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Encouraging the Development of Scientific Literacy in Early Childhood Institutions: Croatian Experience

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***Abstract*—**There is a widespread belief in everyday discourse that science subjects (physics, chemistry and biology) are, along with math, the most difficult school subjects in the education of an individual. This assumption is usually justified by the following facts: low GPA in these subjects, the number of pupils who fail these subjects is high in comparison to other subjects, and the number of pupils interested in continuing their studies in the fields with a focus on science subjects is lower compared to non-science-oriented fields. From that perspective, the project: "Could it be different? How do children explore it?" becomes extremely interesting because it is focused on young children and on the introduction of new methods, with aim of arousing interest in scientific literacy development in 10 kindergartens by applying the methodology of an action research, with an ethnographic approach. We define scientific literacy as a process of encouraging and nurturing the research and explorative spirit in children, as well as their natural potential and abilities that represent an object of scientific research: to learn about exploration by conducting exploration. Upon project completion, an evaluation questionnaire was created for the parents of the children who had participated in the project, as well as for those whose children had not been involved in the project. The purpose of the first questionnaire was to examine the level of satisfaction with the project implementation and its outcomes among those parents whose children had been involved in the project (N=142), while the aim of the second questionnaire was to find out how much the parents of the children not involved (N=154) in this activity were interested in this topic.

***Keywords*—**Documenting, early childhood education, evaluation questionnaire for parents, scientific literacy development.

I. Introductory Background

We discuss fostering the development of scientific literacy, as a research process, both for preschool teachers and children, but also in terms of it being an integral part of the curriculum in institutions of early and preschool education (here in after referred to as "early education"). This paper points out why it is important to start encouraging the development of scientific literacy from early childhood and the reasons for such an approach, as well as the importance of understanding the child as an active and conscious being in practice, not just in theory. Why highlight this? Because in theory we respect the opinion of a child as a conscious and active being from the first day of its life, but in practice we fail to do so. We act this way as well towards their natural curiosity for knowledge and research.

For these reasons, in this paper we try to answer the questions: What do we mean by scientific literacy? What is the role of preschool teachers in creating opportunities for children to explore the environment in which they live? And based on this, see how they learn about the world and themselves in it, and then, present the results of the research into parental attitudes and their involvement in the project, titled, "Could it be different? How do children explore it?"

We use the concept of scientific literacy because we believe that it best denotes the fundamental purpose of children's education, especially in the field of science during the period of early childhood. This does not exclusively refer to the content and issues related to the field of natural sciences, but, above all, to support and foster the spirit of research and exploration in children and nurture their natural potential and abilities that are a matter of science in general: learning about research through exploration.

II. Development of Scientific Literacy

Nowadays, it is not a question whether all members of society should be scientifically literate or not; modern society is deeply imbued with scientific achievements. The consequences of scientific developments affect our lives and environment directly and indirectly on a daily basis. Active and responsible management of natural resources, as well as being able to navigate through our technologically advanced civilization requires that all individuals be scientifically literate.

Scientifically literate individuals will also access information on problems related to their own health and physical abilities more successfully. The scientific literacy of an individual is an important source of economic development, given that it involves an individual who is able to learn, think, solve problems, and also develop creative decisions and solutions. Since Europe is facing new competitive economic, as well as cultural and other social challenges, the European Commission document related to strategic thinking in education emphasized, among other things, that it is equally important to adopt transversal and fundamental knowledge and skills in science, technology, engineering and mathematics (STEM - Science, Technology, Engineering, Mathematics) from the earliest age. These are the skills and knowledge necessary for coping in a technologically dependent society - for later, acting within scientific research and technological development, they serve as a solid foundation for lifelong learning. Given that many European

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countries, including the Republic of Croatia, have endorsed the recommendations of the European Parliament and the Council on Key Competences for Lifelong Learning [1] in creating their national curriculum, in which scientific literacy, along with mathematical and technological literacy, form one of the eight groups of key competences to be developed within the educational system. Scientific literacy today is a fundamental objective of scientific education in almost every curriculum. Scientific literacy thereby understands a combination of specific knowledge, skills, and attitudes from the field of science, and is defined as the ability and willingness to use scientific knowledge and methods used for explaining the natural world in order to ask questions and reach conclusions based on evidence [1].

Scientific literacy is achieved gradually, at various levels of education, in accordance with the age and abilities of the child. When it comes to scientific literacy in early childhood, it is understood that children, within the framework of the research activities, apart from adopting some basic knowledge about practical ways in which the world around them functions, also develop certain skills and attitudes from the field of science. Reference [2] points out the following skills inherent to science and which children can develop in the context of research-cognitive activities: Observation (using all the senses), describing, comparing, classifying, sequencing, recording observations in words, drawing pictures and sketches, making graphs; asking questions and drawing conclusions; solving and identifying problems; communication skills (speaking, listening, recording, reporting); and, social skills (leadership, cooperation, discussing ideas and attitudes, listening to other people's point of view). The following skills are developed from attitudes to science: curiosity, enthusiasm, motivation, responsibility, originality, independent thinking, perseverance, as well as respect for evidence, openness of mind, critical thinking and more.

III. Scientific Literacy in Early Childhood

In addition to providing the possibility of developing a wide range of skills and attitudes in children, there are a few theories or arguments which contribute to the idea that the development of scientific literacy is necessary in early childhood.

