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THE EFFECT OF PROJECT-BASED SCIENCE EDUCATION PROGRAMME ON SCIENTIFIC PROCESS SKILLS AND CONCEPTIONS OF KINDERGARTEN STUDENTS

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Abstract. *The research aims to find out the effect of project-based science education programme conducted with an active learning on scientific process skills and conceptions of 6-year-old children about nature of science. Quasi-experimental research design including experimental and control groups with pre-test and post-test was implemented. Mixed-method research including qualitative and quantitative data collection tools was adopted. The quantitative data were collected with Preschool Scientific Process Skills Scale while qualitative data were gathered with interviews to define scientific process skills of children. The research includes 26 children in total, 17 were in the experimental group and 9 were in the control group. Project Based Science Education Conducted with Active Learning was carried out on the experimental group and Project Based Science Education was carried out on the control group. The research lasted for 32 weeks between October, 2015 and June, 2016. Scores of scientific process skills about nature of science belonging to students in the experimental group were found to be higher than ones in the control group and the students in the experimental group were found to be more familiar with the related conceptions. The findings prove the positive effect of project-based science education.*

Keywords: *active learning, nature of science, project based science education, pre-school education, scientific process skills.*

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Introduction

Students can come across concepts in scientific definitions in their daily lives. The aim of science education is not to educate all people for raising a scientist. However, it is to educate all people for being a science literate and to make them understand how scientists discover theories and hypotheses (Can, 2008).

Science literate can be defined in various ways. One out of these definitions, which is commonly used, describes science literate as a skill of access to knowledge and usage of knowledge that are bases of life-long learning and learning to learn (AASL/AECT, 1998). In other words, an individual who is a science literate, "*comprehends the nature of science and scientific knowledge, comprehends basic science and theories and applies them in an appropriate way; uses their scientific process skills while resolving problems and making decisions; understands the nature of science and technology and interactions between science, technology, community and environment; develops scientific and technical psychomotor skills; shows that they have scientific attitudes and values*" (MEB, 2004, 10).

One of the ways of introducing science to students and especially young children is the use of projects because a child can learn what s/he is taught under the topics of science, science and technology, within the scope of a project" (Bagcı-Kılıc, 2006). Thus, it is required to test the effectiveness of project-based science education on young children and serve their needs accordingly.

When the related literature is carefully examined, it is seen that although there exist separate studies on project-based science education, active learning, scientific process skills and nature of science solely. However, there exist no studies which combine all these four elements within the same research and test their influence of scientific process skills on pre-school children. This research sheds light upon an overlooked area by combining the above-mentioned elements in Turkish context. Therefore, this research aims to reveal the effect of project-based science education programme conducted with an active learning on scientific process skills and conceptions of 6-year-old children about nature of science in Turkey.

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Problem of Research

Students need to develop scientific process skills in order to develop scientific thought, apply scientific processes and acknowledge science (Bagcı-Kılıc, 2006). Martin (1997) divided these skills into two categories:

1. Basic skills (observation, prediction, measuring, classification, representation, inference)
2. Superior skills (identifying and controlling variables, hypothesizing, experimentation, statement of results depending on data, drawing graphics, interpretation and modelling).

After being introduced to basic and superior skills and acquiring them to some extent, students will be able to question, criticize and research problems in their daily lives and resolve incidents they face by means of scientific methods due to these skills. From this point of view, in science education where scientific processes are used actively, experiences of children require to be based on former theories; the children have to ask their own questions and the tasks have to arouse curiosity and encourage them to produce their own thoughts so that they are enabled to carry out observations on a topic thoroughly in a setting organised carefully, encouraged to reflect, represent, state their experiences and share their opinions with others. These processes have to cover daily studies of children and enable them to access to experiences of science (Worth & Grollman, 2003). According to Flavell (1999: 40), at the end of preschool period, students become aware of the fact that the word science is a more certain and debunking word than it is thought. They are also aware that colour of goods cannot be perceived by touching, that it is impossible to make a correct prediction about the whole of an object when only one edge of which is seen. In accordance with this expectation, science education should encourage students by means of various activities in order to raise scientific process skills at higher cognitive levels (Huppert, Lomask, & Lazarorcitz, 2002: 803). Many children's instinctive curiosity motivates them for learning because learning new things is in the nature of children. Skills and processes that students use and develop are the same with the ones scientists use during their research studies. These studies are necessary in order to understand running of nature and to prepare liveable settings. Scientists also carry out observations, classifications, measurements and struggle to reach conclusions, propose hypotheses and carry out experiments (Aydoğdu, 2006). Harlen (1999) emphasized that scientific process skills should be studied by children on their own because scientific process skills are a significant component of scientific literacy. According to Harlen (1999), as scientific process skills and comprehension of nature of science are necessary for scientific literacy, these skills should never be ignored. Therefore, one of the major aims of curriculum is to lead students to adopt scientific process skills in each stage of their education since preschool (Ergin et al., 2005). On the other hand, the nature of science involves epistemological assumptions and values underlying these skills (Abd-El-Khalick et al., 1998). For instance, observation and proposing hypotheses are skills of scientific processes. Regarding these terms, concepts of nature of science involve awareness about the fact that observations carried out on a subject by an individual are influenced by their own perceptions, hypothesising is a dreamy and creative mind activity and both activities are substantially full of theories (Kucuk, 2006). Scientific process has been defined as a mixture of characteristics of various social sciences including philosophy of science integrated with research and mental sciences such as psychology, history of science and sociology of science in implementation of scientific thought, conception of nature of science while producing scientific knowledge (McComas, Clough, & Almazroa, 1998). It searches answers by merging various aspects of social sciences such as "history, sociology and philosophy and by asking questions such as what science is, how it works, how scientists act, how community acts by itself to improve science and merge with studies of cognitive sciences" (McComas et al., 1998: 84). An exact definition of science cannot be made due to its lasting development and evolution. In a similar vein, there are different views about the nature of science (Can, 2008) and students have to understand the nature of science in order to be a science literate (Aktamıs, 2007). As a result, it is important for each individual to understand the nature of science because it is very probable for individuals who do not understand indefinite and continually developing nature of scientific knowledge to behave timidly and shyly when they encounter a new research or a theory which is approved although it is contrary to usual situations (Cotham & Smith, 1981).

