ACTA DIDACTICA NAPOCENSIA

Volume 13, Number 1, 2020 -DOI: 10.24193/adn.13.1.8

LEARNING SCIENCE IN PRESCHOOL BY USING RESEARCH APPROACH

Irena GOLUBOVIĆ-ILIĆ, Ivana ĆIRKOVIĆ-MILADINOVIĆ

Abstract: This paper emphasizes the possibilities and effects of using research approach (discovering scientific concepts through play) as one of the innovative ways of teaching pre-school children. Apart from the fundamental characteristics and importance of using research approach, the paper also presents the results of an empirical research aimed at the influence of different ways of implementing focused activities on children's motivation and curiosity as well as developing thinking and reasoning skills. The research was carried out in the field of Basics of Science, specifically contents about magnetism and it was performed using a method of theoretical analysis, experimental research method (experiment with parallel groups) and interviewing technique. The research results show the existence of differences in children's motivation for discovering scientific concepts through play and their curiosity. On the other hand, their thinking and reasoning skills were not measured in this research because it was not possible in their age due to their inability to read and write.

Keywords: research approach, children's motivation, focused activities, Basics of Science, pre-school children (3-6 years of age).

1. Introduction

Kindergartens and pre-school institutions are places where children gain elementary knowledge from different fields. This is the reason why that educational process must be organized in a way that would ensure children's acquisition of knowledge in a quality and efficient manner. Curiosity and desire to learn lie in a child's nature, and the task of educators is to enable it. At the same time educators should use children´s need to learn, explore, find and ask answers to "develop scientifically literate citizens" (Watters at all, 2000: 5). An educator should devise activities that would satisfy children's curiosity, allow a child to play and learn at the same time. Through inquiry games and activities, children directly learn about the world that surrounds them. By staying in nature, they learn about the importance of the Earth, air, plants and animals, but also natural materials, phenomena and processes. For these reasons, the contents from the field of Basics of Science, especially elements of non-living nature (water, air, soil ...), but also natural phenomena (electric charge, magnetism, motion) are the most suitable for using research approach. Complex, interdisciplinary, authentic and interesting contents of science education aims primarily at introducing children to and preparing them for the scientific understanding and interpretation of numerous natural and social phenomena that they will encounter in their future schooling (Golubovic-Ilic & Cekic-Jovanovic, 2013).

We have chosen a content of magnetism because it is interesting to youngsters (Ningsih at al., 2019), "a commonly negotiated topic at the preschool level" (Kalogiannakis at al., 2017) and allows different ways of experimenting, exploring and testing through play. We have tried to find out through these contents the effects of using a research approach on teaching five-year-old pre-school children, in other words, we have tried to find out if different approaches in teaching science lead to different effects to children's motivation, curiosity and achievement.

Received February 2020.

Cite as: Golubović-Ilić, I; & Ćirković-Miladinović, I. (2020). Learning science in preschool by using research approach. *Acta Didactica Napocensia,* 13(1), 77-86, https://doi.org/10.24193/adn.13.1.8

2. Theoretical approach to the problem

Research approach is one of the various methods that can be used to modernize and intensify educational work in pre-school institutions. It is based on a constructivist educational paradigm grounded in the view that learning is an independent activity of an individual (Gage & Berliner, 1998: 103) and involves active participation of children in learning about and identifying phenomena, cause-and-effect changes, consequences, processes in a motivational and well organized environment (which does not necessarily have to be a study room). At the same time, by combining the methods of conversation, demonstration and practical work, pre-school teachers guide children to explore, check, question their assumptions and discover new knowledge in an age-appropriate way and using appropriate means (Dogan & Simsar, 2018; Golubović-Ilić, 2017; Cassata-Widera et. al, 2008).