First of all, there is no period of life when curiosity is as intense as it is during early childhood. During this period, the child touches, disassembles, climbs, listens, and tries out more things than they ever will in later life [3]. In addition, small children are the most unbridled creators of fiction - to them it is natural to pretend, to become deeply involved in different roles, and to imagine different worlds [4], and it is precisely curiosity and imagination that constitutes the essence of the development of science, and that launches new ideas, activities, thoughts and actions [5]. In this regard, we can conclude that children naturally possess what is most important for the pursuit of science, and encouraging the development of scientific literacy can only continue to support and foster the natural resources of a child. In addition, numerous examples from educational practice [6]-[8] demonstrate that children get involved in science and discovering the complex laws of physics from an early age, long before we start to notice and expect it.

Children do not know how to theoretically explain an occurrence they have discovered or are trying to discover without knowing its name, but the fact is that they are “biologically predisposed to learn about the world around them just as they are predisposed to walk, talk and communicate with others,” as noted by [9]. Also, the laity and individual teachers often show a higher or lower dose of skepticism when it comes to supporting and encouraging children in their attempts and need to understand individual questions or phenomena in the field of science, because they believe these are too abstract and difficult for children of early childhood age to comprehend. Projects such as Balance and static in the nursery [10], Desert vehicle and Newton's axioms [11], Light [12], Exploration of sound [13] and others, show that children are able to understand very abstract scientific concepts and solve complex scientific questions.

This confirms to the thesis which the famous author Bruner proposed in the 1960s and further confirmed in recent works “that every child, regardless of age, can be taught any subject in some appropriate way. (...) Preparedness (to learn) is not inborn but acquired. This general setting rests on a deeper truth that, every area of knowledge can be constructed at different levels of abstraction and complexity. That is, areas of knowledge are created, not caught. They can be made simple or complex, abstract or concrete” [14]. A good example to illustrate these thoughts are Montessori schools that at the beginning of the 20th century created, among other things, materials for mathematical operations with fractions so that young children could easily understand and handle tasks that pose a problem to elementary school children. Children playing with seesaws very early on realize the problem of a seesaw. That is, where to sit or how many should sit on each side to maintain balance. This is a very complex mathematical problem that is given to high school students and which also poses difficulties for them.

IV. “Could It Be Different? How Do Children Explore It?” - Project to Promote Scientific Literacy

At the heart of this project is the encouragement of the development of scientific literacy as an integral part of the curriculum in institutions of early education. Thereby, it is important to determine which conditions in the institutional settings, including the socio-pedagogically (role of teachers, other children, subcontractors), organization, and physical support and encouragement of research and cognitive activities of children, are in order to become an important of part of the curriculum. One of the research questions looks at how to develop a system of monitoring and documenting children's activities using video reflexive methodology and how that can become a means of mutual learning for children and adults in the discovery of a child's potential (methodology of action research with elements of ethnographic approach). In other words, this study hopes to examine the assumptions of many authors [3], [14]-[17], which suggests that children learn about the world around them in a different way, more akin to a scientific approach because they possess the most important element - curiosity. “The focus is on the active search for knowledge or understanding, in order to satisfy a child's curiosity” [18]. So, it is not the primary objective to know all the right answers, but to help children understand that answers to questions about the world can be found through their own involvement in research. Therefore, early childhood is the perfect time to answer their questions, and whereby their understanding of how things work is increased, or as stated in the American National Standard for Teaching Science [19], all children can take part in science, and all should get the chance to become scientifically literate. For this to happen, as early as possible, children should be offered the possibility to gain direct experience by exploring their surroundings in a way which is similar to when a scientist conducts research in their area of interest.

For these reasons, we wanted to know: Can children’s theories be connected to a research approach in scientific research? To what extent is monitoring and documenting of children’s activities really a means of understanding children and a basis for consideration of further activities that would support their learning? Is a lack of expertise in the field of science an obstacle in supporting and stimulating the interest of children in regards to questions and problems in the field of scientific literacy; and if so, to what extent?

By means of direct research of educational practice, based on the philosophy and pedagogy of the Reggio Emilia Approach and a (co)constructivist theoretical approach, the study showed that the documentation of the educational process affects the creation of opportunities for a child to participate in the development of the curriculum and in the study of phenomena that interests them. Based on an analysis of the research results [20], it can be concluded that children are a contribution to the development of new guidelines in the search for an answer to the question: How can a child in early and preschool education become a (co)constructor of the curriculum for their own learning and development? And based on the reflections and video documentation of both the children and the preschool teachers, the study shows how we can contribute to the development of the child’s scientific literacy.

The second research problem within the framework of the project is dedicated to the study of the parents' views about natural sciences and its importance in the lives of their children. The study focused on discussing the influence of the parents’ value systems on creating stereotypes regarding science and their expectations in terms of desired knowledge and skills that their children should develop.