Two major aims of science education can be stated as teaching concepts about the nature of science and enabling students to adopt scientific process skills. The importance of scientific process skills and the notion of nature of science were first emphasized and included in 2013 in Turkey. When the aims of Turkish National Education and 2013 Curriculum are examined, it is seen that there are sentences pointing at the mentioned aim such as "to raise creative and productive individuals with liberal and scientific thinking skills" and "to raise exploring and questioning individuals". It is believed that science education can only be successful if it enables students to adopt scientific process skills and nature of science comprehension, and to implement a curriculum for achieving these aims. The studies in which individuals with scientific thinking skills are brought up and scientific processes such as hypothesising and evaluation of data enabling them to adopt criticizing skills are used are the lessons and studies based on projects. The students who acquire these skills become ready for real life with problem-solving skills.

A project is a study where learners require superior skills such as researching, resolving problems and using what they have learnt in order to produce a distinctive study on works similar to real life (Acıkgoz, 2003). In other words, it is a learning environment where students can construct and conduct their own learning and improve their creativity. In this regard, students try to resolve the encountered problems cooperatively, become decision-makers on their successes, life is brought into the classroom and the classroom is transferred to life (Erdem, 2002). Project-based lessons enable students to produce questions, create a platform for discussion, improve creativity, be equipped for researching, co-operate, produce and use technology (Ayvacı, 2010). Project-based teaching method has been used as an integral part in active education but not as an alternative to be replaced with traditional education today (Katz & Chard, 2000: 2-3). Using projects for educational purposes is significantly effective on child development and education because it has an answer for questions such as what children should learn and which methods should be followed for effective teaching (Curtis, 2002; Tugrul, 2002). This approach is basically carried out at three phases (starting a project, developing the project and concluding the project) in accordance with a plan (Katz & Chard, 2000: 70; Helm & Katz, 2001: 8-9; Katz, 1994: 1-4; Roopnarine & Johnson, 2000: 175). As Feng (1987) stated, a child makes observations, explains, communicates, measures, concludes and predicts as a scientist during applications.

In pre-school period, science education improves cognitive skills, teaches asking a proper scientific question, enables children to acquire skills of data organisation and evaluation, and to deduce understandable results depending on the data (GMMCITC, 1997). Project-based teaching method can be used to increase apprehension of nature of science and usage levels of scientific processes of children attending pre-schools education. A large amount of studies has emphasized the significance of project studies in pre-school period (Katz, 1994). Using enriched and productive project studies motivates children to learn enthusiastically and results in remarkable contributions to early childhood education (Özkubat 2013, Warner, Pam 2001, Danyi et al., 2002, Buyuktaskapu, 2010, Bıcakcı & Gursoy, 2010).

Project-based teaching method has various contributions in educational settings. First of all, it leads children to co-operation and gives learners the opportunity for investigating daily issues deeply. Additionally, it provides rich learning experiences (Marcon, 1999), positively affects academic achievement and cognitive development (Schweinhart & Weikart, 1997: 2), encourages children for lifelong learning by developing their knowledge and skills (Kaptan & Korkmaz, 2002), leads children to new knowledge, books and experiments and to construct information on their own (Devries, Reese-Learnea & Morgan, 1991), teaches children how to set individual goals, internalise information and make evaluations (Hyson, 2008), fosters scientific thinking and problem-solving skills (Harlan & Rivkin, 2004; Sprung, 2006), and guides children to collect data by means of observations, measurements, form and interpret graphics and tables for representing the data (Kantz & Chard, 2000). All in all, project-based teaching method is of great importance in terms of being child-centred, encouraging children for research, investigation and critical thinking. In other words, it means raising young researchers, encouraging them to be interested in social problems and supporting them in all areas (Katz & Chard, 2000).

Active learning has positive affects in educational settings. To begin with, it contains fundamentally social interaction, meets the requirements of learners, enables them to use their cognitive skills and to take decisions related to their own learning, provides cooperation skills and develops cognitive and affective learning skills. It also helps teachers to make their own decisions and gain autonomous teaching styles. Additionally, social interaction has an important place in active learning because learning is an individual and inner process, and increases social interaction. During active learning process, the student does not adsorb directly what is taught but re-produces it by processing information with his/her individual strategies while studying on educational tasks, thinks creatively, learns how to approach problems in a critical way, researches, considers, discovers, interacts with others, and shares their problems and knowledge with others (Açıkgöz, 2003). Active learning and project-based teaching method lead learners to achieve their unique goals when they are allowed to take more responsibility in their own learning. Therefore, using both approaches together is regarded to affect children's learning process more positively. Teachers also should be trained in order to use active learning methods and techniques in pre-school institutions since teachers are regarded as people who help children, consider themselves as learning sources in active learning and create the learning environment and process (Manning & Lucking, 1991).

In research studies based on project-based teaching method conducted in national and international circles,

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it has been observed that there are experimental or scanning studies about school maturity and it has positive effects on scientific process skills and science conception of pre-school children (Buyuktaskapu, 2010: Bıcakcı & Gursoy, 2010; Altun & Demirtas, 2013). In sum, the relevant studies have focused on effects of used teaching methods on scientific process skills, factors affecting scientific process skills, relation between scientific process skills and success and scientific process skills which students have. However, there exist no studies which combine early child education and project-based science education via active learning in terms of scientific process skills and nature of science.

To attract attention to early child education and shed light upon an overlooked area in project-based teaching method, this research provided important insights into science education via active learning in Turkish context. In an attempt to fill an important gap in the literature and serve the expectations of related stakeholders, the research findings can guide future research studies and offer a new perspective upon the implementation of project-based teaching method for teaching science to 6-year-old children.

Research Focus

Although there are many research studies concerning the effects of project-based teaching and active learning on science education, no research has investigated the combined influence of project-based teaching method or active learning on improving scientific process skills and introducing conceptions about nature of science. Furthermore, these research studies have focused on primary and secondary school students aged between7-14 and there are few studies on scientific process skills of pre-school students. From this point of view, this research aims to find out the effect of project-based science education programme conducted with an active learning on scientific process skills and conceptions of 6-year-old children about nature of science.