The main features of the early science education include motivating children in terms of self-research and discovery, independent inferring, adopting certain scientific methods with the appropriate help of educators. On the other hand "in the early years children require support in their investigations and we need to take care in selecting contexts that provide an appropriate basis for experimentation" (Siraj-Blatchford & MacLeod-Brudenell, 2005: 8). Pedagogical, methodical and theoretical knowledge and experience confirm that independent research work, particularly the application of experimental, practical work, helps children understand what they are talking about, explain certain properties and processes, give new examples and use the acquired knowledge in solving everyday problems (Fitzgerald & Smith, 2016; Bulunuz, 2013; Eshach & Friend, 2005). At the same time, they are developing a capacity for self-education - knowledge and understanding of ways and methods for reaching new knowledge and scientific truths, principles of scientific research (Harlen, 2010; De Zan, 2005; Kallery, 2004), for future learning and work in everyday life. The pre-school science activities "should be created so that these can provide opportunities for children to investigate, to make predictions and talk about any subject, to be able to satisfy their curiosity, and to create cause-effect relationships between events" (Dogan & Simsar, 2018: 59).

Research activities involve a combination of elements of the problem-solving method, project-based activities, discovery learning, interactive and cooperative teaching. The place, manner, time and scope of research activities are determined by the pre-school educator as the organizer and manager of the education process, but ideas and suggestions can be given by children themselves depending on their interests and possibilities. Instead of a teacher, a pre-school educator becomes a coordinator, a motivator, an instigator, a diagnostician, an innovator and a partner in work with children (Crawford, 2000; Anderson, 2002).

Educational and upbringing work based on research approach leads to understanding the essence and allows a systematic reflection of what has been learned so that new ideas develop from the previously adopted ones (Harlen, 2010), so children's experiences in the early years can have significant impact on their later learning (Worth, 2010). Research approach enriches the learning process, intensifies it and makes it more dynamic, promotes an active and direct relationship of children with the subject of learning (research), questions previous knowledge, attitudes and opinions of children, encourages and develops critical thinking, integrates children's skills with knowledge and understanding (Jenjić & Dragić, 2016). "In this type of learning, children's active participation is crucial" (Bulunuz, 2013:229). Research activities involve various aspects of a child's personality, making it relate its previous experiences to new knowledge during the research of its surroundings, allowing its verbal interaction and cooperation with other children and motivating it to gain new knowledge using its own activity.

The common teaching practice in Serbian kindergartens, according to the view and perceptions of pre-school teachers, is mainly done by presenting the curriculum (Educational Gazzete, 2006), contents by telling children about scientific concepts, reading, showing certain objects, pictures, experiments, while children are passive, they just watch and listen to educators; the emphasis is on *memorizing*, rather than on *thinking* and *reasoning*, and situations involving children manipulating objects, exploring and discovering through play and inquiry is rare (Ćirković-Miladinović, 2015**;** Eshach & Friend, 2005).

The contents about magnetism belong to the field of Basics of Science, so by combining the experimental research method (experiment with parallel groups) and the survey method, we have tried to determine whether the method of implementing focused activities about magnetism affects preschool age children motivation, curiosity and thinking skills. We chose the topics about magnetism since children have no (or have scarce) previous knowledge and experience about this natural phenomenon (Mayer, 1991), and these are contents that can be presented in an interesting way using research approach. Some research results (Kalogiannakis et. al, 2017; Samarapungavan et. al 2008; Eshach & Friend, 2005) have shown that research approach introduces significant changes in terms of motivation, curiosity, thinking and reasoning skills of children, as it triggers a greater interest and a desire to learn more (intrinsic motivation), develops confidence and opinion, and understanding as well as enhancing thinking skills which are the result of children's own observation and research.

3. Research methodology

3.1. Research goal

We tried to determine the differences in motivation, curiosity, thinking and reasoning skills of preschool children when it comes to content about magnetism depending on the way in which focused activities are implemented, or the influence of different ways of implementing focused activities in the field of magnetism on children motivation, curiosity, thinking and reasoning skills.

3.2. Research tasks

There were two tasks in our research: 1) To determine the differences in terms of motivation for further inquiry and curiosity of five-year-old pre-school children who learned about magnetism through focused activities applying the research approach and children who acquired the same contents in the usual, traditional way by just listening and watching the pre-school teacher talking about certain concepts,

2) Comparing the number of correct answers in the interview of pre-school children who adopted the contents on magnetism by applying research activities and on the other hand, children who adopted the same content in the usual, traditional way.

