Original Research

Children’s University: How Does It Make a Difference?

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Abstract

Last five decades have witnessed the comprehensive growth of science education around the world as the science is regarded as the major tenets of innovation and economic growth. Various extant studies on science education have concentrate on how to deliver and put the science in both curriculum and classrooms. However, there are rarely researches on the evaluation of the science curriculum and its impact on the scientific skills. Likewise, despite the science curricula being implemented from the 2009 onward in Ankara Children’s University, they have not yet been evaluated so far. This is the why it is essential for the evaluation of them due to the changes in the national science curricula and technological developments. This study aims at evaluating to update, change, or reform the science curricula in terms of learning objectives, content, learning activities, and the evaluation. Utilizing the mixed method, the study group was composed of 1,218 participating children and nine science educators. Program evaluation and semi-structured interview forms were developed to collect the data. Then, the QUAN&QUAL data were analyzed by the programs. The findings are as the followings: the curricula meet the expectations of children and help them to learn something new and to develop the skills to use in daily lives. Moreover, the top three things mostly liked are the play-based activities, learning something new and learning further about animals. Science educators have mentioned that children’s sense of curiosity, their active participation, and questions throughout the enactment of the science curricula made them happy.

Keywords

Children’s University, science education, science curriculum, curriculum development, curriculum evaluation

Introduction

At no time in history has strengthening science education been more important than ever. Science is an important and sine qua non medium for the countries to develop and to be industrialized. The current context of science education, science, and the science of learning is shaped by the initiatives at the height of the cold war in United States of America. The 1950s and 1960s saw the first radical change in science teacher education and curriculum reform under the auspices of National Science Foundation (NSF). This milestone in science education, science, and the science of learning has focused on updating the way of science teaching by modernizing the content of science courses. This step led the fundamentals for the succeeding of science education research and reform (Duschl et al., 2007). In this context; scholars of science develop a project titled as “Taking Science to School” so as to enhance, facilitate, and disseminate the science education (Taşar, 2007). This project makes an important contribution to science education in school. Moreover, Gopnik (2009) stated that infants and young learners are intuitive scientists and it cannot be denied that there is a significant relationship between the early spread of science to people and the development and prosperity levels of societies. However, the scientific thinking only is not enough to develop the emotions, intuitions and creative thinking power of human, but the art should not be neglected in personal development.

Duschl et al. (2007) have stated that the study group of science scholars see scientific inquiry as a model or theory for teaching and learning science in the classroom. The term inquiry was preferred to provoke the idea of teaching and learning science by the way scientists actually practiced: problem solving through formulating and testing hypothesis

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An Overview of the Children’s University in the World and Turkey

The main mission of the children’s universities across the world is to consolidate the bound between the science and society. Hereby, these attempts have played an icebreaker service before the society by establishing a fortified bridge between the so-called “Ivory Towered” university and society. Moreover, this invaluable service fulfilled the “community service” mission of the universities embracing three missions: teaching, research, and community service. Accordingly, the higher education appreciates the third mission through the children’s universities in order to expand the cooperation with local schools and communities (Petrova et al., 2020).

The notion under the motto of “Taking Science to School” has been widespread and elaborated to meet the students with the science was embodied with the establishment of the children’s universities in the last three decades. It was aimed to broaden the physical and formal border of the school and to deliver the science education outside the school in the light of developmental traits of children, such as curiosity, questioning and learning (Aral & Özdoğan Özbal, 2017; Köseoğlu et al., 2008). In turn, the first Children’s University (CU) was founded in Birmingham, England in 1993 led by Tim Brighouse in order to seek the answer for many problems, but one focal point was the gap between educational opportunities offered to students in the highest and lowest attaining schools (MacBeath & Waterhouse, 2008; Overton, 2010). The developed policies of CU in many countries as well as Turkey come up with intensive programs, which have provided to support the learning and growth of many children and young people in science education with sharing the responsibilities of the schools and teachers in science education (MacBeath & Waterhouse, 2008; Tymms, 2004). The motto of CU is to teach children the love for learning with a school–university partnership and teachers, and to develop the extra-curricular activities, high quality, exciting, and innovative activities for the disadvantaged pupils outside of the formal school hours. CUs award the achievement and participation through certifications. Raising children’s scientific awareness and understanding is a key outcome for the pupils in turn to be the satellite navigation to better places in life. The impacts of these activities under CUs were found positive, that’s why people are universally encouraged and dedicated (Children’s University, 2019). CU shares the nature of correct questioning methods and in-depth learning with children in an environment of independent discussion and expression as well as the significant and expert contribution to scientific awareness nearly all the schools do not manage. Children in the milieu of CU discover the opportunities to view and evaluate the world through their own eyes. In turn these opportunities provide the affectional bonds to children to raise their attention to novel and creative things. It also creates a playing field of opportunity and opens up access to children of all backgrounds.

In the similar notion of objective spirit in the world CUs; Ankara Children’s University (ACU) is the first CU in Turkey founded in 2009 with the support of the Scientific and Technological Research Council of Turkey (TUBITAK). Soil Science School and Creative Ideas projects were the first two projects of this university. These two programs continued their studies, and in the light of the gained experiences, the faculty in the Department of Anthropology developed the School of Life Sciences curriculum. The success and ongoing growth of ACU continued with the Little Gardeners and Astronomy School. Currently, the role of partnerships in “taking the third mission of the university” to the community and schooling will discover children’s science potential and create a far brighter future than ever. In framework of the strategies to reduce and diminish the barriers between the university and community, ACU has developed and been still carrying out nine science curricula to allow the participants to...
engage with the science educators and to support the school sciences classes through family friendly extra-curricular activities as follows: (1) The Code of Life: DNA; (2) Insect Festival School; (3) Who Shakes Our World?; (4) Astronomy School; (5) Thinking Owls; (6) School of Life Sciences; (7) My Little Friends: Insects Science School; (8) I am a Veterinary Surgeon Science School, and (9) Is There Any of You Who Doesn’t Like Math? As for February 2009, ACU has been affiliated as a member of EUCU.NET (European Children’s Universities Network). This affiliation provides an opportunity for observation of the carried-out studies abroad with exchanging the information with the third-parties. By the experiences of Ankara University about the Children University, the project titled as Innovative Science Education Methods: Children’s University was launched on May 2009 with the funding of the Scientific Research Projects (BAP) Coordinator of Ankara University.