There are many studies that examine the effects of using various teaching methods and techniques on students' conception of nature of science (Khishfe & Lederman, 2006; Khishfe, 2004; Lederman, 1999; Matkins et al., 2002; Kenyon, 2003; Akerson & Abd-El-Khalick, 2003; Irwin, 2000; Metin, 2009: Küçük. 2006). Also, there are many studies that examine the increase of scientific process skills after project-based learning (Akman et al.2003; Şahin and Yıldırım, 2006; Chin and Kayavizhi, 2002; Wong et al., 2010; Germann, Aram, and Burke, 1996). However, there is no research which supports that project-based science education programme conducted with active learning increases conception of nature of science and there are not supportive researches that claim that project-based science education programme conducted with active learning increases scientific process skills of students.

Methodology of Research

General Background of Research

This research aimed to reveal the effect of project-based science education with the help of pre-test and post-test so this research is based on experimental research design. Mixed-method research including quantitative and qualitative data was adopted to benefit from both numerical and non-numerical data and reflect the diversity of data collection tools. Purely numerical or non-numerical data could be misleading and not reflect the deep traits of the phenomenon in question (Cresswell, Plano Clark, Gutmann, & Hanson, 2003; Dörnyei, 2007). Therefore, this research aimed to combine both qualitative and quantitative means to provide a rich set of data and examine the phenomenon in detail and used mixed-method research (Denzin & Lincon, 1998). The piloting was conducted on a different group of learners at the same age (N: 20, 10 in control group and 10 in experimental group) in May in 2015 prior to the research and lasted for one month in the form of pre-test and post-test. The scope of the piloting covered the implementation of project-based science education with an active learning to develop scientific process skills and enhance conceptions of 6-year-old children about nature of science. The piloting was carried out to detect misunderstanding, unexpected situations during practice and offer effective solutions to overcome difficulties in advance, which improves the validity and reliability of the research. The teachers who were involved in the research were trained about the principals and effects of project-based science education and active learning. Before and just after the activities were carried out, "Pre-school Scientific Process Skills Scale" and "Interview Form about Nature of Science" were personally conducted on each child in experimental and control groups by the researchers. All children in the classroom were assured to participate in the activities, fulfil the scale and answer the interview questions with the help of the researchers. In this way, the soundness and credibility of the research were ensured.

Sample of Research

The research employed purposeful sampling because the participants were chosen according to specific criteria (Patton, 1990; Creswell, 2005). The researchers decided to focus on 6-year-old pre-school children who were considered to be neglected in terms of gaining scientific process skills and learning conceptions related to nature of science. Attaching importance to early child education is the other reason to work with this age group. To detect the effect of the intervention, that is project-based science education with an active learning, there were control and experimental groups in the research. Out of 26 children, 17 children were included in the experimental group while nine children were included in the control group. The children were chosen from the private kindergarten school which is in close proximity to the researcher. Thus, convenience sampling was used. That's why there were 26 children in total because in that school there were two classes for 6-year-old children.

Instrument and Procedures

In the research, semi-structured interviews, as a means of qualitative data, were held for deeper understanding the students' thoughts while their scores were gathered via Preschool Scientific Process Skills Scale developed by Buyuktaskapu (2010). Since the scale was developed and its validity and reliability were proved to be sound in Turkish context, the researchers did not feel the need to conduct adaptation procedures. The scale consists of 24 questions including basic scientific process skills such as observation (4 questions), classification (4 questions), estimate (4 questions), assessment (4 questions), data recording (4 questions) and inference (4 questions) skills. Assessment scale was applied face-to-face in a period of 30 minutes by the researchers. The scale consists of 6 factors as follows: observation, classification, estimation, assessment, data recording and reasonable inferences. Pre-test was conducted in a quiet ambiance and a separate place from educational environment for children to concentrate and get motivated by sitting face-to-face at appropriate tables and chairs for them. The scale was carried out personally on each child separately by the researchers. Answers of children were recorded on a scale form. It took about 30 minutes for children to complete the pre-test procedures. After the pre-test, the intervention took place in the form of introduction and implementation of project-based science education based on active learning. In control group, the children received science education purely via active learning, whereas the children in experimental group received science education via of project-based science education based on active learning. The intervention took place between October, 2015 and June, 2016 and lasted for 32 weeks. After the intervention period, in the last month of the academic year in June, 2016, post-test was applied to both groups of children. As for the interview form, it was originally developed by Lederman and Khishfe (2002) and then translated into Turkish and adapted by Guler and Akman (2006). The interview form has six open-ended questions as in the following: What is science?", "Who is scientist?" and "what does a scientist do?" The questions "How can scientists imagine pictures of dinosaurs although they have never seen them?" "Some scientists assert that dinosaurs disappeared due to meteors, what do you think?" and "Do scientists have a broad imagination?" were added at the end of the adaptation process. The questions were asked twice in that the children were required to answer the same questions both before and after the intervention. These questions aimed to reveal students' opinions about scientific knowledge based on data, the nature of scientific models, the changeability of scientific knowledge, the difference between observation and inference in producing scientific knowledge, the subjective structure of scientific knowledge and the role of imagination and creativity in the production of scientific knowledge. During preparation of the activities, principles of active learning and project-based teaching method were taken into consideration. Accordingly, the activities were organized to push the children to use their cognitive skills to carry out the educational tasks and answer the questions depending on self-regulation and decision-making related to various sides of learning process. In this way the children are enabled to act with real objects depending on the topic of the project and set goals. The prepared activities include eight project topics: apple, leaf (see Appendix-1), calendar, penguin, potato, camping, Ataturk and children, living beings and life. The research was carried out between October and June in 2016 (32 weeks) and the activities were prepared by the first researcher. Although all children received science education with active learning, the children in the experimental group differed with the inclusion of project-based teaching activities because the teacher in the experimental group referred to project-based science education in combination with active learning and conducted the lessons blending these two different teaching practices.

The teacher of the experimental group was trained on active learning and how to apply it in the classroom

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by the first researcher. In the experimental group, active learning activities such as cooperative learning (learning together, let's ask together and learn together, bread and butter, round table, speed round, let's tell me about it, ball bearing, jigsaw, think-pair-share, cobweb, snowy mountain king, the queen of the snow-capped mountains, thought corridor, formulation, venn diagram and role playing) were included in the implementation of project activities. The teacher of the control group conducted the given project activities by using self-study, answer-question and plain narration. To ensure the effective implementation of the activities, both researchers visited and checked the classrooms and activities regularly every week.