3.3. Research methods, procedures and instruments

The method used in the research was a theoretical analysis method, but also an experiment with parallel groups.[1] By applying the experimental method, we wanted to find out whether differences in motivation, curiosity and knowledge of children about magnetism would arise after the implementation of focused activities on identical contents, in different ways and in two educational groups - experimental and control. In doing so, we considered the achievements and knowledge of children from two aspects: (1) how they formulate answers to questions and (2) the number of correct answers to questions (individually - per child and on average - at group level). For the needs of the research we have created five unit plans for implementing focused activities on the topic of *Magnetism*. The contents on magnetism processed by the pre-school teachers with the children during five working days consisted of the following units: 1) The notion of magnetism – What is the magnet? 2) Natural and artificial magnets - What can we do with a magnet? 3) The effect of magnet - magnetic forces (What does a magnet attract?), 4) The application of magnet and 5) Magnetic field - Where do we feel the effect of magnet? The essence of all five units was the use of research approach - discovery through play, inquiry, experimental activities and practical work, which means that children

[1] The experimental research method involves introducing methodical innovations (in our case research activities) into the regular course of teaching work to determine their effectiveness in comparison with some other pedagogical procedure, method or teaching strategy. In doing so, this method involves two groups of respondents - *control*, in which the planned contents are processed in the usual way, and *experimental*, in which processing is done based on models designed for research purposes. The application of this method implies an initial and final measurement before and after the experiment begins ("introduction" of an independent variable), which was not used in our research due to the age of our respondents (this could be used in research when respondents are older and when they have ability to read and write).

independently, with suggestions and supervision of preschool teachers, in pairs and groups, perform experiments and examine certain properties of the magnet. On the other hand, the pre-school teacher in the C-group received only the names of the units of activity and was tasked to do it in the usual, traditional way (as he usually does with children) during the following week. He was informed beforehand that children will be interviewed after the content is processed but was not familiar with the aim and details of the research.

Out of the research techniques, we used interviewing and semi-structured interview instrument - a series of 5 open-ended questions designed for research purposes. In order to determine and to check whether there are differences in the number of correct answers of children in both educational groups, we conducted a semi-structured interview with all the respondents a week after the implementation of various methods of processing the content on magnetism. The questions during the interview were modified, adapted to the children's answers to the previous question, and the formulations were changed and supplemented with sub-questions so that children could better understand what they were asked. For the purpose of more accurate data processing and detailed content analysis of children's responses (how many correct answers were given per child and in a group overall), interviews with children were recorded using a voice recorder with the consent of their parents, pre-school educators and the kindergarten administration.

3.4. Research sample

For the purpose of this research, two suitable samples were selected: a sample of respondents - children and a sample of educational content, that is, five unit plans that were conducted with children. When it comes to the respondents, the sample consisted of two groups of five-year-old children in the pre-school institution named "Pionir" from Jagodina (Serbia) - *children of the experimental group* (E-group = 32 enrolled children) and *children of the control group* (C-group = 33 enrolled children). Since the number of "attending" children varied[2] on a daily basis, the results were presented for a total of 40 children (we have selected only those children who were present and participated in this examination all five days, meaning, only 40 children out of 65 were selected for the final results) for the convenience of mutual data comparison: 20 in the E-group and 20 in the C-group.

3.5. Organization and course of research

The research was conducted in two phases: 1) the first phase involved the implementation of the contents in E- and C-group, however *in different ways*; 2) the second phase consisted of an interview with the children of both groups. Before we started the research in the pre-school institution, we payed several visits to these groups of children and in some free activities talked about magnets - where the magnets can be seen; what magnets are for, why we can use them, where we can get them etc. What we got as their answers were that magnets were considered as fridge decorations, something that we bring home as travel souvenirs or something that can be a holder for a message. Both groups' responses were similar, that is, children only had experiential knowledge about magnets and they did not possess knowledge based on scientific facts. These visits were conducted with the purpose of finding out the initial knowledge of the children that were research participants.

