	0
	[51-60]	2
	[61-70]	16
	[71-80]	5
Summative exam (1st session)/100	[30-40]	0
(N=22)	[41-50]	3
	[51-60]	9
	[61-70]	7
	[71-80]	3
Total score (Formative +	[30-40]	0
Summative exams)/100	[41-50]	0
(N=22)	[51-60]	11
	[61-70]	7
	[71-80]	4

Figure 5 compares students' scores in formative, summative scores with their final total score for the course Teaching science methodology.

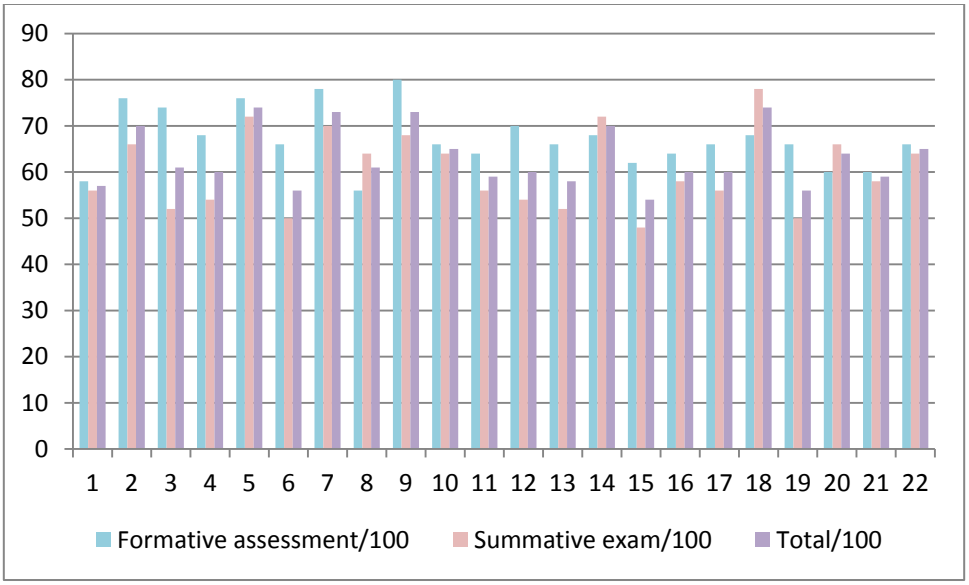


Figure 5. Students' scores from formative and summative tests

Data and Results from the Member Checking Session

Students were asked to fill in a post-questionnaire before the display of the main findings using the PowerPoint (Figures 6, 7 and 8).

About science and the scientist

This is what I concluded about your drawings:

- The scientist you drew is a white male, working alone and doing experiments especially in chemistry. He is a normal person with no mythic stereotype (such as the crazy scientist or Frankenstein). He has good qualities such as smart, respects others' opinions, tolerant.. Your favorite scientist are mostly from social and psychology science (Montessori, Piaget..), because you are now learning about them at the faculty and because you need them in your work as a teacher. As for scientists like Newton, Einstein.. You mentioned them because you knew about them in the science textbooks in school time. Only one student mentioned an Arab scientist (Ibn-Alhaytham) because you do not learn about them in school?
- Tell me, why your scientist is not a female, or of different race?
- Why your scientist did not use any technology in his work?

Figue 6. PowerPoint slide 1 from Member checking session

All students have a known picture about science and it is experiment, plants, animals, humans and this picture we took it from school till now, so we never go to any place to see different picture about science, we see only the picture in chemistry and physics books (Student 19). The scientist is a male and not a female since we always learn the male is scientist at school and the male is stronger than female to work in this field, but it is a wrong idea (Student 20). According to what I learned, all the answers are as a definition and the most answers are that science is everything related to life and to discover, doing experiments and to learn about living and non-living things. I thought imagination is related to literature (Student 12). What you said in the PowerPoint is true, because we learned about some scientists (Newton, Einstein..) from our school. But there are others we are learning about now at the faculty such as Montessori… for Arab scientists, we do not have a lot of information about them. Also all what we learned that they are males, since females should stay at home and work in it. And not all scientists had technology (Student 22). Another student wrote, I believe most scientists are not Arabs because the fact they are related to what we are learning at the present time. A scientist is mainly a male it is because that's what we hear, this is what they told us. Technology is not mentioned because we are not seeing it daily, in our everyday life and I'm not having a relative who is a scientist to observe (Student 3). The scientist is a normal person, who takes correct and incorrect choices (Student 15). The scientist is a normal person, he could

be male or female (Student 14). The scientist did not use technology since we have a background about scientists using old materials (Student 8). It seems we should learn more about science (Student 10).
Only one student' view about scientists persists; the scientist which I drew is not a female because the male is more intelligent than the female and he has a scientific thinking (Student 1).