Data Analysis

The research is based on mixed-method research. The data were gathered from a scale and an interview form so quantitative and qualitative data analysis tools were employed to analyse the data. Statistical Package for Social Sciences (SPSS-20) was used to gather mean and standard deviation values of participant scores, and to conduct t-test in order to find out whether there exists significant differences between the participants in experimental and control groups in terms of their scores in pre-test and post-test while content analysis in the form of constant comparison method was applied to interpret and categorize the interview results.

Qualitative data coming from the items of the interview form were analyzed with constant comparison method of grounded theory, which is exchangeably used instead of content analysis. The two researchers were both involved in the categorization and interpretation of the interview findings to decrease the subjectivity of the qualitative data analyses. Both coders followed a zigzag pattern because they moved back and forth while analyzing the written answers of the children in line with the coming flow of data. In other words, the coders constantly compared the written answers with the old ones and new ones to be consistent while forming the emerging categories (Glaser & Strauss, 1980). Since both coders were knowledgeable about the relevant literature and informed about the results of previous research, Informed Grounded Theory (Thornberg, 2012) was adopted in the present research. Reaching a general conclusion and making judgements from details require passing some stages because forming the general framework out of non-numerical data necessitates devoting time and energy due to the repetitive nature of qualitative data analysis.

Both coders finished their analyses individually and then revised the previously formed categories after about three weeks to ensure intra-rater reliability. In addition, after 25% of the interview results were analyzed, the two researchers held a meeting and compared their analyses to find out the agreement levels according to the inter-rater formula suggested by Miles and Huberman (1994: 64), and the inter-rater reliability level was calculated to be 82% and the disagreed categories were identified. They mainly discussed upon the answers which could cause disagreement. After the first meeting, the coders went on to analyze the rest of the interview results and when 100% of the data were analyzed, there was a second meeting where the inter-rater reliability was calculated again. In the second calculation, the inter-rater reliability was found to be 92%, which indicated a high level of agreement. However, both coders went on discussing upon the disagreed categories till there was complete agreement.

Results of Research

The gathered results have been classified in two categories, namely quantitative and qualitative results.

Quantitative Results

The pre-test and post-test scores of the children in experimental group where the participants were taught science topics with the help of project-based science education in combination with active learning are presented in Table 1.

Table 1. Comparison of scientific process skills score of the experimental group students.

Scientific Process Skills	Groups	N	M	SD	t	p
Observation	Pre-test	17	3,47	1.125	-6,428	.0001*
	Post-test		4,94	1.088		
Classification	Pre-test	17	2,82	2.580	-5,757	.0001*
	Post-test		5,94	2.106		
Measuring	Pre-test	17	2,12	.993	-2,977	.009*
	Post-test		3,29	1.448		
Predicting	Pre-test	17	3,35	1.766	-4,237	.001*
	Post-test		5,71	1.611		
Saving data	Pre-test	17	4,00	1.541	-4,727	.0001*
	Post-test		5,82	1.185		
Inference	Pre-test	17	3,41	1.698	-6,689	.0001*
	Post-test		6,24	1.715		

p<0.05

According to Table 1, the average of pre-test and post-test scores of children in the experimental group on scientific process skills increased significantly in terms of all sub-dimensions, which means that project-based science education in combination with active learning causes a significant increase at children's scientific process skills and conceptions about nature of science. According to these results, the development in children's scientific process skills and conceptions about nature of science resulted from the activities of project-based science education activities conducted with active learning. Scores regarding the scientific process skills of the students who received project-based science education in control group are presented in Table 2.

Table 2. Comparison of scientific process skills score of the control group students.

Scientific Process Skills	Groups	N	M	SD	t	p
Observation	Pre-test	9	3,56	1.509	-2,578	.033*
	Post-test		5,11	1.167		
Classification	Pre-test	9	3,56	2.920	-2,125	.066
	Post-test		5,44	2.007		
Measuring	Pre-test	9	2,33	1.323	,000	1.00
	Post-test		2,33	1.871		
Predicting	Pre-test	9	4,44	2.242	,104	.920
	Post-test		4,33	2.062		
Saving Data	Pre-test	9	3,33	2.291	-4,400	.002*
	Post-test		5,78	1.394		
Inference	Pre-test	9	2,78	1.856	-1,361	.211
	Post-test		4,44	2.603		

p<0.05

According to Table 2, average scores of pre-test and post-test of children in the control group regarding scientific process skills increased significantly only in their skills of observing and recording data. This means that project-based science education activities, which are not combined with active learning, do not lead a significant increase in children's scientific process skills. Additionally, it can be inferred that the development in children's scientific process skills resulted from activities that were performed in the control group and behaviours related to children's skills of observation and recording data were affected positively.

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Table 3. Comparison between experiment and control group.

	Groups	N	M	SD	t	p
Experiment Group	Pre-test	17	19,18	7.367	-9.979	.001*
	Post-test		31,94	5.539		
Control Group	Pre-test	9	20,22	8.197	-4.102	.003*
	Post-test		27,78	7.138		

When the tables are analysed, it is seen that there is a highly significant difference between the total scores of scientific process skills of children in the experimental and control group. The activities performed in the experimental and control group influenced scientific process skills.

Qualitative Results

The answers given to the questions in the interview form were separately and individually analysed and presented one by one. The categories were formed on the basis of the answers of the children and are summarized in Table 4.

1. *Answers of preschool students in the group of age 6 to question "what is science?" were categorised by utilising the below grouping:*

Group 1. I don't know.
Group 2. Knowledge symbols (DAST, Chambers)
(Science is to do everything or be able to do everything; perform science; try and find something. It is books. It is learning how to perform science.)
Group 3. Symbols indicating a research has been conducted (DAST-Chambers; Barman-DAST-C).
(It is carrying out experiment; experiment of everything; finding something; doing a lot of new things).
Group 4. Classification according to occupations (It is repairing; scientist; being a scientist; it means scientists who work for us).
Group 5. Unrelated answers.
(Science phone, science car, science planet, mind)

Table 4. Distribution of answers of preschool students in the group of age 6 to question "What do you associate science with?"