ACU primarily and literally aims at developing children’s skills in scientific thinking and creativity through the science programs. Under this aim, ACU offers the science education opportunities to an average 3,000 pupils every year by widening participations and school engagements. The science programs within ACU strengthen the ties between the university and society, and in turn provide the opportunity for children to learn by doing. Moreover, ACU aims at amalgamating the science and art in a melting pod to develop the skills of children in the critical thinking; scientific thinking and reasoning; creativity; judgment and decision-making; questioning; curiosity, and problem solving by active learning strategies.

**Defining the Problem**

Reviewing the national and international literature and its impact over the attitude toward science (Arisoy, 2007; Azizoglu & Cetin, 2009; Çepni et al., 2006; Gibson & Chase, 2002; Hacimeminoglu, 2019; Hren et al., 2004; Jenkins & Nelson, 2005; Kayabası et al., 2019; Kaya & Kaya, 2019; Lindahl, 2007; Marulcu et al., 2014; Orduna- Armando, 2017; Osborne et al., 2003; Overton, 2010; Öztürk & Bozkurt-Altan, 2019; Sağlam & Aral, 2015; Ünal & Aral, 2014; Weinburgh, 1995; Yücelyigit & Aral, 2021), comparing the studies on children’s perceptions of their experience. The results of the studies and researches have suggested that students tend to hold negative attitudes toward science. Such an attitude prevents almost all students from developing positive attitudes toward scientific research, reasoning, thinking, and inquiry. In this context, Children Universities are important places to develop positive attitudes toward science. Determining this gap in the review of literature, the enacted science programs in Ankara Children’s University (ACU) and its counterpart in the world are theoretically and practically aimed at fostering and developing children’s creative and scientific thinking skills, and develop a positive attitude toward science through the extra-curricular activities. Nonetheless, one big gap in the research about the Children’s Universities was that none of the previous studies explored the impact of the science programs over the positive or negative attitude when the children participated in those, namely, how they experience the science curricula, and in turn depict their in-class and extra-curricular experiences about the programs. Hence, this study was designed to evaluate the nine science curricula implemented in Ankara Children’s University in views of the science educators and children in order to bridge this gap in the existing study.

**Aim and Research Questions**

This study probes ways of which the science curricula implemented in Ankara Children’s University was experienced by the children and teachers who participate in the classes. Toward this aim, this study was guided by the following four research questions:

1. How is the distribution of the participating children’s respond to the Evaluation Form?
2. What are the insights of the participating children about the science curricula?
3. What are the insights of the science educators about the science curricula?
4. What is the extend of congruence between the intended, enacted, and observed curriculum?

**Methods**

**Research Design**

This study employed a mixed-method design in an attempt to combine the strengths of QUAN and QUAL methods (Creswell, 2009). This design provides “more complete understanding of research problems than does the use of either approach alone” (Fraenkel & Wallen, 2012). The data collection instruments were enriched using “questionnaire, observation, and interview.” In this study, it was aimed at evaluating the science curricula in Ankara Children’s University (ACU). Accordingly, a sequential explanatory design was utilized in this study. In this design, firstly, QUAN data are collected; then QUAL data are so, which seems separate, but tightly connected (Creswell, 2009). The QUAL data are used to help further explain the QUAN data in order to fulfill this connection (Creswell, 1999). The key reason behind the use of the sequential explanatory strategy was to yield the incremental and important data for the evaluation of science curricula in ACU.

**Participants and Study Setting**

**Selection of Participants**

This study was carried out with three different study groups in Ankara Children’s University. The first study group consisted of 1,218 participating children (male = 626 and 51.4%;
female=592 and 48.6%) in nine science programs. The distribution of participating children in nine science programs was as follows: (1) The Code of Life: DNA (n=109; 8.9%); (2) Insect Festival School (n=117; 9.6%); (3) Who Shakes Our World? (n=146; 12%); (4) Astronomy School (n=109; 8.9%); (5) Thinking Owls (n=125; 10.3%); (6) School of Life Sciences (n=125; 10.3%); (7) My Little Friends: Insects Science School (n=146; 12%); (8) I am a Veterinary Surgeon Science School (n=184; 15.1%), and (9) Is There Any of You Who Doesn’t Like Math? (n=231; 19%). Accordingly, the most preferred science curriculum was “Is There Any of You Who Doesn’t Like Math? (n=231; 19%)”; the lowest one was “The Code of Life: DNA (n=99, 8.1%) in Ankara Children’s University.”

The second study group were the science educators of nine science curricula. These were the faculty members from the various faculties, such as Languages, History and Geography; Educational Sciences, Science, Engineering, Veterinary Medicine, and Agriculture. Moreover, the documents of nine intended science curricula were evaluated.

**Study Setting**

Ankara Children’s University in Ankara was chosen as a research site—in which there were the nine-science curriculum/program were carried out for the primary and lower secondary schools. This setting was selected because it was founded in 2009 as a first children’s university in Turkey and had been in a full-service operation since then. Before having been founded, the faculty members of Ankara Children’s University had conducted various projects for developing the science education for the children. Upon this academic and intellectual infrastructure, the faculty had developed the sort of science curricula under the roof of Ankara Children’s University. However, there had been no follow-up evaluation until today and hence the need for this study.