4. Results of research and Discussion

The first research task was to find out the differences in motivation for further inquiry and curiosity of five-year-old pre-school children in learning about magnetism. During the analysis of children's responses given in the interview, we allowed for the fact that not all children were motivated for further research activities in the same level. Namely, children in the experimental group were more motivated during the activities and showed their curiosity by asking their teachers to do these activities more often while the children in the control group were less motivated to participate and their attention

[2] Author's note: There were children who were absent during the research or processing of the contents for some reason and those who refused (did not want) to answer questions during the interview.

span was shorter, they did not show their willingness to listen and watch similar research activities conducted by their teacher. We separately pointed out characteristic answers of the children to certain questions in both groups.

The first question – *How do we call objects that have the ability to attract metal objects*? - there were no incorrect answers in the whole sample - all children in both groups gave the correct answer. Magnets and magnetism are contents that are interesting, challenging, and new in relation to the usual contents taught by educators in the field of Basics of Science (animals, seasons, occupations of people ...) to children of this age (Kalogiannakis at al., 2017; Bulunuz, 2013; Meyer, 1991). Children have certain experiences about magnets, most of them have seen magnets (usually souvenirs and fridge decorations), but they have the desire, curiosity and the need to touch them, examine them, explore their properties: what they attract, in what forms they can be found, through which media and materials they work ... In this context and for the reasons given, in the whole sample, there was no child who did not know or gave a wrong answer. Also, this data supports the fact that all participants in this research, regardless of the way in which contents about magnets were processed (usual, traditional way or using research approach), memorized the new term *magnet/magnetism* (these are not synonyms, but for children aged 5 there is no essential difference), or that motivation, interest, adoption of something new (to them) resulted in the maximum number of correct answers. The achievements of children were certainly influenced by the fact that during the interview we showed objects (in this case a magnetic rod), bearing in mind that it is important for them to have sensory experiences while talking on a particular topic.

We got various answers to the question *What makes a magnet different from a rubber toy*? Using this formulation of the question we wanted to check that children learned the basic features of a magnet (which distinguishes it from other objects) to attract metal (or iron and steel) objects. In fact, we were interested in finding out how the children who dealt with magnet and magnetism contents in different ways would explain the difference between magnets and rubber objects (we chose an object close and familiar to them) and what they would use as the basic criterion for distinguishing or comparing them.

Table 1. *Responses of children about distinguishing a magnet from other objects*

What makes a magnet different from a rubber toy?		
E-group		
Expected answers	*Spontaneous answers*	*Other answers*
- By a magnet, we can draw metal objects and by a rubber toy, we can't. -A magnet can attract iron objects and a rubber toy can't. - Because a rubber toy is not a magnet and cannot attract metal objects.	- Because the *magnet is plastic*. A magnet can attract everything made of iron, and a rubber toy can't. - *The magnet is hard and the rubber toy is soft.* A magnet can attract metal objects, and a rubber toy can't. - *We play with rubber toys* and they cannot attract iron things, and magnets can attract iron things.	- A magnet can attract metal things, and a rubber toy can attract rubber things. - I don't know.
C-group		
Expected answers	*Spontaneous answers*	*Other answers*
- A magnet can attract metal objects, and a rubber toy can't. - A magnet can attract metal things and a rubber toy can't	- *Because the magnet is hard, and the toy is soft.* And the magnet attracts metal things, and the rubber toy does not.	- One can make a toy with a magnet. - The toy is rubbery, and the magnet is hard, and the toy is sweet. - I don't know.