About the sources of the scientist stereotypical image

To the question, where did you have your image about a scientist?
Most students agreed that the scientist in their pre-drawings were from books and magazines, TV, we are used to have a male scientist, as a student commented. Student 11 wrote: from school and school books. My scientist is not a female or from a different race, not because I am against that but it happened to be a man, because I drew him using a telescope. Student 13 commented that from school, science courses from grade 1 till grade 12, from TV programs such as National Geographic and movies about science. The scientist that we talked about is that we know only from school, whose theories we use in our daily life. Another student responded that from books and from reading and from my science teacher at school. My drawing was male because we did not take scientist female so much. Scientists in the drawings did not use any technology in his work, but they use the microscope sometimes (Student 22).
Finally, a student summarized the position of her peers: Each one of us has a totally different point of view. But we all agree on the same idea that a scientist is a good person (Student 11).
About NOS aspects

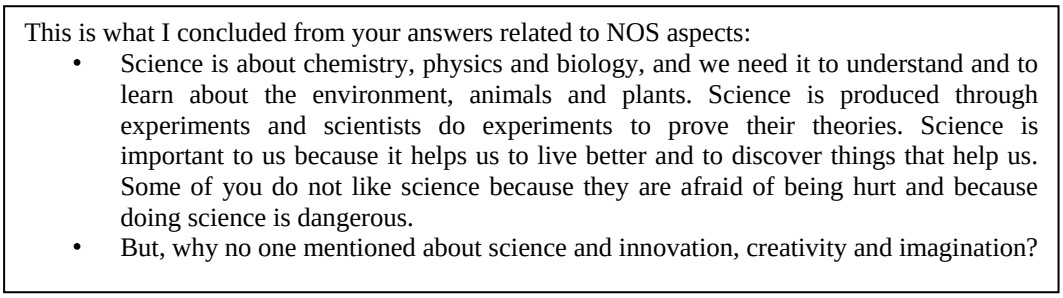


Figure 7. PowerPoint slide 2 from Member checking session

Students' responses about interpretations and question in Figure 7 varied. A student wrote: students have a known picture about science and its experiments, plants, animals, humans and this picture we took it from school till now, so we never go to any place to see different picture about science, we see only the picture in chemistry and physics books. Another comment was: science is a study related to chemistry, physics and biology. It can be produced by experiment to prove theories. I did not mention the relationship between science and imagination, because I did not know this before. In addition, a student believed that all Lebanese students learn in the same way and have the same idea about science. Also all schools focus on science content and ignore materials that include creativity and imagination. Furthermore, a student mentioned that, according to what I learned, all the answers are as a definition and the most answers are that science is everything related to life and to discovery, doing experiments and to learn about living and non-living things. I thought imagination is related to literature. Finally 2 students defined science as everything which has a relation with humans, plants, animals.. To discover, or to explore. The goal of science is to discover and explore more about everything.

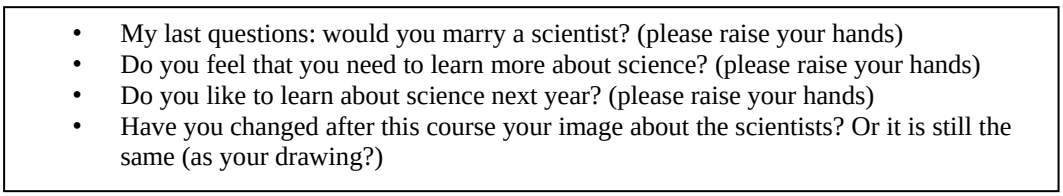


Figure 8. PowerPoint slide 3 from Member checking session

To questions in Figure 8, only 2 students said that they would marry a scientist; many disagree because they thought that a scientist has no social life. Out of the 17 students, 13 students agree that they need to learn more about science. Finally, all students said yes, that they changed their image about scientists; unlike their pre-drawings, they would draw a scientist at work differently.

Results related to Research Question 3: Did ECE pre-service teachers benefit from the course at initial education program "Teaching Science for Early childhood Education" at the Faculty of Education, Lebanese University? in case yes, in what ways?