Category	Pre-test		Post-test		Pre-test		Post-test	
	experiment group				control group			
	f	%	f	%	f	%	f	%
Group 1 (I don't know)	4	23.5	-	-	3	33.3	1	11.1
Group 2 (Knowledge symbols)	3	17.6	5	16.7	1	11.1	2	22.2
Group 3 (That surveyed symbols)	4	23.5	24	80	1	11.1	2	22.2
Group 4 (Grouping occupation)	1	5.8	-	-	-	-	-	-
Group 5 (Irrelevant answers)	5	29.4	1	3.3	4	44.4	4	44.4
Total	17	100	30	100	9	100	9	100

It has been found out that the children have limited knowledge about science when their pre-test results in Table 4 are reviewed. In the experimental group, the answer "I don't know" (Group 1) and unrelated answers (excluded ones) (Group 5) provided by the children in the pre-test to the question "What is science" disappeared at the post-test. At the post-test, symbols showing that a research has been conducted (Group 3) such as "it is doing science, trying everything and finding something" were replaced with these answers with an increase of 56,5%. In the control group; the answers related to "I don't know" (Group 1) decreased at the post-test. A significant change was not found out in other phases. It has been found out that the students in the experimental group provide answers based on experiments and discover more in the latest interviews when compared to pre-interview. In other words, children started providing definitions with their reasons. It might arise from the inclusion of project-based science education activities combined with active learning as the starting point to carry out a research. As the children in both groups identify science more procedurally, they don't recognize its intellectual aspect. The reason may be that the children do not have many experiences about the intellectual aspect of science because they generally recognize it from various sources and with their definitions used in daily expressions and do not experience scientific processes by themselves.

2. *Answers of the students to question "who is a scientist?" were categorised by utilising the below groupings:*

Group 1. I don't know.
Group 2. Knowledge symbols (DAST, Chambers).
(A scientist is a person who knows everything).
Group 3. Symbols indicating a research has been conducted (DAST-Chambers).
(A scientist is a person who carries out experiments; does science; researches on something; invents; finds everything and seeks).
Group 4. Gender (DAST-Chambers, Newton and Newton, Barman-DAST-C).
Group 5. Classification according to occupations
(Nurses, telephone operator, doctors, watch man).
Group 6. Defining scientist and alternative characters (DAST-Chambers, Newton v Newton).
(A scientist is a person who found vaccine, balloons, buoyancy of water. A person who invented rocket, balloon and car).
Group 7. Technology (DAST-Chambers).
(A scientist is a person who searches on computer).
Group 8. Naming of scientist (Researcher).
(Newton, Edison, Archimet, Maria Curie, Graham Bell, Montgolfier Brothers, Pole, Van Gogh).

Table 5. Distribution of answers of preschool students in the group of age 6 to question "Who is scientist?"

Category	Pre-test		Post-test		Pre-test		Post-test	
	experiment group				control group			
	f	%	f	%	f	%	f	%
Group 1 (I don't know)	9	56.2	-	-	3	30	3	30
Group 2 (Knowledge symbols)	-	-	-	-	-	-	-	-
Group 3 (That surveyed symbols)	4	25	6	17.1	4	44	4	44
Group 4 (Gender)	-	-	-	-	-	-	-	-
Group 5(Grouping occupation)	-	-	-	-	-	-	-	-
Group 6 (Identification and alternate characters, the scientist)	3	18.8	5	14.3	2	22	2	22
Group 7 (Technology)	-	-	-	-	-	-	-	-
Group 8 (Naming the scientist)	-	-	24	68.6	-	-	-	-
Total	16	100	35	100	9	100	9	100

According to Table 5, the children in both groups were revealed not to be able to name scientists in the pre-test (Group 8). It was detected that the frequency increased in the experimental group (from 0 to 24) and the children could name different scientists when the post-test was analysed. According to the children's answers in the post-test, they perceive scientists as people who perform experiments, research and invent (Group 3). In the

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experimental group, the students who participated in the research and could not perform naming, were seen to try to define a scientist (f=6) with statements including symbols showing that a research has been conducted. In the pre-test, children's answers such as "I do not know" (Group 1) given to the question "Who is a scientist?" disappeared in the experimental group. These answers were replaced with definitions (Group 6) and naming (Group 8) where the children provided alternative characters regarding scientists. The answer for defining a scientist in the pre-test such as " I do not know" was replaced with expressions such as "a person who found buoyancy of water", "brothers who found hot air balloon " or with directly naming. There is no classification in relation with technology in the pre-test and post-test, which may arise from the performed activities' being based on simple materials and not including technology. When Table 4 is analysed, it is seen that there is no indication related to gender classification of scientists (Group 4) in the pre-test and post-test concerning this classification. This case might arise from the fact that the concept of "scientist" was used instead of "science man" and the attention was drawn to this concept throughout the research. The children in both groups were requested to draw a scientist after the question "Who is a scientist?" had been asked. Their drawings were assessed in two different ways. As the children's drawings were examined, it was seen that they could name scientists by drawing although they were not guided by any researchers especially in the post-test. However, the children drew scientists without naming in the pre-test. That's why two different assessments were used in the assessment of scientist drawings. In the first assessment, the children's drawings were assessed in terms of gender of scientist and whom they took as a scientist model in their drawings. The second assessment of drawings was based on the classification of Newton and Newton (1992) classification as indicated in Table 6 below.

Table 6. Distribution of second assessment of drawings made by preschool students in the group of age 6 after the question "Would you draw an experimenting scientist?"