**Data Collection**

The research procedures were carried out under a systematic approach. The function of the member checking validating was utilized to validate the research data. Moreover, the triangulation of the data source was used to validate the findings for the sake of the trustworthiness. Data were collected, as part of a project funded by Ankara University Scientific Research Project Office as the supporter of this research, via the data collection instruments (document analysis, semi-structured interview form, and questionnaire) in May–December 2018. The researchers informed the participating children and science educators for collecting data consent of them.

**Instrument**

Evaluation form, semi-structured interview form, and document analysis were used to collect the data. For the data collection, an evaluation form was used to collect the QUAL + QUAN data from the participating children about the enacted science curriculum and its teaching-learning process. This form consists of 13 items developed by the researchers. The items were classified as “1 = Yes, 2 = No, 3 = Partially, 4 = Non-Respondent.” The Evaluation Form also have four open-ended questions. The instrument was pilot tested on a small group (n=53) in order to validate that the questions were understood and correctly interpreted. Additionally, a semi-structured interview (Feedback Form) was designed to collect QUAL data from both participating children and science educators. This form contains nine open-ended questions about the pros-and-cons of the science curriculum; children’s perspectives and children’s positive and negative experiences in ACU. In the part of documents analysis, nine science curricula were reviewed and the recorded videos on the teaching-learning process of enacted science curriculum were analyzed.

**Data Analysis**

The study contained both QUAN and QUAL data. In the level of data analysis respectively, the QUAN analysis (frequency and percentage) of the evaluation form was carried out by SPSS 21.0. Summary statistics (frequencies and percentages) were calculated and tabulated. For the QUAL data, the recorded semi-structured interviews were transcribed verbatim and uploaded to MAXQDA 11.0. All sets of QUAL data from the study were analyzed by the researchers. Inductive thematic qualitative data analysis was applied. The researcher read each data set twice for common understanding of each code and sub-codes. Essential codes and sub-codes were then highlighted in each set of data. Then, the highlighted codes and sub-codes were sorted into categories that had descriptors for similar/dissimilar information (Cohen et al., 2007). Next, data analysis was integrated to examine emerging patterns and themes in terms of codes and sub-codes, and to refine data collection strategies (Miles et al., 2018). In framework of document analysis, the 1,013-minute videos were transcribed verbatim and coded. These results gave a hint for the enacted science curriculum and it was compared with the documents of the intended science curriculum about learning objectives; content, teaching-learning process (strategies, methods, and techniques) and assessment process. In turn, the whole part of the intended nine science curricula were revised and reformed in view of Bloom’s revised taxonomy. Thus, this document analysis helped to see the similarities and differences between intended and enacted curriculum.

**Results**

The results of this study were structured in four divisions, respectively. In the first, second, and third division, there are two sourcing data collected from both nine science educators and children. The first and the second data were collected
from participating children by an evaluation form; the third
data collected from nine science educators and participating
students by semi-structured interviews. The last data covers
the extent of congruence between the intended, enacted, and
observed curriculum.

The Distributions of the Participating Children’s
Respond to the Evaluation Form

The results of this division were tabulated under a set of
major highlights reached from a 4-point evaluation form
consisting of “Yes; Partially; No; Non-Respondent” about
the nine science curricula. The tabulation was distributed
into two section. The first section is the highly positively
rated with “YES”; the second one is the highly negatively
rated with “NO” in wake of a science curriculum by the
participating children. The highly positively six children’s
responses in terms of the effectiveness and impact of the
science curriculum over them are given in Table 1.

As seen in Table 1, children’s positive responses in terms
of the effectiveness and impact of nine science curriculum
over them are distribute as follows, respectively: “enjoyed
participating in science curriculum (n=1013; 85.6%); learn-
ing something new (n=995; 81.7%); suggesting the science
curriculum to my friends (n=916; 75.2%); wishing to par-
ticipate in a different science curriculum (n=891; 73.2%);
wishing to participate in science curriculum again (n=872;
71.6%); having enjoyed studying at the fields of science
(n=832; 68.3%).” Despite the minority of the participating children
positioning “a negative image” toward the following state-
ments: “transferring something new to daily life (n=160;
13.1%); learnings in science curriculum having made my life
easy (n=156; 12.8%); seeking to participate in science cur-
riculum again (n=152; 12.5%); lastly having developed the
new skills though the science curriculum (n=149; 12.2%).”
All in all, the participating children, who a negative image
about the science curricula, have found them as “not enough
to develop the curiosity; not finding a chance to learn new
things; finding the science uninteresting; lastly not useful in
everyday life.”

The Insights From the Participating Children

At the end of the Evaluation Form, the participating children
received an open-ended question, which covers the follow-
ing three points: (1) the mostly desiring side of the science
curriculum; (2) the mostly undesirable side of the science
curriculum; and (3) suggestions to the science curriculum.

Asking the participating children about three things mostly
liked in the science curricula, all of them wrote down the top
top three things to the first line of open-ended box as the follow-
ings: (1) learning about animals, (2) having the surprises during
the lectures, (3) playing games and doing enjoyable activities.
The top three things to the second line of it were (1) playing
games and doing activities, (2) learning something new, (3)
learning about animals.” For the third line; they wrote down the
followings: (1) playing games and doing enjoyable activities,
(2) learning about animals, (3) wishing to know insects and
learning something new.” When evaluating the views stated by
the children, the most recursive and mod of the statements was
“playing games and doing enjoyable activities.”

Asking the participating children about three things mostly
not liked in the science curricula, all of them wrote
down the top four things to the open-ended box as the fol-
lowings, respectively: (1) not able to express my thoughts
adequately, (2) not learning something new, (3) playing
games and doing enjoyable activities, (4) getting to know
insects. Overall, when evaluating the statements, it was
understood there were not enough space to give voice and
power to the participating children in the learning environments.
The participating children have the top three suggestions to the science curricula as follows: (1) learning something new, (2) different learning activities and games; lastly (3) learning about more animals.