Data from the post-questionnaire showed that the 17 students, who were present during the debriefing session, agreed that their expectations about the course *Teaching science Methodology* was largely fulfilled. In particular, epistemology and teaching strategies for KGs. Furthermore, all students want to learn more science courses. e.g., I would know more about science because I do not have enough knowledge (Female 13).

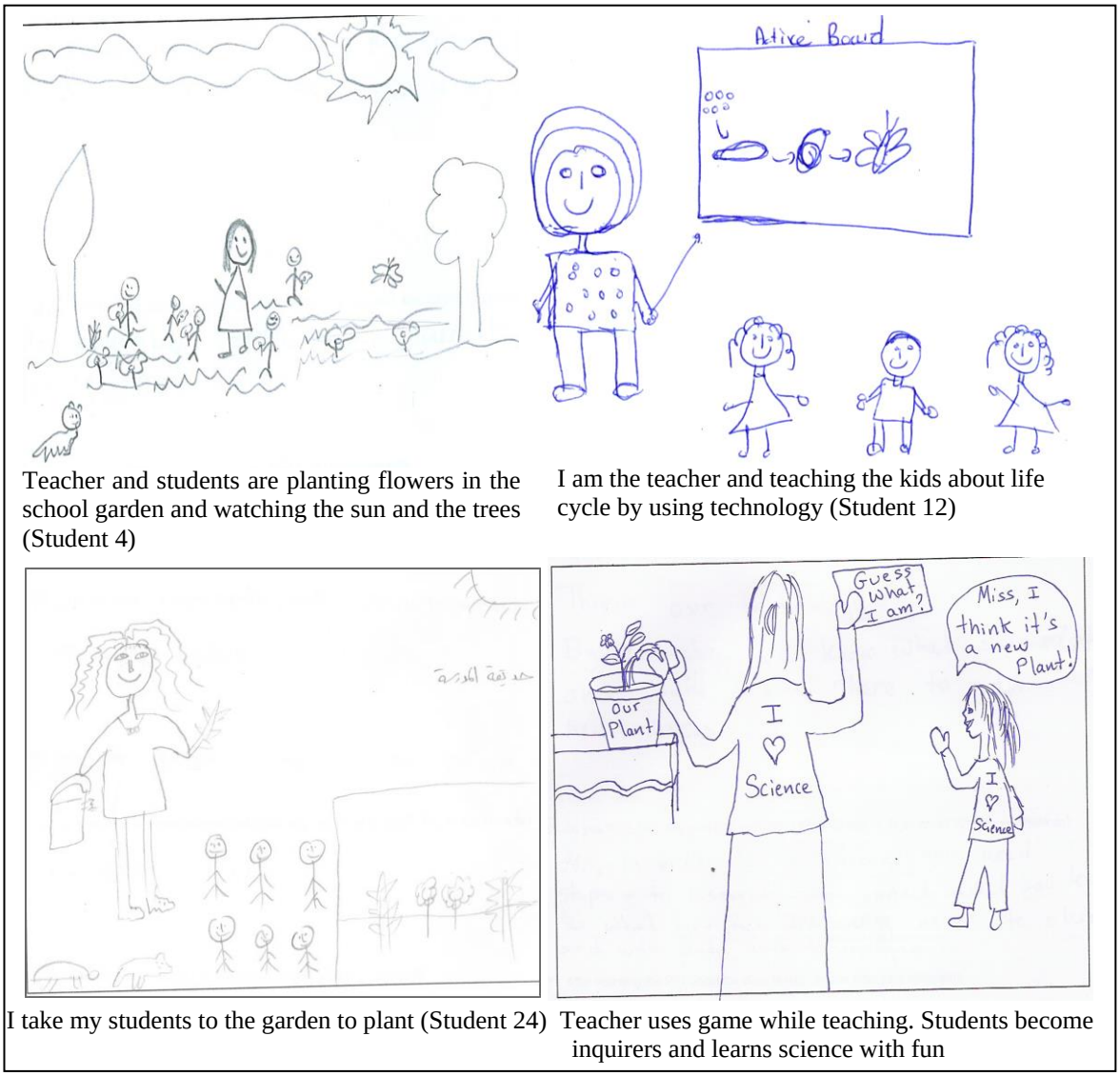
From the post-questionnaire, in Table 12, 16 drawings were analyzed according to DASTL or Draw-About-Science-and-Teaching-Learning (El Takach et al, 2018).