Categories	Pre-test		Post-test		Pre-test		Post-test	
	experiment group				control group			
	F	%	f	%	f	%	f	%
Male scientist	11	73.3	14	93.3	7	77	7	77
Female scientist	3	20	-	-	-	-	1	11
Science teacher (male)	-	-	1	-	-	-	-	-
Scientist assistant (male)	1	6.7	-	6.7	1	11	3	33
Scientist assistant (female)	-	-	-	-	1	11	-	-
Total	15	100	15	100	9	100	11	100

When Table 6 is examined, it is seen that the children were found to discriminate gender in their drawings and have generally drawn a male scientist without any naming. It is considered that the children drew male scientists because the male students participating in the research are more in number. In the post-test drawings of the children in the experimental group, each child except for two of them named their scientists. The children mostly drew Newton and Montgolfier Brothers. When drawings of the children in the experimental group were analysed and assessed in terms of the gender of scientists whose pictures were drawn, they were found to have drawn mostly male scientists (Newton, Montgolfier brothers, Science teacher, Archimet and Edison). It might have resulted from the fact that the science teacher who conducted the research was a male and they performed in-class activities about Newton, Archimet and Montgolfier Brothers. In the control group, only one student mentioned a female scientist in the post-test. However, there was not any change on the rest of students.

Table 7. Distribution of second assessment of drawings made by preschool students in the group of age 6 after the question "Would you draw a scientist?"(Newton & Newton 1992)

Categories	Pre-test	Post-test	Pre-test	Post-test
	experiment group		control group	
	f	f	f	f
Study symbols	4	17	2	2
The interior work	3	10	5	6
The outdoor work	1	4	-	2
Apron	1	4	5	2
Information symbols	2	6	1	1

According to Table 7, there was not any detail in the figures of the scientists drawn by the children in the pre-test. In the experimental group, the children -except for four of them- did not use any symbol indicating that a scientist conducts research in their drawings. When post-test drawings were examined, drawings were found to have more details and include experimenting and research (f=17). In addition, it was detected that the children mostly have a point of view in which the scientists conduct their research indoor (f=10).

Children's answers to question "what does a scientist do?" were categorised by utilizing below groups:

Group 1. I do not know.
Group 2. Knowledge symbols, the related topics (DAST, Chambers; DAST-C-Barman).
(A scientist does science, produces science, invents some things and invents electric, telephone).
Group 3. Symbols indicating a research have been conducted - (DAST, Chambers, Newton and Newton).
(Scientists perform experiments, try some things and re-try when they do not achieve, they try everything, they check if experiments can be performed, if not they try again.)
Group 4. Study environment (Newton and Newton); Occupational groups-
(They repair telephones, watches).
Group 5. Alternative characteristics (DAST-Chambers; Newton and Newton).
(They look after every one; they have a shave, get dressed, ask questions, make movies and do good things).

Table 8. Distribution of answers of preschool students in the group of age 6 to question "What do scientists do?"

Categories	Pre-test		Post-test		Pre-test		Post-test	
	experiment group				control group			
	f	%	f	%	f	%	f	%
Group 1 (I don't know)	1	6.7	-	-	2	22	2	22
Group 2 (Information symbols)	6	40	4	9.8	1	11	1	11
Group 3 (That surveyed symbols	4	26.6	34	82.9	1	11	1	11
Group 4 (working environment- Professional grouping)	3	20	-	-	2	22	-	-
Group 5 (Alternatively character traits)	1	6.7	3	7.3	1	11	-	-
Total	15	100	41	100	7	100	4	100

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When Table 8 is examined, it is seen that the children provided answers based on knowledge symbols (Group 2) such as they do science, produce science and find something new in the pre-test. However, the percentage of the answers based on this group considerably decreased (30,2%) in the post-test of experimental group. In the control group, this change is very small. In the post-test results, working environment and occupational symbols (Group 4) given in the pre-test were observed to disappear. Besides, the children's expressions, which include symbols (Group 3) indicating that a research has been conducted such as "scientists carry out experiments" and "they conduct researches" were observed to increase in the post-test. The reason for this case may be the children's realising that science's starting point is to research and this is performed by the scientists after performing activities related to science. This result is also corroborative for the increase of symbols (Group 3) included the research and given in Table 6 and 7.

Table 9. Distribution of answers provided by preschool students in the group of age 6 to question "How do scientists know the image of dinosaurs even though they have not seen any?"

Categories	Pre-test		Post-test		Pre-test		Post-test	
	experiment group				control group			
	f	%	f	%	f	%	f	%
I don't know	2	13.3	1	5.9	4	44.4	3	33.3
Of photography	3	20	1	5.9	2	22.2	1	11.2
Fossils and bones	2	13.3	15	88.2	1	11.2	3	33.3
Unrelated replies	8	53.4	-	-	2	22.2	2	22.2
Total	15	100	17	100	9	100	9	100

Neither experimental nor control group students are aware of the fact that scientists interpret data in order to reach information about features of dinosaurs such as their shape, colour, tail and structure, and they make deductions in light of these data. They stated that scientists have reached information about dinosaurs by observing fossils and so on, which are obtained as a result of excavations. One of the students in the control group indicated in the post-test that our ancestors, who had seen dinosaurs, drew pictures on the walls of caves. The student also stated that scientists know appearance of dinosaurs by interpreting these pictures. As is seen in the Table 8, children in both groups try to reach unknown information about dinosaurs based on the limited information they have. In addition, they consider that dinosaurs' home ranges can be in relation with their physiological structures. Therefore, the children stated simply that scientists reach deduction based on the information they already have even though they did not use the word of "deduction" in their statements. Before the application, the children had not been aware of this side of science. The reason may be that children are not enlightened about the subject except for cartoons. Besides, the children had been thinking of research process only as discovering fossils. According to the results of post-tests of both experimental and control group, the children were thinking that all information about dinosaurs was reached when fossils were found. This finding demonstrates that the children are aware of only observation, which is a fundamental step of conducting a research.

As the children in the experimental group explained the extinction of dinosaurs mostly with volcanic eruption in the pre-test, they stated that "lava is burning and destroyer". These statements did not change in the post-test. There is no student who says that lava is neither burning nor destroyer. In the control group, most of the students remarked that dinosaurs became extinct due to meteors. The number of the students who think in that way increased in the post-test. Even such comments as "meteors destroyed everything and volcanoes erupted because of meteors both became effective in their extinction". In both groups, the extinction of dinosaurs was correlated with ejection of lava or meteors. However, only one student in control group remarked "Both were not the cause" without finding any reasons, which shows that children speculate by interpreting only the data they are presented with.

Table 10. Distribution of answers of 6-year-old pre-school students to questions "Is a scientist creative and does he/she have an imagination?"