The research project of the Center for Childhood Research and NGO, “Rainbow”, is a project aimed at learning about children and conducting research with young children, and involves learning through experience, as well as cooperative learning between children and adults that has been developed over the past three years, and which we have attempted to test or transform into practice. Research and cognitive workshops in collaboration with experts from various fields of science enables the children to explore different phenomena. The focus of this study was those areas of science which arose from the children's questions through play. The study researched sound (quiet sounds, loud noise), light, wind, air, and water, but also thermodynamics, statics, and optics. The project, as such, is innovative because scientists from different fields were included in the educational endeavor in order to satisfy the children's curiosity in discovering and understanding the world around them. Children were enabled to learn about the world and phenomena by employing research as one of the most natural forms of learning. Science is not static, and therefore, we did not teach children using scientific facts, instead we exposed them to a stimulating environment in order to gain the experience of being actively involved in experiments, discussions and explanations, which enabled them to come to their own truths and theories. In this sense, it can be said that by recording (documenting) the children’s activities and the individual knowledge they expressed, and that analyzing the collected material has become an everyday practice and is key to understanding children, and accordingly, in planning further activities. The value of these documents, as well as a joint reflection, has been recognized by the children as well. For example, while browsing one of the activity recordings, a girl called, Gaia (Six years and nine months old) commented: “Teacher, it’s very fortunate that you have recorded this, otherwise we would not remember how we used to think and what we used to say.” They had the opportunity to express their own experiences and impressions of the research through a variety of media, materials and techniques in creative workshops in collaboration with artists, mathematicians, physicists and biologists. In this project, digital cameras and video cameras were used in the same way one would use brushes, paint, and paper. Aside from the obvious documentary purpose of these forms of media, they can also be invaluable in the service of personal creative expression. The children constantly photographed and recorded, and the preschool teachers documented all activities. With minimal changes, a selection of these photos and videos were also exhibited. Encouraging children to creatively use media in the kindergarten environment also supported their research spirit and creativity in a positive and interesting way.

The use of digital media and information technology has expanded the possibilities of children's logic, imagination, research, and various fantasies. Given the speed with which children can change the shapes, sizes, colors of the images they have created, it gives them the opportunity to completely adapt the traditional process of constructing images. The introduction of these new resources into the examination of the children’s own perspectives in a game presented firstly from a scientist’s, and then from an artist’s point of view, has supported the creative ways they express themselves.

A preschool teacher taking part in the study offered the following interesting opinion on the project: “Gradually I am beginning to learn that with children I can explore those contents which I know nothing about and that the purpose is not to merely offer scientific content, but to encourage and develop in children a way of thinking ascribed to scientists (a more complex way than the everyday, rational thinking) through that content. This means to motivate children to think, ask questions, create hypotheses and verify them, express confirmation or rejection, to upgrade, revise, modify, etc. Therefore, I ask them the right questions that will enable them to develop sensitivity for the detection of problems, and I even "plan out" a problem. I think that this is a way of recognizing the value and the potential of scientific content, because precisely by looking for the answer to or explanation of some natural phenomenon or some other scientific content the children develop and upgrade their skills and knowledge. Also, from experience, I know that time plays an important role and facilitates a higher level of a child's thinking, reflection and questioning of a certain problem. It has been shown that if children have the opportunity to observe, touch, manipulate certain things or phenomena on a daily basis, their questions and attitudes towards them will become more complex, and they will notice things that we preschool teachers did not even consider."

External collaborators - artists (sculptors, fine artists, experts in new media) discovered in direct workshops with the children and preschool teachers "...how much children are able to do when they are motivated and inspired to artistically express themselves, especially when they notice the high level of enthusiasm of their preschool teacher..." Scientists (a Professor of Physics and Biology, from the Department of Physics, University of Rijeka) said that they "...very quickly observed that with children were able to "dive" a lot deeper than we expected."

The children showed that learning can be different, and in the previous chapters the study has attempted to describe this, i.e. there is no difference between scientists and children. Children are big scientists, just as scientists are small children. Both are surprised when they discover something. They want the freedom to create, discover, construct, (de)construct in a unique and original way. This study offered them something different. It offered an interactive game, included scientists and artists, and as researchers, we engaged ourselves in a (co)construction of the educational reality in which we supported the research and the children's creative potential. We discovered the beauty of mutual learning and creating in the discovery of the children's potential and what a child can do if given the opportunity.

V. Sociological Perspective on the Role of Parents in Supporting the Development of Scientific Literacy

There are a multitude of studies that confirm that the level of the parents' involvement is one of the most important factors of a child's educational success [21], [22]. Using the language of interactional theory, we can say that parents fall into the category of "significant others" - those actors whom children respect as the basic guides and landmarks in their daily lives. Reference [23] emphasizes that "actively involved parents can improve the children's motivation to learn; they raise their educational expectations and improve their results." It should be added that the parents' involvement can stimulate the children's curiosity to explore various scientific fields. For sociologists, it is certainly a challenge to explore the parents' attitudes and involvement in a project related to the development of scientific literacy in early and preschool age children, because up to this point, research related to this age group has been on the margins of sociological interest. Sociological research in the field of education in Croatia has been focused on structural limitations of certain social groups' participations in the educational hierarchy. Topics related to the lower educational achievements of people of lower socioeconomic status [24], of lower levels of cultural capital [25], and the achievements of women compared to men [26], [27], have been researched. Most of the research was conducted on a sample of students, with the starting points as follows: 1) educational success is important for the prosperity of individuals and society in general; and, 2) women should enroll in technical and science faculties in greater numbers. The first level of the educational vertical is extremely rare in the focus of the Croatian sociologists' interest. One of the few texts that deal with this topic is the analysis of regional differences in regards to the connection between the number of children in preschool programs and the employment of women [28]. Therefore, in this study we are trying to highlight another sociologically unexplored area in our society.