### The Insights From the Science Educators

The results of this division were a set of eight themes encapsulating key ideas about the nature of nine science curricula, on which there was consensus by nine science educators. Although some of the themes are already the anatomy (learning objectives, teaching-learning, process and the like) of science curricula, others are about the developmental process of them. The themes are as the following: (T1) The most enjoyable sides of the science curriculum, (T2) The deficiencies of the curricula, (T3) The emergence of science curriculum development idea, (T4) The curriculum development process, (T5) The curriculum reform, (6) The enactment of learning objectives in the curriculum (T7) The allocated time, and (T8) The Realization of intended learning activities.

**The description of the themes.** The explicit descriptions of generated themes in this study are as followings. The “T1” theme covers the insights of science educators about what they felt happy and they were pleasure when the educators saw children being happy during the science curriculum. The most enjoyable part of the curriculum was to arouse children’s curiosity, questioning, and inquiry about a science topic subject and to facilitate their active participation during the teaching-learning process.

**P1:** “The excitement and happiness of the students while playing a veterinarian near to the end of the curriculum has always made me very happy.”

**P3:** “I enjoy it so much when I hear sophisticated, in-depth answers and comments.

**P6:** “Although their unending questions tire us, it also makes us very happy. Their joy ‘after’ seeing their DNA is worth seeing. It is our greatest happiness, especially when they come, hug and kiss us.”

In the “T2” theme, the insights of educators about the deficiencies of the curricula could be categorized under four titles: Deficiencies in evaluation; material and finance lack; lack of educators, and lack of child-centered curriculum. The educators generally have criticized the fact that the classes were teacher-centered/dominated during the enactment of the curriculum. In some of science curriculum, it was emphasized that deficiencies in the evaluation process had been stemmed from the lack of a valid and reliable assessment tool. The lack of material-finance was driven by non-availability of an allocated specific budget to the curriculum. Finally, the educators expressed the lack of qualified assistantship to support them in the course of curriculum implementation.

**P1:** “At the end of the program, a professional assessment scale, questionnaire studies and tests should be increased in order to understand whether our program has achieved its full purpose.”

**P6:** “The biggest deficiency of our program is the budget and the number of staff.”

**P7:** “I don’t think the program needs any support other than that it needs support in terms of practitioner support.”

**P2:** “Our shortcoming is that the programs need to be student-oriented. I have a lot of dominance in my program. It needs to be student-oriented, and I’m not quite able to do that.”

In the “T3” theme, the idea of developing the science curriculum were emerged from the various reasons: the former developed projects by the educators; adapting the science curriculum abroad; aspiring to meet the science with children; popularizing the logic of science; raising the awareness about the science; creating a bridge between the science and community, and invigorating the K-12 education with science. Moreover, the science educators also develop the science curriculum that children could develop a key

### Table 2. Results of the Highly Negatively Rated in Evaluation Form.

| Items                                                                 | Yes       | Partially | No        | Non-Respondent |
|-----------------------------------------------------------------------|-----------|-----------|-----------|----------------|
| Wanting to be a scientist in the future                               | 474 (38.9)| 282 (23.2)| 453 (37.2)| 9 (0.7)        |
| Having developed the curiosity to further learn about the newly      | 589 (48.4)| 328 (26.9)| 295 (24.2)| 6 (0.5)        |
| learnings                                                            |           |           |           |                |
| Transferring something new to daily life                              | 785 (64.4)| 267 (21.9)| 160 (13.1)| 6 (0.5)        |
| Learnings in science curriculum made my life easier                   | 738 (60.6)| 319 (26.2)| 156 (12.8)| 5 (0.4)        |
| Seeking to participate in science curriculum again                    | 872 (71.6)| 182 (14.9)| 152 (12.5)| 1 (0.1)        |
| Having developed the new skills through the science curriculum        | 802 (65.8)| 255 (20.9)| 149 (12.2)| 12 (1)         |
understanding the types of vertebrates, such as fish, amphibians, reptiles, birds, and mammals. Herewith, children could be assisted to learn the content and to relate the with the old in subject matter presented by their teachers. Lastly, the science educators have tried to eliminate or minimize the fear toward the subject fields of science; to increase the social awareness about the subject fields of it, and to share the science experience the society.

(P5): “During my academic visits to Canada, Italy and Belgium, I found that educational content for children was created in the Anthropology department. When I returned to Turkey, I heard that something called CU was in the process of being established. When we heard this idea, we started working to create a program called Life Sciences and prepared the program.”

(P8): “In our country, mathematics is always seen as one of the most difficult field of sciences. It is even seen as a fearful dream of children. Since it is my field of study, I thought about what I could do to make children love math.”

(P9): “We have been actively organizing popular events at Ankara University Kreiken Observatory (AUKO) for about 15 years. Based on these experiences, we wanted to provide astronomy education especially for 5th, 6th and 7th grade students.”

In the “T4” theme, there seemed several similarities and differences in the process of developing the different science curriculum. But the broad five modularity and commonality steps for developing the science curriculum was conducted with the support and help of the curriculum-developers from the Faculty of Educational Sciences as follows: (1) Determining the age group for the all science curriculum; (2) need-analysis for all curriculum; (3) a child-centered approach for the science curriculum; (4) facilitating the good practices and examples of the conducted projects; (5) conduction a pilot study for all curriculum.

(P8): “The process of creating the program was primarily in the form of a project proposal. Before creating the project proposal, I came together with a program developer from Hacettepe, two mathematics teachers, three classroom teachers and a software developer. We talked about what kind of activities we could design during the summer. First of all, the age group was important to us. We planned to start from 10-12 age group.”

(P3): “In the process of creating the program, videos of the activities in the West were watched, related literature was searched and all necessary materials (thought-provoking animations, philosopher words, game designs, stories to be used, etc.) were selected and prepared accordingly. Attention was paid to children’s coming from different parts of Turkey, their differences in terms of interests, abilities and tendencies. A team of 3-4 people has been formed in this direction.”