In Table 1. we see some selected children's answers that were put into three groups: expected, spontaneous and "other" (which we could not classify to any of the previous groups.). The expected group contains the correct answers - to say what a magnet can and what a rubber toy cannot do regarding the possibility of attracting metal objects. In addition to the expected, we have also separated a group of responses that we called "spontaneous". Children aged 5 years have not yet developed scientific concepts, they are in the pre-operational phase of cognitive development (according to Piaget's theory of cognitive development - Wadsworth, 2004), which implies providing answers in relation to their specific experiential experience relating to handling objects, identifying and naming different materials in objects, identifying their external characteristics - shapes, colours, sizes ... In this case, they choose something more striking and most interesting to them (centering) as the criterion for distinguishing magnets and rubber toys, so in the foreground they put other features of these items such as strength ("*Magnet is hard and rubber toy is soft*"), possibility to use those objects while playing ("*We can play with a rubber toy, and a magnet can attract iron things*"). The third group of responses are incorrect answers and answer "I don't know". We can interpret the answer "I don't know" in different ways. When they do not want to answer the question asked, not because they do not really know, but because they are not able to verbally express their opinions, children often tend to make up and utter an answer not related to the question asked or say what first comes to their mind. It is difficult to determine whether a child really thought about the question or gave such an answer just for the sake of answering. According to some authors (Waterman at al., 2004; Lonka at al., 2000), their answer "I don't know", which appears after the age of five, can be considered as an indicator of a certain maturity of thought and progress in children's thinking. In contrast, one should take into account the fact that among the children in both educational groups there are those who were born at the beginning of the year (January, February) and at the end of the year (November, December), so they have not reached the same level of cognitive maturity[3]; therefore, this can be one of the reasons why they cannot answer the question and/or it is easier for them to say they do not know. Regardless of the criterion for distinguishing a magnet from a rubber toy, we also classified spontaneous answers as correct answers, since it was important for us to see that the children noted the basic difference between these two objects. The conclusion is that both groups were quite successful, so in the E-group, 17 children gave the correct answer, 2 children gave an incorrect answer and one child said it did not know, while in the C-group, the correct answer was given by 13 children, 2 children gave a wrong answer and 5 of them said they did not know.

By the third question - *What objects are attracted by magnets*? we wanted to check if the children had acquired knowledge of the objects attracted by magnets, so we classified their answers "metal" and "iron" as correct. When asking this question, we put a nail, a paperclip, a key, a glass marble, a plastic tea spoon and an eraser on the table in front of the children. By acknowledging such responses, we deliberately did not recognize the principle of scientificity (although during the activities we noted that magnet does not attract all metals), since we believed that at that age it was too much and impossible to expect children to adopt and master the term "metals". This concept is too abstract at their age, so it is enough to distinguish metal from other materials such as wood, glass, plastic, rubber... Based on this, the results show that all E-group children gave the correct answer, while in the C-group the correct answer was given by 17 children. In addition, C-group children gave answers that were not heard in the E-group, e.g. C $_{(17)}$, *It can stick to a fridge*. (our sub-question: What material are fridges made of?) *Of stone*. or C $_{(9)}$: *It can attract a nail*. (What material are nails made of?) - *Of glass*. Based on the above examples, we notice that the two children know which objects are attracted by the magnet, but they do not know how to designate, identify and/or differentiate materials. What is important to us is that, as with previous questions, E-group children showed better achievements than C-group children.

We got interesting data by analyzing children's answers to Question 4 - *through which materials do magnets work*? When asking this question, we placed a sheet of paper, a glass cup, a plastic tray and a piece of plywood on the table in front of the children. The correct answer was given by 18 and 12 children in the E-group and C-group, respectively. By analyzing the formulations of their responses, we noticed that E-group children, based on the experiences they gained during the experiment, listed

[3] At this age, the 10-month difference affects the difference in the level and pace of intellectual development of children.

more materials, explained how they discovered through which materials the magnet worked, how the magnet worked through glass, cardboard, wood ... while the C-group children most often stated paper and wood or chair as materials through which the magnet worked and, at the same time, not all of them knew from which material the chair was made. With this, we once again confirmed our impression that children of the C-group have poor knowledge of and do not differentiate materials. Based on their answers, we can assume that the educator mentioned and maybe even showed the effect of a magnet through paper and wood (chair), so the children gave the answers according to the memory of what they saw.