A. Research Objectives of Parental Attitudes towards the Project

An evaluation questionnaire was created upon the completion of the project for those parents whose children participated in the project. A separate questionnaire was also created for those parents whose children did not participate. With the first questionnaire, we wanted to examine to what extent the parents of those children who participated in the project were satisfied with the implementation and outcomes of the project. And for those parents whose children did not participate in the project, to what extent they were interested in this field. Regarding the first category of parents, the study was interested learning about the following:

1. To which extent are the parents satisfied with the involvement of various project participants (preschool teachers, children, scientists and experts, their personal involvement)?
2. To which extent are the parents happy with individual parts of the project?
3. Parents' proposals regarding possible improvements (open questions).
4. Do the parents notice any changes in the children's behavior, which they estimate to be a result of the child's participation in the project?
5. What are the parents' attitudes toward the theoretical foundations of the project, which was the guiding principle in drawing up all the educational elements of the project?
6. Is Inglehart's cultural value theory applicable to the parents' attitudes toward science?

7. The second category of parents, whose children were not involved in the project, was asked questions five and six, with one additional question:
8. Would you include your child in a natural science project if your kindergarten organized it?

B. Sample and Methodology

The survey was conducted in eight kindergartens in the Istria County (six kindergartens) and the Primorje-Gorski Kotar County (two kindergartens). The research was conducted on two occasions, in 2013 and 2014 on the total sample of N = 296 parents whose children attended the kindergartens. Results interpretation for the first year of project implementation was published in the following papers: [29], [30]. The sample included parents whose children participated in the project (N = 142), as well as parents whose children did not participate in the project (N = 154). The survey was conducted by means of questionnaires, whereby anonymity was guaranteed. Early childhood and preschool teachers handed out the questionnaires in their kindergartens after they were familiarized with the content of the questionnaire and the basic ethical guidelines.

We created, especially for this topic and researched population (parents of children of early and preschool age), a questionnaire which consisted of four instruments.

I) **Attitudes toward the theoretical background** were measured to examine whether the parents agree with the elements of the socio-constructivist theoretical framework of the project. The respondents were offered a Likert-type scale with four items, associated with a five-point assessment scale:
1. It is better that a child creates his own theories than to provide him with all the answers.
2. Scientists presented the children precisely with what they usually do.
3. Although my child is satisfied with the participation in the project, I think that at this age he cannot fully understand scientific phenomena.
4. I like the fact that a child can do their own research, but I think that some scientific facts should eventually be adopted.

II) **Attitudes toward the role of science in society and education** were also measured with the Likert-type scale containing twelve items, with a five-point assessment scale. We started from Inglehart's assumption about the existence of two types of values: materialist and post-materialist types. The materialist type was measured using the following six items:
1. Society should be built on science foundations.
2. Only a child who is familiar with science has a chance to succeed in life.
3. If more children were familiar with science, we would develop production much faster in the future.
4. Science provides us with the basic knowledge about the world.
5. If a child likes to learn, they should be directed toward science.
6. Science helps economic development.
7. The post-materialist type was measured using the following six items:
8. The fundamental task of studying science should be to save the planet for future generations.
9. Knowledge of science helps the modern man preserve some of the skills that are slowly becoming forgotten.
10. Prevention of science abuse is more important than social progress.
11. Science teaches children that all parts of the universe are interconnected and intertwined.
12. The goal of practicing science is to enrich the general human culture.
13. Science should primarily develop creativity in children.

III) **Parents' school experience** was measured using four nominal variables (open questions):
1. Which subject did you like the most during your education?
2. Which subject did you like the least during your education?
3. Which subject were you especially good at during your education?
4. Which subject did you especially struggle with during your education?

IV) **Socio-demographic variables** tested with the questionnaire were: gender (dichotomous variable), gender of the child (dichotomous variable), age (parents should enter their age), work activity (employee, entrepreneur/craftsman/free profession, retired, and unemployed), position in the job hierarchy (manager, employee, and unemployed) and the level of education (primary school, high school, college, university or higher).

C. Sample Structure

The socio-demographic characteristics of the respondents are presented in Table I.

As expected, more mothers (80.4 %) than fathers (19.6 %) took part in the survey, which is in line with the results of previous research in which it has been found that mothers more often pick up the children from kindergarten than fathers, and are generally more active in the life of the kindergarten [31], [32]. Approximately an equal number of parents of boys and girls participated in the survey. The average age of the parents was 35 years, whereby the youngest parent was 23 and the oldest 50.

Most parents have a completed college or university degree (51.3 %) and almost all are employed (92.8 %). It should be noted that this deflection in employment, when compared to the average Croatian population, is due to the fact that working parents have a priority in enrolling a child in the kindergarten, and sometimes it is a necessary prerequisite to be able to apply for enrollment.

TABLE I
SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE RESPONDENTS (%)

Gender	
Female	80.4
Male	19.6
Child's gender	
Female	50.0
Male	50.0
Education level	
Primary school	0.7
Three-year high school	15.1
Four-year high school	33.0
College (or three-year studies)	20.8
University (faculty)	30.5
Age ($\bar{x}$)*	35.26
Min-Max	23-50
Work activity	
Employee	76.0
Private entrepreneur/ craftsman/free profession	16.9
Retired	3.6
Unemployed	3.6
Position in the workplace	
Manager (more than 10 subordinates)	6.9
Manager (less than 10 subordinates)	23.8
Employees (no subordinates)	62.3
Unemployed	7.0

* The *age* category shows the mean, and the minimum and maximum value of years.

We should add that one in six parents are self-employed (16.9 %), and slightly less than a third of the parents are managers (30.7 %). Our sample is, therefore, specific and homogeneous in comparison with the general Croatian population.

D. Satisfaction with the Project

Parents whose children participated in the project demonstrated a high level of satisfaction with the engagement of the majority of participants in the project (Table II).