(P9): “Astronomy activities for the 5th-7th grade students were observed during the creation of the program. After evaluating the appropriateness/adequacy of the program with practitioners from Educational Sciences Faculty, we carried out our pilot program to gifted students in 2012. The students’ desire to stay at the observatory and make more observations, and their verbally positive feedbacks showed that we were on the right path. Over the years, we have enriched our program by adding new activities.”

In the “T5” theme; the whole science curriculum in ACU was reformed and updated in the lights of the findings of evaluation. These reforms and updates covered the educational materials and resources; the contents of the nine science curricula; the duration of nine science subjects teaching. Lastly, all science curricula were re-arranged in accordance with the characteristics of the target age group (gifted, special needs groups, etc.).

(P1): “We update every event we organize, our activity program may vary according to the age groups of children, educational level, types of schools they study (private schools, public schools, vocational schools, schools for gifted ones, etc.).”

(P7): “Initially, the program was developed for high school students and then adapted to the secondary school level. Upon request from various age groups, the program was revised. In addition, similar programs, especially abroad, were continuously monitored and appropriate activities were included in the program. Similar investigations and updates are currently being made.”

In the “T6” theme; the science educators evaluated their lectures to have achieved the learning objectives during the enactment of the science curriculum. Depending upon the feedback of participating children and recorded enacted curriculum; there was a concordance between the intended and enacted curriculum.

(P9): “We carry out the curriculum/programs in accordance with the learning objectives. The best proof of this is that the students do not want to go to their homes at the end of the day and their desire specifically to make more observations with telescopes.”

(P6): “The program is implemented in accordance with its purpose. Children of all ages and schools are very happy at the end of the activity, expressing that they have learned many new things and have changed their perspectives.”

In the “T7” theme; there were two distinctive views of science educators about the duration and allocated time for the curricula. One camp was on the sufficiency side of duration for raising the awareness in participating children (taking into their attention span persistence or distractibility) toward the science; another camp was the insufficient or limited side of duration for carrying out the various in the in-class activities; games, or wrap-up activities.

(P8): “I think the time allocated to the curriculum/program is sufficient. Because I think there happen a change in the opinions
of children in both half-day and full-day practices. Of course, s/he is not expected to fully adopt that field of science at once, but at least the child raised an awareness towards science. Therefore, I think that either the full or the half-day period is enough.

(P5): “In fact, when our program first started, during a couple of years we made it as one-week camps and the children enjoyed these one-week camps very much. Therefore, half-day programs are not currently considered sufficient.”

The last and the “8” theme; there were two different views on whether the in-class activities could be enacted as intended. The science educators, who thought the in-class activities were implemented as designed, have attributed the following reasons: the infrastructure of their curriculum; pre-instruction preparations, and previous experiences. The science educators, who thought those were not implemented as designed, have pointed the followings: The shorten duration of curriculum and the impractical learning environment for children to express themselves.

(P5): “Not fully implemented. Currently, with half-day programs, only the introduction of the program is done. In other words, a very in-depth activity cannot be done. For example, if we have 7 workshops, we can only implement one or two. We are unable to implement all workshops for economic reasons.”

(P3): “Especially when you have to use the indoor area, the area is very small and the lack of an image that children can feel completely comfortable is a negative effect. It is a disadvantage that the venue where the activities are implemented visually resembles to the classroom.”

(P9): “Since the activities are held at AUKO, the venue, infrastructure, telescope, tools and equipment are suitable for the program. Together with our experienced practitioners, the activities can be implemented as designed.”

The Extent of Congruence Between the Intended, Enacted, and Observed Curriculum

The results of this division were constructed to describe the big picture of the intended, enacted, and observed science curriculum. Under this rationale, the results were obtained from two different documentary sources: the written (intended) science curriculum on paper developed by the science educators and the recorded (enacted) science curriculum within classroom. Firstly, the researchers have analyzed the written documents of the intended science curriculum in terms of four curriculum domains (aims/learning objectives and learning activities only). Then the researchers observed and recorded the enactment process of curricula. Then, all video-records were transcribed verbatim into a written format in order to compare between the intended, enacted, and observed curriculum and to yield a scientific evidence for the revision, change, or updates of the science curricula.

Having observed and analyzed the enacted curriculum in terms of two curriculum domains, the intended (written) curriculum were revisited, reformed, changed, or updated around the following findings. The all learning objectives (aims or goals) were categorized under three domains of Bloom’s taxonomy: cognitive, affective, and psychomotor. All of them were re-stated by omitting some verbs, such as “know, understand” as it was not a behavioral and measurable. Then the statements of learning objectives were uttered in the concrete expressions using the words, such as “recognize, distinguish, and explain etc.” For instance, “distinguishes whether a species is insect or not” instead of “knows whether a species is insect or not”; “list the name of insects” instead of “has basic knowledge of insect names.”

In other words, this approach to “learning objectives” involved the expression of science curriculum “measurable objectives,” “understandable to children and science educators.” By implementing this change process so as to produce measurable objective, the participating children in science curriculum would be better equipped to meet the future science skills. Moreover, the learning objectives available in the “enacted curriculum,” but not in the “intended” were added to the intended curriculum. Contrary, the learning objectives not available in the “enacted curriculum,” but in the “intended” were omitted to the intended curriculum or vice versa.

There is a basics for the learning objectives in a curriculum. That is, the learning objectives are aimed for the student, but not for teachers. In this mentally, the learning objective statements aimed for the teachers in the science curriculum, for examples “provides children a chance to question life” or “raise awareness about ways to lead a good and beautiful life” were converted to the learning objective statements aimed for students, for examples “explains the ways to lead a good and beautiful life by questioning life.” Other basics for the learning objectives are “one action verb per learning objective.” Accordingly, the outcome statements in the science curriculum were re-stated, for instance “defines important concepts related to earthquake and explains the difference between the concepts of magnitude and intensity.” This statement consists of two actions in one statement. In turn, this statement was re-arranged by omitting the conjunction “and” and putting a full stop to abide by the scientific rules for the learning objectives.