Table 12. Students' drawings according to the 15-DASTL indicators

Drawing analysis indicators	**Number of indicators**
a. Teacher's indicators	**35**
1. Teaching practices (e.g. frontal teaching, lab work, group work…)	16
Fieldtrip	8
Demonstration	4
Frontal teaching	2
Game with cards	2
2. Use of technology in instruction (e.g., LCD projector, active board…)	3
3. Teacher' facial expression (e.g. no expression, happy face, smiling…)	
Smiling	15
4. Teacher' gender	16
Female	
b. Student's indicators	**15**
1. Student presence	15
2. Student on task	15
Planting	13
Watching a science activity	2
c. Learning environment indicators	**16**
1. Indoor/outdoor instruction (e.g. classroom, laboratory, outdoor activity…)	16
Classroom	8
Outdoor	8
2. Class management (e.g. how students are seated)	4
In rows	3
On the carpet	1
3. Captions (e.g. teacher's talk, students' talk)	
Science and I love science	2
4. Class interaction (teacher/ student, student/student)	22
Teacher/student	13
Student/student	9
5. Symbol of research (lab equipment,..)	3
6. Symbol of knowledge (book, chalk and board..)	4
7. Technology represented (computer/laptop, calculator..)	3
d. Others	**-**
1. Use of a mind/ concept map	-
2. Use of philosophical metaphor	-
No drawings	**1**

Overall, 8 students draw themselves with their students outdoor, doing real science (planting and observing living species), while 8 drew themselves in class planting with their students or teaching about transportation. Only 3 students drew themselves using ICT in teaching. Finally, 15 teachers stressed on creating an engaging atmosphere by drawing themselves and their students with smiley faces.

Figure 9 shows some students' drawings to the question: Draw a picture of yourself doing science in KGs for your students.



Teacher and students are planting flowers in the school garden and watching the sun and the trees (Student 4)

I am the teacher and teaching the kids about life cycle by using technology (Student 12)

I take my students to the garden to plant (Student 24)

Teacher uses game while teaching. Students become inquirers and learns science with fun

Figure 9. Students' post-drawings about teaching and learning science

Conclusion

Results showed that prospective teachers' views about NOS improved significantly after attending only one course and the that majority of students agreed on the importance of learning more about science for their professional development.

Prospective early childhood teachers' views about science at the end of the course were: all students of the sample agreed that they did not learn before about science literacy and NOS during their school years. There was more emphasis on using terms such as, discovering, sharing ideas, creative work, science is linked to real life. Terms such as, I like science, were more frequent.

Overall, from the pre-questionnaire, Science is about chemistry, physics and biology, and we need it to understand and to learn about the environment, animals and plants. Science is produced through experiments and scientists do experiments to prove their theories. Science is important to us because it helps us to live better and to discover things that help us. Some of students did not like science because they are afraid of being hurt and because doing science is dangerous.

Also, the scientist is a white male, working alone and doing experiments especially in chemistry. He is a normal person with no mythic stereotype (such as the crazy scientist or Frankenstein). He has good qualities such as smart, respects others' opinions, tolerant.. Students' favorite scientist are mostly from social and psychology science (Montessori, Piaget..). As for scientists like Newton, Einstein.. They knew about them in the science textbooks in school time. Only one student mentioned an Arab scientist (Ibn-Alhaytham) because you do not learn about them in school. The majority of the participating students gave examples of Western scientists only and only very few of them named female scientists. One explanation for this could be that the national science textbooks mostly illustrate Western male scientists (Yacoubian et al. 2017).
From the post-questionnaire and the debriefing session, all agreed that a scientist is a good person, but he has no social life. Moreover, they believed that they had the stereotypical image of science and scientists from the science textbooks. They realized that science is related to our daily life and it is linked to socio-economic issues. Finally, the science teacher is doing activities with her student outdoors (fieldtrip), or a teacher using ICT in her teaching.

Recommendations

Future studies on large the samples are encouraged in the future, especially those KGs and primary pre-service science teachers' studies in Lebanon are scarce.

Finally, the initial program LMD (Licence-Master-Doctorat) for Early Childhood Education extends over 3 years or 6 semesters. The total credits are 180. Undergraduate courses credits in pure science are only 4 credits (Science activities for ECE course). This study shed the light on the importance of science and NOS for their future career. This study would be a valuable proposition to include the course History and Nature of Science (HNOS) for ECE students and one elective course about science, for the LMD reform committee at the Faculty of Education, Lebanese University.

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Author Information

Suzanne El Takach
Lebanese University, Faculty of Education
Unesco Area, Beirut
Contact e-mail: *suzanneeltakach@ul.edu.lb*