TABLE II
PARENTS' SATISFACTION WITH THE PROJECT (%)

	1	*2*	*3*	*4*	*5*
To which extent are you satisfied with the participation of your child in the project?	0.7	0.0	3.5	14.8	81.0
To which extent are you satisfied with the preschool teachers' engagement in the project?	0.0	0.0	0.7	13.5	85.8
To which extent are your satisfied with the scientists' and professionals' engagement in the project?	0.7	0.0	4.3	35.3	59.7
To which extent are you satisfied with your engagement in the project?	2.2	8.0	32.6	34.8	22.5
To which extent are you satisfied with the preschool teachers' presentation of the project?	0.0	0.7	2.8	24.1	72.3
To which extent are you satisfied with the final exhibition?	0.7	0.0	4.5	31.3	63.4

1= not at all satisfied; 2 = not very satisfied; 3 = somewhat satisfied; 4= very satisfied; 5 = extremely satisfied.

Over 95 % of parents (categories four and five) were satisfied and completely satisfied with the participation of early childhood and preschool teachers, children, and scientists. The average grades of the early childhood and preschool teachers' presentation of the project and the final exhibitions are also >4.5. The only item that received an average score of <4 is the engagement of the respondents, where as many as one third of parents stated that they are neither satisfied nor dissatisfied. The fact that parents were the least satisfied with the level of their participation in the project suggests that there is considerable room for their more active participation in such projects.

In addition to the upper scale, parents were given open-ended questions to emphasize those aspects of the project they were most satisfied and least satisfied with. The parents frequently mentioned the final presentation of the children's work and experiments as their favorite part of the project. Listed below are the most interesting views of the parents:

> "The children were able to experience being a part of a project and experiments, and many times they were given the freedom and enough time to research for themselves, and to think and reflect about each experiment." (Mother, 36)

> "I think it is a laudable project because it promotes scientific, logical, analytical, and abstract thinking in children, which they can greatly benefit from in everyday life, in further education, and it can generally help in the progress and development of society as a whole. Through play a child learns in an interesting way about scientific procedures, the use of evidence, drawing scientific conclusions which in a unique way brings them closer to the world of science and "scientific" thinking, and generally awakens the children's curiosity and creativity." (Mother, 37)

> From the negative aspects of the project the parents emphasized the unequal participation of individual children in the project and the limitation of the project regarding a small number of groups in the kindergarten. Parents emphasize spatial and temporal constraints of the project exhibition.

> "Regarding the final exhibition of the project, there was not enough time to see everything and space was limited, too many children (people) and not enough room for everyone." (Mother, 34)

With the aim of improving the project, they proposed more time to observe the children's works, a greater involvement of parents in the project and the involvement of a large number of kindergartens in the project.

The parents believe that children will be able to use their acquired research and analytical skills not only in primary school, but also later in life, and that they will familiarize them more with subjects such as physics and chemistry, and provide the necessary confidence to fulfill school obligations.

> "The experiences that the kindergarten children have gained in this project should be further complemented and their interest in the experiences and their knowledge should be stimulated so that they are not forgotten, so that they are further complemented in primary school." (Mother, 34)

Indeed, some believe that the work mode practiced in the project should be a model for teaching science in future education:

> "Schools should use the same approach when handling problems, and learning should be performed through experience and research." (Mother, 43)

Some parents obviously believe that this form of learning goes beyond the classic opposition of free time (time for play) and school time (time for learning).

One parent noted a positive social element of the project:

> "I do not know whether my child will remember this project, but I hope he has understood that together with other children he can create something - build. That when they do something together they can achieve a lot." (Mother, 33)

We asked those parents whose children did not participate in the project the following question: Would you include your child in a science project if the kindergarten organized it? Although this category of parents did not have a clear image of the form and content of the project, almost three-quarters of them responded positively. A negligible percentage of parents responded that they were against it, while a quarter of them were indecisive (Fig. 1).

We understand the parents' predominately positive attitude toward the inclusion of their children in the project as an indicator of confidence which the analyzed sample of respondents has in kindergartens as institutions and their employees.

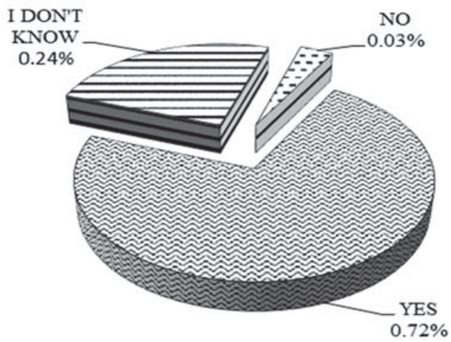

Fig. 1 Would you include your child in a natural science project if the kindergarten organized it?

E. Changes in Children's Behavior

We were interested in whether the parents have noticed changes in their child's behavior after the implementation of the project that might have been triggered by it. Over half of the parents noticed a change in 10 of the 11 offered dimensions of their child's behavior (Table III).

The majority of parents noticed that the project triggered a more general curiosity in their child (80.9 %); that the child more often asks questions that are associated with the area of natural sciences (78.1 %); that the child shows more interest in technical appliances (71.2 %); and that at home the child recounts some parts of the project (78.5 %). Two-thirds of the children want to do home experiments (66.4 %) and with greater interest, watch TV shows that cover topics from the area of science (64.9 %). Children play somewhat less games related to the area of science (57.2 %), skim through science books (52.2 %), use science terminology (50.9 %), and encourage their family to participate in science activities (50.4 %). The smallest percentage of children (16.3 %) stated their desire to become a scientist when they grew up.