Categories	Pre-test		Post-test		Pre-test		Post-test	
	experiment group				control group			
	f	%	f	%	f	%	f	%
Creative	11	73.3	16	100	5	55.6	6	100
It is not creative	4	26.7	-	-	4	44.4	-	-
Total	15	100	16	100	9	100	6	100
Imagination is developed	13	86.6	16	100	2	28.5	4	50
Imagination is not developed	2	13.4	-	-	5	71.5	4	50
Total	15	100	16	100	7	100	8	100

According to Table 10, after the research the children's realisation that scientists use their imagination, creativity and points of view on research studies conducted on dinosaurs changed. After the research, surprising that children have such thoughts both before and after the research. As is mentioned above in Table 8 and 9, research studies on dinosaurs are based on the research of cases which occurred in the past. Scientists who conduct such research studies try to produce scientific information about living beings by using data obtained from fossils without seeing those living beings. That is why it is natural and normal that children have such statements. However, the good and promising side of the research is that children stated that the scientists did not see dinosaurs and realised that scientists produced scientific information on dinosaurs by using available data even though they did not see them. Children also realised that scientists use their imagination and creativity aside from the data when there is not enough information about a thing they have never seen.

Discussion

This research aimed to find out the effect of project-based sicence education programme combined with active learning on the scientific process skills of 6-year-old children and on their conceptions about nature of science. In light of the pre-test and post-test reults, it was found out that the children in the experiemental group increased their scientific process skills and enahnced their conceptions regarding nature of science compared to the children in the control group who received science education only in the form of project-based activities. These results suggest the necessity of project-based science education blended with active learning for pre-school children. Apart from the quantitative findings, the qualitative findings gathered from the interviews shed light upon the neglected superiority of using project-based education in combination with active learning because children's awareness, knowledge and conceptions upon nature of science showed progress in the course of research.

The results of the research bear some similarities and differences with those of previous studies in the related literature. For instance, it has been found out that the children have limited knowledge about science in their pre-test results, which is in parallel with the results of Newton and Newton (1992) and Güler and Akman (2006). Also, there exist many research studies supporting the claim that the students receiving science education via project-based education activities increase their scientific process skills and enhance their understanding of nature of science (Khisfe & Abd-El-khalick, 2006; Lederman, 1998, Bağcı-Kılıç, 2006). In addition, it was detected that the frequency increased in the experimental group (from 0 to 24) and the children could name different scientists in the post-test. However, in the study of Guler and Akman (2006), there was not any classification and the children did not name scientists although the same question was asked to the children.

The participant children were found to discriminate gender in their drawings and have generally drawn a male scientist without any naming. It is considered that the children drew male scientists because the male students participating in the research were superior in number. These results are in common with the findings of research studies conducted by Barman (1997), Kibar Kavak (2008) and Kaya, Doğan & Ocal (2008) on primary school students. In sharp contrast with Newton and Newton (1992), the participant children aged between4-6 mostly drew female scientists. Additionally, it was detected that the children mostly think that scientists conduct their research indoor

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(f=10). In the analysis of literature, it was encountered that the children usually image the scientists as people with glasses, gown, uncombed hair, beard and being asocial (Mead & Metraux, 1957; Güler & Akman, 2006; Öcal, 2007; Camcı, 2008; Kaya et al., 2008; Korkmaz & Kavak, 2010;). However, the images of the scientists only with gown were drawn in this research by the children and no illustration or verbalisation was encountered as in previous studies. These results, where a scientist is regarded as a person who conducts experiments and research, have similarities with the results of previous research conducted at different educational levels (Newton & Newton 1992; Barman 1997; Barman 1999). Finson (2002: 336) also reached similar results related to the gender of scientist.

Whenever "scientist" is said, there are stereotyped scientist images regardless of the age such as a white gown, glasses and laboratory. Even though the students of experimental group who participated in the research had various theses concerning the working environment of scientists, they brought forward laboratory settings in their pictures. They even drew tools and equipment which are present in laboratories. In the pictures, the scientists who are getting ready for experiments in the laboratory or dealing with computers were seen. In the experimental group where questions such as "What do you associate science with?", "Who is a scientist?" and "What do scientists do?" were asked and the answers such as "I do not know" were obtained in the pre-test, but these answers were not uttered by the students in the post-test. All in all, interviews with the experimental group implied that project-based science education applied with active learning is necessary and effective. This model also enables students to learn the contents of scientific terms to be taught. In project-based science education, students identify science properly and do not lose their confidence in science while scientific knowledge changes. In this case, it is obvious that scientific point of view in individuals will improve. Such applications enable pre-school students to be raised as science literate.

Conclusions

Comparison and analysis of qualitative and quantitative findings revealed that the children improved their scientific process skills and enhanced their conceptions about nature of science. Project-based science education programme, which is performed with active learning, has been found out to have an effect on teaching science process. Small-scale inquiry works, observations, starting with group decisions and project questions, performing activities and their representation in these activities have become effective in children's learning scientific processes.

This research demonstrates that children can gain the scientific process skills necessary to conduct scientific research from early childhood, the project-based learning approach can be successfully applied before school and science programs can be developed to improve research skills. According to the results of the research, children gain scientific process skills at a higher level through project based learning activities compared to active learning. When this research is sytnhesized with other research results, it can be seen that such applications can give more responsibility to students for learning, attract their attention more, help them get more effective and lasting process skills, motivate children more in learning processes, make everyday life clearer in the eyes of children, form positive attitudes towards teaching and learning among students and families.

In light of the gathered data the present research suggests that it is important to generalise pre-school curriculums based on science to improve the skills of scientific thinking and nature of science. Therefore, teachers and pre-service teachers should be trained in organising and implementing this process. In addition, pre-school teachers should develop projects related to various subjects, which will arouse children's interest. Due to all reasons above, sources including instructive examples of project activities, which are enriched with active learning methods and techniques, should be prepared for pre-school teachers.

Pre-school prospective teachers should be trained in more detail about how to use project-based learning in science process skills activities and how to improve scientific process skills in undergraduate courses. Lacking knowledge and skills of teachers who work in pre-school institutions in the same subject should be corrected with the help of in-service trainings by the necessary institutions. Family-based education programs that support children's scientific process skills should be implemented in pre-primary education institutions.