The findings regarding the domains of learning activities were collected by the same way in the learning objectives. Having observed and analyzed the enacted curriculum in terms of learning activities, the intended (written) curriculum were revisited, reformed, changed, or updated around the following findings. The researchers tried to find a strong relationship between the learning objective and learning activities. For this purpose, the learning activities available in the “enacted curriculum,” but not in the “intended” were added to the intended curriculum. In contrast, the learning activities not available in the “enacted curriculum,” but in
the “intended” were omitted to the intended curriculum or vice versa.

Discussion

Last five decades have witnessed the comprehensive growth of science education around the world as the science is regarded as the major tenets of innovation and economic growth. Many universities have institutionally supported the spread of third mission of them with the help of “Children’s University.” Recently, not only universities, but also non-governmental organizations have implemented the extra-curricular activities to the scientific thinking, skills, and competencies. Several studies revealed that Children’s University. Accordingly, various extant studies on science education have concentrate on how to deliver and put the science in both curriculum and classrooms. However, there are rarely researches on the evaluation of the science curriculum and its impact on the scientific skills and on the attitude of children. Likewise, despite the science curricula being implemented from the 2009 onward in Ankara Children’s University, they have not yet been evaluated so far. Hence, the aim of this study probes ways of which the science curricula implemented in ACU was experienced by the children and teachers who participate in the classes around the four research questions and steps.

The results are not only aligned with previous research in this related literature, but also provides new insights to the experiences of a science teaching-based extra-curricular in ACU. There is a common tradition about extra-curricular activities as non-academic as being out-of-formal school time and non-part of the formal curriculum. Different organization (e.g., student societies), NGOs, and Children’s Universities provide a various range of extra-curricular activities, but these activities do not involve a grading or credit as the participant is voluntary-based and optional (Seow & Pan, 2014). Based upon this essence, the results of the participating children’s opinions about the science curricula can be divided into two dichotomies: Positive and negative. The main similarities to early studies (e.g., Buckley & Lee, 2021; Tamayo et al., 2017; Yeniay Üsküplü, 2019) relate to the first side of dichotomy. The first and positive face of it are thought that the science curricula not only provide the opportunities for children to develop a positive attitude toward the science, but also to learning several new fundamental science concepts in a natural, playful, and entertaining way. The present results also confirm Shulruf et al.’s (2008), Crall et al. (2013), Alabay et al. (2020), and King et al.’s (2021) results that extra-curricular activities have a positive effect on both student outcomes, achievements, tendency in scientific process skills, developing a positive attitude toward science. Extracurricular science education develops a higher level of epistemic curiosity (Schiefer et al., 2020) and have the power to reduce declines in STEM career identity and science motivation (Stringer et al., 2020) and have the power to reduce declines in STEM career identity and science motivation (Stringer et al., 2020) and Habig et al. (2020) states informal science education programs fosters persistence in STEM education. Furthermore, Walan and Gericke (2021) has shown that staff being friendly and well-furnished settings were valued a strong and important indicator for children during the lectures at a Children’s University. This means that experiencing out-of-school activities in a university made the children participation and visit far more interesting and exciting. The second face literally interests in the negative impact on the attitudes toward the science by assessing the how educational experiences influence these attitudes. Put in other words, for nearly half of participating children opinions this compromises a substantial revision in the enacted science curricula because children were less conscientious in learning something new and in new researches in science. Moreover, children have weak and infirm belief in being able transfer the learned things in extra-curricular activities to the daily life and in finding science as useful in everyday life. These present results also corroborate the previous results (Kurniawan et al., 2019) which put forward the connection between the attitudes or interest of students toward science and being diligent in learning about science.

Apprising the opinions of the participating children provided to discuss and evaluate the science curricula in a different point of view and experience. Based upon the insights of the children, the results were literally divided into two broad categories: (1) desiring experience and (2) undesiring experience. The first category covers that the participating children found the science curricula enjoyable; experienced and learned something new about science; confronted with different activities, and should promote lasting learning of science and appreciation of science. Moreover, these studies valued “actively participating in the learning environments; recognizing the enjoyable learning, and able to learn something new in a short time.” The present results are in harmony with Skukan et al. (2020) who claimed that educational games and fun have been an effective tool for engaging students to overcome the difficult tasks during the learning. Also, the game in learning was an intellectual foster as well as knowledge, attitudes, and action. The second category contains that the participating children found the learning environment “not feel free to speak”; not found any opportunity to learn things new; not valued the learning activities humble and enjoyable. All in all, given that these results were appreciated, there were not enough room for children to voice in the learning milieu. Some studies also had similar results.
Lecturing children in undesirable, boring, and non-children friendly learning environment and activities hinder their learning and desire for science in favor of science teaching and learning. Kairollovna et al. (2021) assert that while experiencing the extracurricular activities in Children’s University, children should not study haphazardly, conversely, pre-designed and prepared lectures should be in a playful way, which means both experiencing the basics of the science and having fun for being there. Finally, yet importantly, Matusov (2018) and Hammer and van Zee (2006) argue that if children’s inquiries, interests, puzzles, excitement, and questions are kept out of classroom and school curriculum, this instruction will not access to children and practice of science education will not create any room for children learning and thinking.