Regarding the last question *What is the name of the instrument/device used for determining cardinal directions?,* there are also differences in formulations of responses. That was when we showed a compass. In the E-group there were children (4 children) who recognized the instrument, they knew how to describe it, but they did not know how to designate it: 1) *I know, but I cannot remember. Its needle is a magnet and serves us to return when we get lost*; 2) *I forgot. I know it is round and has a point that is sharp*; 3) *Looks like a watch, but I don't know its name*; 4) *I do not remember. It serves us to know where to go*. Such formulations of child responses could be explained by the fact that the word *compass* is completely new in their vocabulary and that very few of them, regardless of which group it belonged, were able to hear and use the word or see a compass "live" before these focused activities in the kindergarten. During the realization of the unit *Application of magnet* some children forgot the very word, but in the formulation of their responses, they described the appearance and purpose of using a compass because they were able to see the "real" compass and to watch the creation of an improvised compass made of a magnetized nail and a cork that are placed in a bowl of water. In C-group, only 2 children knew the correct answer. What is interesting is that among the wrong answers, we have noticed the identification of a compass with musical instruments ("*Maybe the one that clanks*," "*Is it a guitar*?"). This can be explained by the fact that the children in question heard the word "instrument" (centering) and related it to what is familiar to them - musical instruments. In addition to the above, another characteristic answer was given by a child who said "*Globe*". We explain such an answer by the fact that his mother teaches geography.

If we start from the fact that we asked each child five questions[4], regardless of the group they belonged to (E or C), and pay attention to the number of (minimum and maximum) correct responses of children in groups. We have observed that differences between these two groups in the number of correct answers (these are presented in the Table 2. that follows):

Table 2. *Number of correct responses per child in E-group and C-group*

Experimental (E) group		**Control (C) group**	
Respondents	Correct answers	Respondents	Correct answers
E1	4	C1	**0 min**
E2	3	C2	1
E3	4	C3	2
E4	4	C4	1
E5	3	C5	1
E6	3	C6	1
E7	3	C7	**4 max**
E8	4	C8	2
E9	**2 min**	C9	3
E10	4	C10	1
E11	**5 max**	C11	2
E12	4	C12	**4 max**
E13	4	C13	2
E14	3	C14	3
E15	3	C15	1

[4] Not concluding the sub-questions asked so that the children could better understand what we asked them.

E16	4	C16	3
E17	4	C17	**0 min**
E18	**2 min**	C18	1
E19	4	C19	3
E20	**2 min**	C20	2

The second research task was to compare the number of correct answers of children in E- and C-groups. E-group children had the opportunity to touch, experiment, check, examine and test magnets for 5 working days, while C-group children adopted the same content *in a different way*. As a consequence, the children of C-group *memorized* instead of *understanding*, and due to the lack of practical application of magnet, they easily and quickly forgot the acquired knowledge that was tested one week after. Bearing in mind that independent research work leads to an active, direct relation of children with the educational content (regardless of the field in question), encourages their curiosity, the desire to learn, activates them in terms of reflecting, and makes the educational process more dynamic and more intense (Golubović -Ilic, 2017; Siraj-Blatchford & MacLeod-Brudenell, 2005).

The maximum number of correct answers per child in the E-group was 5 (1 respondent), while in the C-group two children had a maximum of 4 correct answers. On the other hand, the minimum number of correct answers in the E-group was 2 (3 respondents), while in the C-group there were two children with no correct answers (min = 0). In the E-group, there were 69 (out of possible 100) correct answers (on average 3.45), and C-group children had 37 correct answers (on average 1.85). The above data, the number of correct answers in these two examined groups, confirm the research assumption that E-group children have given more correct answers compared to the C-group children when it comes to content on magnetism. Overall, children in the experimental group showed more interest and motivation for the activities dealing with magnetism content than the children in the control group. Children in experimental group wanted even more activities in the period that followed and asked their teachers what will be organized for them next, showing again curiosity and willingness to participate and learn. This curiosity and motivation was lacking in the control group.