To offer a different path for future reseachers, the effect of educational programs supporting science process skills on children's language-cognitive-psychomotor skills, attitudes toward science teaching, and academic achievement can be examined.

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Appendix 1. Leaf Project

- Collection-Corner : Leaf pictures, leaves
- What do we understand when we say "leaf"? (Mind Map)
- Things which we curious about leaves (Fast tour)
- Leaves and interesting features (narration)
- Leaves as a smallest cleaning tool (narration)
- Collecting leaves from park or garden (One pocket given to each kid)
- Touching the leaves which are in the pocket and telling what do you feel (Fast tour)
- (Counting and checking the collected leaves)
- Classifying the collected leaves from the garden according to their colours (Cooperative Learning)
- Classifying the leaves according to wet or dry (Cooperative Learning)
- Investigating leaves by magnifying glass
- What are the duties of the leaves? (Ball-Baering)
- Classifying the leaves according to their shapes (Cooperative Learning)
- Classifying the leaves according to their margin (Cooperative Learning)
- Colouring the leaves which are given on worksheet appropriate to the instructions
    - Count the orange leaves and colour the same amount of leaf
    - Count the brown leaves and colour the same amount of leaf
    - Count the red leaves and colour the same amount of leaf
    - Count the green leaves and colour the same amount of leaf
- Create a pattern from the collected leaves
- What are the duties of the leaves? (Ball-Bearing)
- Why do trees shed their leaves in the fall? (Ball-Bearing)
- Preparing leaf touching dominoes
- Photosynthesis (expression)
- My leaf chart (picture of my leaf, size of my leaf, colour of my leaf, I love my leaf, because...)
- Answering questions about the picture which describes trees and leaves living autumn (Ball bearing, fast tour, cooperative learning, individual practice)
    - The picture below telling us which season?
    - Why do you think the tree is crying?
    - If the tree could talk, what would he tell us?
    - Why doesnt leaf want to break off from the branch? what are the leaves which are cut off from branch going to do now?
    - What is the tree saying to his leaves?
    - Colouring the unpainted leaves according to autumn season
- What happens in autumn? (spider web)
- What do we understand when we say "autumn"? (Mind Map)
- Compliting the tree and around it according to autumn season (butter-bread)
- Which kind of changes do we have in our clothes in autumn season? (fast tour)
- Selecting and exhibiting appropriate clothing for the autumn season (butter-bread)
- Which kind of foods occur in autumn season?(fast tour)
- "Autumn came to Greengrocer" exhibition
- Preparing the graph of children's most favorite autumn fruit

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- Preparing autumn board (Cooperative Learning)
- Autumn doors (Cooperative Learning)
- Autumn leaves and colours
  - What do animals do in autumn? (Jigsaw)
  - Preparing the different kinds of puppets such as finger,stick etc of the animals which are preparing for the hibernation (butter-bread)
  - What do animals talk to each other, which kind of songs do they sing and how do they prepare to hibernation before they have hibernation? (Animation at the puppet theater)
- Autumn:.. (Formulation) (Cooperative Learning)
  - Finding the pictures about autumn season from the newspapers and magazines and preparing autumn booklet (butter-bread)
  - The 20 things which I learned about autumn (fast tour)
  - Long live autumn festival
  - King and Queen of the snowy mountain finding solutions for autumn problems
- What do animals do in autumn? (think-match-share)
- What does the tree thinks which has lost his leaves? (opinion corridor)
- What would leaves say to humans if they could talk? (fast tour)
  - Painting which describes autumn season (butter bread)
  - Compliting the tree and around it according to autumn season (butter-bread)
  - Autumn landscape in our garden
  - Taking and exhibiting autumn photos
  - Autumn-winter, spring-summer images of the trees which shed their leaves
  - Which kind of changes occur when the spring come up? (Let's tell)
  - Compliting the tree according to spring season
  - What does re-sprouting leaves tree think about? (opinion corridor)
  - Making and compliting leaf print (butter-bread)
  - What can be hiden between leaves? (fast tour)
  - How do bees, butterflies etc. play games between leaves in your opinion? (think-match-share)
  - Which kind of games can we play by collected leaves? (think-match-share)
  - Playing games with collected leaves
  - Why dont some trees shed their leaves? (Jigsaw)
  - What else can we do from leaf?(butter-bread)
  - Sticking and compliting leaves (butter-bread)
  - Sticking the given numbers of leaves to trees (individual study)
  - Leaf humans (Cooperative Learning)
  - Creating clothes from leaves
  - My family with leaves
  - Leaf puppets
  - Science and experiments with leaves
  - How many fasola can be placed on the leaf? (guess first then compare the results by applying)
  - How many ladybugs can be placed on the leaf? (guess first then compare the results by applying)
  - How many leaves in the pocket? (guess first then compare the results by counting)
  - How many leaves can be sticked to the tree (guess first then compare the results by applying)
  - Choose a tree in the garden. Ask the kids in the morning. How many leaves was shed from the tree today? (guess first then compare the results by counting)
  - Dropping the leaves into the ring (game)
  - Sorting the leaves by colour tone (cooperative learning)
  - Leaves became road, finding the road activities (maze)
  - Picturing from the leaves (Circle table)
  - Numbers from the leaves (butter-bread)
  - Printing trace of the leaves (individual study)
  - What else can we do from the leaves? (butter-bread)
  - Creating a poem about leaves (cooperative learning)

    - Leaf-finger-ring-roll puppets (Leaves talking)
    - Autumn at the window (butter-bread)
    - Interesting leaves (expression by paints)
- Creative Art Activities: complating leaf pictures, leaf brackets, leaf prints, leaf masks...
- Creating clothes and crowns from the leaves (butter-bread)
- Preparing the movie about the leaf life (Movie Making)
- Good and bad news about the leaves (fast tour)
- Way of story with the leaves
- Questions and answers about the leaves (ask together-learn together)
- King and Queen of the snowy mountain finding solutions for leaves' problems
- Making a leaf collection (individual study)
- Preparing a leaf board
- The 30 things which I learned about leaf (fast tour)
- Leaves...................(Formulation) butter-bread
- Museum of our leaves (exhibition of the collected and created leaves)

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