Over and above the results marked by several opinions of the participating children about their experiences during the science curricula, there was required to understand and appraise the opinions of the science educators to elaborate and yield the clear implications of the results. For the science educators there have been pros and cons of what the science curricula were taught in university. The first pros thing is that the emergence of the idea of developing a science curriculum was inspired by the international studies or researches, such as similar international project, lectures, or implemented curricula. The second pros is that the motivation basis for meeting the science with children and teaching them was practically to adjust the needs of the public schools in pursuit of exchange of science knowledge in Turkey. These depict the reasons of the science educators’ conceptions and practices why the science teaching was seen in terms of raising a communal awareness about science and in turn disseminating norm of publicity toward the science. The present results are line with the recent study by Yeniay Üsküplü (2019), who found that the purpose and motivation of establishing children’s universities were to develop the science skills in children; to support children’s holistic development in classrooms with and without walls, and increase university-community cooperation to realize a mission of the universities. The results revealed that the broader goal of developing a science curriculum as extra-curricular activity was to promote the dissemination of effective science teaching and legitimate science teaching materials for the sake of being a bridge between university and community. Contrary, there were the cons insights about the science curricula. The foremost cons were emerging some factors hindering and enabling to achieve the learning objectives, which was caused by the insufficient educational material, lack of time, incompetency of science educators, and non-child-centered science curriculum even if the science curricula were organized within the walls of a university. This evidence could be explained an evaluative study (Gorard et al., 2017) in which the results assert that the most exiting extra-curricular programs might cost too much in terms of utilizing resources and staff time. These drawback and weakness results echo the findings of a study by Güvenir (2018), who indicated that pre-school teachers could not implement the science curriculum activities in the pre-school by reason of the lack of time and educational material. Additionally, these are in agreement with the results Dağlı (2014), who found already the lack of educational materials and resources matters during the instruction. The last and but least cons were related to the absence of curriculum development standards in science curricula, which makes the curriculum more likely being a teacher-made curriculum based upon their experience, knowledge, and abilities. In support of the results, Tisz et al. (2020) indicated that as being an important figure in children’s science teaching, teachers are insufficient and unqualified in science teaching and curriculum development. Overall, the results could be deduced that not only curriculum and curriculum making, but also instructional materials are worthwhile and beneficial for both university and public schooling. Because these factors are acted to assist children’s performance of science experimentation and learning, but they differed in ways uttered by science educators’ and teachers’ expertise.

The last results of this study were constructed to describe the extend of congruence between the intended, enacted, and observed science curricula. To this aim, the rule (learning objectives aimed for the student, but not for teachers) was considered in the course of the evaluation process. Around this perspective, the two varying documents (the written, that is to say, intended and recorded, that is to say, enacted) were analyzed in terms of four curriculum domains (aims/learning objectives and learning activities only) to yield the adamant evidences and evaluative findings for the revision, change, or updates of the science curricula. The analyzing results range from the re-categorizing of the all objectives by Bloom’s taxonomy and the re-visit and re-stating of them for the sake of the behavioral and measurable objectives. These results in agreement with Anwar and Bhutta (2014), who generates that curriculum designers retain and enhance children’s attitude toward science by adopting more interactive teaching methods and more reasonable objectives for children. While watching and evaluating the recorded lectures, the learning objectives available in the “enacted curriculum,” but not in the “intended” were added to the intended curriculum. Contrary, the learning objectives not available in the “enacted curriculum,” but in the “intended” were omitted to the intended curriculum or vice versa. Besides, the results for the learning activities were collected by analyzing the enacted curriculum. In this respect, the learning activities available in the “enacted curriculum,” but not in the “intended” were re-organized by the intended curriculum. What is more, the observation results revealed that children-economically disadvantaged also had a window of opportunity to benefit from such an extra-curricular activity under the roof of a university. These children could learn lots of something new in a supported and well-organized learning environment. Moreover, they have found a chance to experience the...
science education with their peers on an heterotically, but equal classroom atmosphere. These results validate Tamayo et al. (2017), who claimed that the equal accessibility and teacher support for the participation of students are worth handling for the fundamental pillars for a fully inclusive education. Also, UNESCO (2011), Pedder (2006), Blatchford et al. (2003) say that accessible and adaptable education system and learning strategies will prevent and overcome the barriers and negative impact on quality, quantity of learning opportunity for different children to participate in learning. Depending upon these overall results, children’s universities and their curricula should support the active participation and learning of all children from different socio-economic background. Further, these organizations facilitate many benefits, especially for children with disadvantaged backgrounds. Correspondingly, it can be asserted that the science curricula helped children to learn something new and has been employed as a means of eliminating or minimizing the inequalities among the participating children in terms of their economically disadvantages. In order to overcome imbalances in STEM participation and remain relevant in a multicultural society, informal STEM education organizations attempt to involve a greater cross section of their communities (Garibay & Teasdale, 2019). In parallel with these results, MacBeath and Waterhouse (2008) underlined the need for an organization, such as the Children’s University, which equalize the whole children by melting their socio-economic and family status in the so-called classroom. They argued this was the reason for need largely on the evidence of the continuing gap between the highest and lowest achieving schools and between the highest and lowest achieving pupils. Also, the results are overlapped by the similar studies in the literature. Results of these studies (Aral & Özdoğan Özbal, 2017; Carol-Ann Burke, 2020; Marulcu et al., 2014; Overton, 2010; Öztürk & Bozkurt-Altan, 2019) have showed that many positive results could be emerged or employed for children, especially for the ones with economically disadvantaged. These children can actively participate in the learning process; learn a variety of things new and develop positive attitudes or point of view toward the science, broadening the perspective, and re-defined in each children’s community context how university education in an informal science education is realized and experienced. Therefore, their scientific process and life skills are supported throughout lifelong. Furthermore, these present results were coincided with MacBeath and Waterhouse (2008). They claim that Children’s University could acknowledged to be successful when achieving the following goals: enabling children’s participation in voluntary learning activities; meeting the educational needs of children by addressing their creativity; creating a local and national agenda; creating cooperation between community-business environment and higher education; inspiring children, who cannot imagine the concept of university. Last but not least, Morrison (2012), and Tekerci and Kandır (2017) mentioned that science education curricula/programs have a positive effect on children’s science performance and scientific process skills.