5. Conclusions

Modern pre-school education requires focused activities, learning and content processing in pre-school institutions to be focused on children. As subjects in the educational process and partners of their educators, they should actively participate in the choice of topics, planning and implementation of focused activities. They need a stimulating environment, a positive climate, materials and adequate resources to satisfy their innate curiosity, the need to explore, discover, and examine.

They learn from everything and based on everything they do, learn from what they see, hear, try and experience. Learning is not simply a transfer of knowledge from one generation to another and cannot be identified with memorizing or repeating the content the teacher talks or talked about. Also, the beginning of any learning is not ignorance, but the previous knowledge that is the result and consequence of previous experiences and learning. "It is guided and driven by personal meaning, needs and interests (...), it consists of several components and overwhelms various processes of the entire personality" (Rulebook on the General Foundations of Preschool Curriculum, *Official Gazette*, 2006: 33).

The new educational paradigm implies a lot of changes in relation to the previous way of working, so today, instead of content (*what*), it is more interesting and more important *how* teachers educate children. More important is the research *process* than the research *results*. Because of that, we explored the effects of using a research approach, that is, the influence of different ways of implementing focused activities on motivation, curiosity and basic knowledge about magnetism of children. The results confirmed that children who adopted the contents of magnetism by applying the research approach adopted more knowledge, that is, they had more correct answers both individually and on average, compared to children who adopted the same contents in the usual, traditional way.

The conclusion of the entire research is that there are differences in motivation and curiosity as well as the number of correct answers of preschool children regarding the field of magnetism depending on the way in which focused activities are implemented, in favour of children who have adopted the contents by applying research activities. The identified differences on these two examined groups were the results of the way in which focused activities were implemented, i.e. children who acquired knowledge by applying research approach showed better understanding and more correct answers than children with whom educators use a combination of verbal (monologue and dialogue) and demonstration methods during the processing. For this reason, learning by insight and research approach through play should be used whenever there are justified reasons, conditions and opportunities, not only in the field of Basics of Science but also in other fields of education and upbringing.

References

Anderson, R. D. (2002). Reforming Science Teaching: What Research says about Inquiry, *Journal of Science Teacher Education*, 13 (1), 1–12.

Bulunuz, M. (2013). Teaching science through play in kindergarten: does integrated play and science instruction build understanding? *European Early Childhood Education Research Journal,* 21 (2), 226 -249.

Cassata-Widera, A., Kato-Jones, Y., Duckles J. M., Conezio, K., French, L. (2008). Learning the Language of Science, *The International Journal of Learning,* 15(8), 141 – 152.

Crawford, A. B. (2000). Embracing the Essence of Inquiry: New Roles for Science Teachers, *Journal of Research in Science Teaching*, Vol. 38, No 9, 916–937.

Ćirković-Miladinović, I. (2016). Preschool teachers' beliefs on foreign language learning abilities of pre-school children. In Kopas-Vukašinović, E. i Stojanović, B. (Ed.), *Savremeno predškolsko vaspitanje i obrazovanje: izazovi i dileme*, Knjiga 20 (pp. 141-154). Jagodina: Fakultet pedagoških nauka.

Gage, N. L., Berliner, D. (1998). *Educational psychology,* Boston: Houghton Mifflin Company.

Golubovic-Ilic, I. (2017). *Istraživačke aktivnosti u nastavi prirode i društva*, Fakultet pedagoških nauka Univerziteta u Kragujevcu, Jagodina.

Golubovic-Ilic, I. & Cekic-Jovanovic, O. (2013). Modernizing Science Lessons by Using the Scientific (Inquire-Based) Method. In A. Barakoska (Ed.), *Education between tradition and modernity* (pp. 238 – 248). Ohrid: Institute for pedagogy, Faculty of philosophy.

http://eprints.ugd.edu.mk/5768/2/TOM%202.pdf

De Zan, I. (2005). *Metodika nastave prirode i društva,* Zagreb: Školska knjiga.