TABLE III
OBSERVED CHANGES IN CHILDREN'S BEHAVIOR AFTER PARTICIPATING IN THE PROJECT (%)

	NO	YES
The child demonstrates greater general curiosity.	19.1	80.9
The child recounts some parts of the project at home.	21.5	78.5
The child more frequently asks us questions related to the area of natural sciences.	21.9	78.1
The child shows a greater interest in technical appliances (computer, cell phone, etc.)	28.8	71.2
The child wants to do experiments at home.	33.6	66.4
The child watches science shows with increased interest.	35.1	64.9
The child more frequently plays games connected to the area of science with his friends.	42.8	57.2
The child skims through science books with greater interest.	47.8	52.2
The child more frequently uses science terminology.	49.1	50.9
The child encourages the entire family to participate in science activities.	49.6	50.4
The child wants to become a scientist when he grows up.	83.7	16.3

We can conclude that the first objective of the project has been completed because children in various everyday activities show greater interest in the area of science after participating in the project.

F. Parents' Views on the Theoretical Foundations of the Project

We were interested in the parents' attitudes toward the implementation of the project and to its theoretical foundations.

TABLE IV
PARENTS' VIEWS ON THE THEORETICAL FOUNDATIONS OF THE PROJECT'S APPROACH (%)

	1	*2*	*3*	*4*	*5*
It is better that a child creates his own theories than to than to provide him with all answers.	5.0	5.8	20.1	26.6	42.4
Scientists presented the children precisely with what they usually do.	1.5	2.2	29.2	46.7	20.4
Although my child is satisfied with the participation in the project, I think that at this age he cannot fully understand scientific phenomena.	9.2	7.8	27.7	36.9	18.4
I like the fact that a child can research on his own, but I think that some scientific facts should eventually be adopted.	6.4	11.3	29.8	31.9	20.6

1 = strongly disagree; 2 = disagree; 3 = neither agree nor disagree; 4 = agree; 5 = strongly agree

Although these were discussed in more detail in the previous chapters, it is worth remembering that these are the ideas that children use to shape their knowledge and that the research process is more important than a mere adoption of scientific facts and that it is important to develop creativity in research and learning, etc.

Over half of the parents accept all four given claims, even though they are different theoretical provenances. Most parents agree with the socio-constructivist, saying "It is better that a child creates his own theories than to than to provide him with all answers" (69.0 %). More than two thirds (67.1 %) believe that this project has brought the calling of a scientist closer to the children, and they agree that scientists presented the children precisely with what they usually do. Two statements that are in line with the traditional socialization theory were also accepted by over half of the parents: "I like the fact that a child can research on his own, but I think that some scientific facts should eventually be adopted" (52.5 %), and, "Although my child is satisfied with the participation in the project, I think that at this age he cannot fully understand scientific phenomena" (55.3 %). At the same time, accepting the claims of different theoretical provenances is not a specificity of our questionnaires. It is a feature found in research regardless of the population whose views are being researched. This perceived inconsistency can be attributed to the influence of two opposing concepts of the child and childhood that simultaneously exist in the public opinion today. The first concept is traditionally based on the functionalist theory of socialization to which the Piagetian developmental psychology connects. It starts from the assumption that socialization is almost exclusively the result of biological and physiological one-way processes. Key participants are "serious" adults who are trying to integrate "immature" children into society. In order for this process to be successful, children need to firstly adopt the knowledge and social norms that adults consider as eligible. This is a pattern that is still dominant in our educational practice, so we understand the acceptance of the above paragraphs as a result of parental socialization. In contrast, the new sociology of childhood, from which the co-constructivist approach has developed, is based on the premise that childhood is a creation of a given socio-cultural and historical context, and it is understood differently in different societies. In this approach, the child is seen as an active subject and as an object of their own practice. This is an idea which is nowadays becoming increasingly present in the public arena, such as in the empowerment of children's rights.

G. Materialist and Post-Materialist Values and Attitudes Towards Science

Previous research of scientific literacy was generally carried out from the pedagogical and psychological perspectives. In a small number of sociological papers, we come across the linking of scientific literacy with socio-economic indicators [33], [34], religiosity [35] and gender [36]. Our goal was to connect the scientific literacy and attitudes toward science with value structures.

Taking into account the recent changes in social values in Croatian society, which have been driven by changes in the political and economic systems [37], but also by globalization and modernization processes, we assumed that there are two basic types of values that have different understandings of the role and importance of science in society. We used Inglehart's cultural theory of materialist and post-materialist values as the theoretical framework [38]-[40] and applied it to our specific topic of science to describe the two opposing value orientations. The first value orientation (or type) has a more traditional view of the role of science in a society. Science is the carrying part of a massive industrialization and production in a surging economic society, in which engineers are among the most respected professionals, and children are encouraged to pursue a career that is associated with natural sciences, especially mathematics and physics. The second value orientation (type) gives priority to ecology with respect to economic prosperity, as well as to skills rather than mere knowledge. This is a critique of the role of science and its association with a growing awareness of the curbed growth of the 1970s. The post-materialist value orientation brings into question the optimistic scientific vision of a science-based happy future.