Dogan, Y. & Simsar, A. (2018). Preschool Teachers' Views on Science Education, the Methods They Use, Science Activities, and the Problems They Face. *International Journal of Progressive Education*, 14(5), 57-76.

Eshach, H., Friend, M. (2005). Should Science be Taught in Early Childhood? *Journal of Science Education and Technology*, 14 (3), 315-336.

Fitzgerald, A., Smith, K. (2016). Science that Matters: Exploring Science Learning and Teaching in Primary Schools, *Australian Journal of Teacher Education*, 41 (4), 64 – 78.

Harlen, W. (2010). *Principles and big ideas of science education*, College Lane, Hatfield: Association for Science Education.

Jenjić, S., Dragić, Ž. (2016). Istraživački rad učenika u projektnoj nastavi prirode i društva, *Učenje i nastava*, II (3), Beograd: Klett društvo za razvoj obrazovanja, 547–570.

Kallery, M. (2004). Early years teachers' late concerns and perceived needs in science: an exploratory study, *European Journal of Teacher Education,* 27 (2), 147 -165.

Kalogiannakis, M., Nirgianaki, G. M., Papadakis, S. (2017). Teaching Magnetism to Preschool Children: The Effectiveness of Picture Story Reading, *Early Childhood Education Journal*, 46 (5), 535-546.

Lonka, K., Hakkarainen, K, Sintonen, M. (2000). Progressive inquiry learning for children — Experiences, possibilities, limitations, *European Early Childhood Research Journal,* 8 (1), 7-23.

Ningsih, A. R., Afifah, R. N., Qonita, Gumala, Y., Handayani, H., Suhandi, A., Syaodih, E., Maftuh, B., Hermita, N., Samsudin, A. (2019). A preliminary study: how is extent the fourth-grade students understanding of the magnetic force? *Journal of Physics*: Conference Series, 1280 – 052048

Meyer, K. (1991). Children as experimenters: Elementary students' actions in an experimental context with magnets. Doctoral dissertation, University of British Columbia.

https://open.library.ubc.ca/cIRcle/collections/ubctheses/831/items/1.0055294 Accessed 24 May 2019.

Rulebook on the General Foundations of the Pre-School Curriculum, *Official Gazette of the Republic of Serbia* - Educational Gazette, 14/2006 (http://www.mpn.gov.rs) Origunal title: *Правилник о општим основама предшколског програма*, Службени гласник Р Србије – *Просветни гласник*, 14/ 2006.

Samarapungavan, A., Mantzicopoulos, P., Patrick, H. (2008). Learning Science Through Inquiry in Kindergarten, *Science Education*, 92 (5), 868 – 908.

Siraj-Blatchford, J., MacLeod-Brudenell, I. (2005). *Supporting Science, Design and Technology in the Early Years*, Open University Press.

Wadsworth, B. J. (2004). *Piaget's theory of cognitive and affective development: Foundations of constructivism*. New York: Longman.

Waterman, A., Blades, M., Spencer, C. (2004). Indicating when you do not know the answer: The effect of question format and interviewer knowledge on children's 'don't know' responses, *British Journal of Developmental Psychology*, 22, 335–348.

Watters, J., Diezmann, C., Grieshaber, S. and Davis, J. (2000). Enhancing science education for young children: A contemporary initiative. *Australian Journal of Early Childhood,* 26 (2), 1-7.

Worth, K. (2010). Science in early childhood classrooms: content and process, *Early Childhood Research & Practice,* Vol.12, No.2, Collected papers from the SEED (STEM in Early Education and Development) Conference, University of Illinois at Urbana-Champaign.

https://ecrp.illinois.edu/beyond/seed/worth.html Accessed 12 June 2019.

Authors

Irena Golubović-Ilić, PhD, Faculty of Education, University of Kragujevac, Jagodina, Republic of Serbia. E-mail: golubovic.ilic@gmail.com

Ivana Ćirković-Miladinović, PhD, Faculty of Education, University of Kragujevac, Jagodina, Republic of Serbia. E-mail: ivanajag@yahoo.co.uk