TABLE V
ATTITUDES TOWARD SCIENCE (%)

Particles	*1*	*2*	*3*	*4*	*5*
V1 Society should be built on science foundations.	1.8	7.1	39.4	36.5	15.2
V2 Only the child who is familiar science has a chance to succeed in life.	18.0	29.7	31.1	16.3	4.9
V3 If more children were familiar with science, we would develop production much faster in future.	6.0	9.9	41.0	30.4	12.7
V4 The fundamental task of studying science should be to save the planet for future generations.	1.1	3.9	14.0	40.4	40.7
V5 Science provides us with the basic knowledge about the world.	1.8	2.8	16.4	51.6	27.4
V6 The goal of practicing science is to enrich the general human culture.	2.1	3.2	17.1	43.9	33.6
V7 Prevention of science abuse is more important than social progress.	3.6	6.8	32.7	32.0	24.9
V8 If a child likes to learn, they should be directed to science.	4.9	16.2	34.2	26.4	18.3
V9 Science should primarily develop creativity in children.	1.1	3.9	18.1	43.1	33.8
V10 Science helps economic development.	1.1	4.7	28.6	39.9	25.8
V11 Science teaches children that all parts of the universe are interconnected and intertwined.	0.7	2.9	22.7	44.2	29.5
V12 Knowledge of science helps the modern man preserve some of the skills that are slowly becoming forgotten.	1.1	2.5	18.9	45.6	32.0

1 = strongly disagree; 2 = disagree; 3 = neither agree nor disagree; 4 = agree; 5 = strongly agree

These types are artificial constructs and are simplified in the light of a complex reality, but we believe that the general understanding of the role of science in a society is guided by these two stereotypes. We assume that people are guided by these ideas when thinking about science. In our case we assumed that the parents were guided by them when faced with the possibility of including their child in a project, which promotes scientific literacy, making this a useful insight into the work of educational professionals and sociologists. The co-constructivist approach to teaching science focuses more on the research process and that a child constructs their own knowledge through experience [41], rather than by reading the entire subject content or the correct answer to a factual question. Therefore, we believe that parents who are more post-materialistically oriented will more greatly support a co-constructivist theoretical framework of the project than those parents who are materialistically oriented and consider the learning process as incomplete if the child has not adopted all the scientific facts.

Table V shows the descriptive analysis of attitudes toward science. Most of the items are highly accepted, while items V4, V5, V6, V9 and V12 are accepted by more than three quarters of respondents. All of these items, with the exception of the item V5, express post-materialist values. Parents look at science primarily as a means of preserving nature/the planet and as a development of certain skills. The materialist value expressed in items V1 is partially accepted and the least accepted is item V2, which claims that only that child who is familiar with science has a chance to succeed in life (21.2 %). We can conclude that the descriptive analysis shows that parents express more post-materialist values.

TABLE VI
VARIMAX TRANSFORMATION OF VALUE TYPES

Particle	Saturation	
	F1	**F2**
V2 Only the child who is familiar with science has a chance to succeed in life.	**.786**	
V3 If more children were familiar with science, we would develop production much faster in the future.	**.785**	.251
V10 Science helps economic development.	**.704**	.217
V1 Society should be built on scientific foundations	**.591**	.403
V8 If a child likes to learn, they should be directed to science.	**.549**	.462
V9 Science should primarily develop creativity in children.	**.524**	.470
V4 The fundamental task of studying science should be to save the planet for future generations.	.117	**.699**
V12 Knowledge of science helps the modern man preserve some of the skills that are slowly becoming forgotten.	.298	**.694**
V7 Prevention of science abuse is more important than social progress.	.107	**.684**
V11 Science teaches children that all parts of the universe are interconnected and intertwined.	.332	**.616**
V6 The goal of practicing science is to enrich the general human culture.	.438	**.596**
V5 Science provides us with the basic knowledge about the world.	.475	**.483**

In the next step, we applied the factor analysis under the component model with GK criterion, which extracted two factors (Table VI). Together they interpret the 53.46 % of the total variance. All particles have a satisfactory high saturation on the factors. The initial factor solution was transformed into the orthogonal varimax position.

Table VI shows the results of the varimax transformation of the component analysis. Saturations of less than 0.10 are not entered into the table. Below is a separate display of the two factors.

Six variables, that highly saturate the first factor, describe the materialistic value type, with one exception: Science should primarily develop creativity in children. This variable has the lowest value of saturation and at the same time a rather high saturation value on the second factor, so it is possible that it was ambivalently perceived by respondents. This factor explains 27.48 % of the total variance (Table VII).

TABLE VII
MATERIALIST TYPE

Particle	Saturation
V2 Only the child who is familiar with science has a chance to succeed in life.	.786
V3 If more children were familiar with science, we would develop production much faster in the future.	.785
V10 Science helps economic development.	.704
V1 Society should be built on scientific foundations.	.591
V8 If a child likes to learn, they should be directed to science.	.549
V9 Science should primarily develop creativity in children.	.524

Six variables that highly saturated the second factor describe the post-materialist value type (Table VIII), with one exception: Science provides us with the basic knowledge about the world. This variable has the lowest value of saturation and at the same time a high value of saturation on the second factor, so it was probably ambivalently understood. This factor explains 25.99 % of the total variance.

TABLE VIII
POST-MATERIALIST TYPE

Particle	Saturation
V4 The fundamental task of studying science should be to save the planet for future generations.	.699
V12 Knowledge of science helps the modern man preserve some of the skills that are slowly becoming forgotten.	.694
V7 Prevention of science abuse is more important than social progress.	.684
V11 Sciences teaches children that all parts of the universe are interconnected and intertwined.	.616
V6 The goal of practicing science is to enrich the general human culture.	.596
V5 Science provides us with the basic knowledge about the world.	.483

Our initial assumption of the existence of two value types, materialist and post-materialist, has therefore been confirmed. Distributions of individual variables and factor scores have shown that parents are more accepting of the post-materialist understanding of the role of science in the lives of their children. Interestingly, the statistical analysis did not establish the connection between sociodemographic variables and value types, which is probably due to the homogeneity of the sample.

H. Differences between Parents whose Children Participated and did not Participate in the Project

We compared these two groups of parents to determine whether the participation in the project is related to the value types (Table IX).

The t-test has shown differences among parents with post-materialist values ($t = -2.375$, $p<0.05$). Parents whose children participated in the project are more prone to post-material values. Parents did not choose this project among several available projects in the kindergarten. In other words, we cannot claim that parental value structure influenced the decision on the inclusion of their children in the project. It is possible to assume that there is a recurrent impact of the project on their views. However, in order to decisively make such a far-reaching conclusion, it would be necessary to research the parents' value structures before and after the participation of their children in the project.

TABLE IX
VALUE TYPES AND THE CHILDREN'S INCLUSION IN THE PROJECT: T-TEST FOR INDEPENDENT SAMPLES

		N	$\bar{x}$	F	Sig.	t	Sig. (two-way)
Materialist type	Child participated	139	.03	3,053	.082	.463	.644
	Child did not participate	119	-.03				
Post-materialist type	Child participated	139	-.13	5,831	.016	-2.375	.018
	Child did not participate	119	.16				

In the next step, we searched for the connection between the value type and attitude toward the theoretical framework of the project of encouraging scientific literacy. A low correlation ($r = 0.202$, $p < 0.05$) was found only between the materialistic type and attitude that scientists presented the children precisely with what they usually do (Table X).

TABLE X
VALUE TYPES AND ATTITUDES TOWARD THE PROJECT: CORRELATIONS

	Particle	N	Pearson' correlation coefficient	Sig. (two-way)
Materialist type	Scientists presented the children precisely with what they usually do	117	.202*	.029

Let us assume that the homogeneity of the sample is the reason why the assumption that post-materialistically oriented parents show more support for the co-constructivist theoretical framework of the project than parents who are materialistically oriented, was not found.

I. School Experience

We assumed that the respondents' personal school experience could be linked to the attitudes toward the project and the value type. Table XI shows the experience of parents with school subjects during their education.

Mathematics is a subject that has left the biggest impression on the respondents: at the same time, it is the most liked (17.9 %) and the least liked (20.6 %) subject. It is followed by science subjects (biology, chemistry, and physics), which 15.5 % of respondents singled out as their favorites, and 26.0 % as their least favorites. The statement from the beginning of the text has proved true because respondents share the conviction of everyday discourse regarding the "difficulty" of mathematics and science subjects. When it comes to the evaluation of their success in mastering certain subjects, the distribution is similar to the previous one, with one interesting exception. The percentage of those who were most successful in science courses has dropped to 6.8 %, while the percentage of those who were least successful in them has remained high at 22.3 %.

TABLE XI
PARENTS' EXPERIENCE WITH SCHOOL SUBJECTS

	Subject	%		Subject	%
Which subject did you **like the most** during your education?	Mathematics	17.9	Which subject did you **like The least** during your education?	Mathematics	20.6
	Science subjects	15.5		Science subjects	26.0
	Croatian languages	9.1		Croatian language	8.4
	Foreign languages	11.5		Foreign languages	15.9
	Other subjects	35.2		Other subjects	16.3
	Missing	10.8		Missing	12.8
	Subject	**%**		**Subject**	**%**
Which subject were you **especially good at** during your education?	Mathematics	18.9	Which subject did you especially **struggle with** during your education?	Mathematics	24.7
	Science subjects	6.8		Science subjects	22.3
	Croatian language	15.2		Croatian language	11.5
	Foreign languages	18.2		Foreign languages	8.4
	Other subjects	26.0		Other subjects	14.9
	Missing	14.9		Missing	18.2

A statistical analysis has shown neither a connection between these variables with sociodemographic characteristics, nor a connection with value types.

VI. CONCLUSION

Evaluation of the project on encouraging scientific literacy in children has shown that the parents of children involved in the project were extremely satisfied with its implementation and outcomes, and that the parents wish for a continuation of such activities in the future both in early childhood, preschool and school periods of their child's life, as well as in the application of a similar approach in other areas. Parents have noticed many positive changes in their children's behavior and have pointed out in particular that they would like to be more involved in such projects, although they accept attitudes that are not in accordance with the theoretical foundation of the project. This, after all, can mean that both parents and children are part of the educational system, whose improvement they desire. It is worth repeating that the positive attitude toward this type of project was also expressed by the parents whose children did not participate in the project.

A descriptive analysis of values shows that parents express more post-materialist than materialistic values, although they are not consistent at it. The factor analysis singled out two factors: materialist and post-materialist type. A further statistical analysis has neither found a link between socio-demographic variables and factors, nor between the parents' school experiences and other variables. Finally, it should be noted that the sample (as always when doing research in kindergartens) was homogeneous and specific, which limits the interpretation and conclusion.

We would like to conclude with a motivational sentence from one of the parents: "After this experience, the children will have better ideas and a greater imagination than before."

In other words, we want to emphasize that a child has an innate need to explore and discover the world around them, and their own place in this world. By encouraging the development of scientific literacy the preschool teacher supports this innate need of the child, nurtures their research potential, creates an incentive context in which he can develop their own scientific literacy, i.e. acquire practical knowledge in the field of science and develop important skills and attitudes toward learning in one research process which is in line with its interests.

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