Conclusion and Implications

Overall, the results for this study have concluded that the science education for children is a very useful practice for them. To benefit more from the science curriculum, the frequencies of the organization and implementation time of them can be extended. Hereby, this will change the way of perception that children think a university science curriculum as a truanty or stealing from the schools. The learning objectives, subject-matter, learning activities, and evaluation of the science curricula should be re-arranged and reformed in terms of the different learner profiles and difficulty levels. Thus, higher-level achievements and learning objectives might be included into the science curricula. Additionally, monitoring and examining the science curriculum of Ministry of National Education (MoNE) in Turkey should be benefit to yield a harmony between the curriculum of Children’s University and the counterpart of MoNE. Besides, a follow-up study can be carried out to determine to what extend science curriculum have an impact over children’s school and daily lives.

The children’s enquiries, individual interest, excitements, and questions about science and life should be included to the formal and non-formal science curriculum. In this way, teachers and science educators will access to the children and their self-containment and create a room for children’s agency and critical thinking.

While arranging the science extra-curricular activities, it is important to reckon children’s former experience and formal curriculum in order to provide the learning opportunities that are different from their formal teaching of science. Here, the classroom settings are learning environment are important to offer a different learning experience that definitely differs from the schooling. Additionally, the subjects and its contents should be chosen the conducive features to surprise and trigger children and to elevate their cognitive levels of science. Last but not least, while developing the science curriculum and extra-curricular activities, the science educators create the wide-scope of hands-on experiments for the sake of children.

According to the results of this study, two implications are appreciated: (1) There is a close link between the extra-curricular activities and children’ attitude toward science. In turn, children could develop a nucleus that has a positive or negative effect over their attitude toward science in parallel. (2) The prevalence of Children’s University in learning and teaching the science supports children’s unanswered questions about the science. Thereby, the science educators in Children’s University need to encourage and engage the children in understanding and utilizing the science in the real life.
Ethical Consideration

The procedures for science research protocol were followed after ethical clearance in advance. The permission (numbered with 137 on April 13, 2017) to conduct the evaluation of the science curricula in Ankara Children’s University was ensured by Ankara University Ethical Committee. This study was carried out according to the published guidelines for ethical research conduct of Ankara University Ethical Committee. All the participants for this research gave consent for participation on a voluntary basis and the privacy of all collected data was anonymized and aggregated. The study group in this research was designed equitably to avoid bias, and a copy of the research data was verified by participants (Cohen et al., 2007). The research findings were shared with the participants of this research upon completing the project report.

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References

Akkaya, S. (2006). The teachers’ opinions on the effect of the science and nature activities implemented in the pre-school institutions on the children’s ability to solve problems [unpublished master thesis]. Anadolu University.

Akman, B. (2003). The science education in pre-school education. *Journal of Education for Life*, 7(79), 14–16.

Alabay, E., Yıldırım-Doğru, S. S., & Akman, B. (2020). The effect of Sciencecenter(TM) assisted science education program on 60-72 Months old children's scientific process skills and scientific belief and tendency. *Hacettepe University Journal of Education*, 35(1), 20–39.

Anwar, N. P., & Bhutta, S. M. (2014). Students’ attitude towards science in lower secondary classes: Comparison across regions. *Educational Research Journal*, 17(1), 77.

Aral, N., Aslan, B., Gülleroğlu, H. D., Özdoğan Özbal, E., Aydos, S., Kadan, G., Kartal, M., & Dinçer, A. (2020). *Science Education: The Examples from Ankara Children’s University [Bilim Eğitimi: Ankara Çocuk Üniversitesi Örnekleri]*. Ankara University Press.

Aral, N., & Özdoğan Özbal, E. (2017). Alternative learning environments in teacher education: Science centers and applications in Turkey. In I. Koleva & G. Duman (Eds.), *Educational research and practice* (pp. 502–507). St. Kliment Ohridski University.

Arıl, N., Özdoğan Özbal, E., Gürsoy, F., Çetin Sultanoglu, S., Fındik, E., & Yurteri Tiryaki, A. (2019). Üniversite ve Toplum Bütünleşmesinde Örnek Bir Uygulama Bilim Üniversitelerde Çocuklarla Buluşuyor. *Journal of Education for Life*, 33(2), 202–215.

Ardaç, D., & Mugalolu, E. (2002). *Bilimsel süreçlerin kazanımına yönelik bir program çalışması. V*. Ulusal Fen ve Matematik Eğitimi Kongresi, ODTÜ.

Arisoy, N. (2007). Examining 8th grade students’ perception of learning environment of science classrooms in relation to motivational beliefs and attitudes (unpublished master thesis). Middle East Technical University.

Ayvaci, H. Ş., & Yurt, Ö. (2016). Child and science education. *Journal of Child and Civilization*, 1(1), 15–28.

Azizoglu, N., & Cetin, G. (2009). The effect of learning style on middle schools’ students’ motivation and attitudes towards science, and the relationships among these variables. *Kastamonu Education Journal*, 17(1), 171–182.

Başdağ, G. (2006). 2000 Yılı fen bilgisi dersi ve 2004 yılı fen ve teknoloji dersi öğretim programlarının bilimsel süreç becerileri yönünden karşılaştırılması [Unpublished master thesis]. Gazi University, Turkey.

Blatchford, P., Bassett, P., Goldstein, H., & Martin, C. (2003). Are class size differences related to pupils’ educational progress and classroom processes? Findings from the institute of education class size study of children aged 5–7 years. *British Educational Research Journal*, 29(5), 709–730.

Buckley, P., & Lee, P. (2021). The impact of extra-curricular activity on the student experience. *Active Learning in Higher Education*, 22(1), 37–48.

Büyüktaşkapu, S., Çeliköz, N., & Akman, B. (2012). The effects of constructivist science teaching program on scientific processing skills of 6-year-old children. *Education Sciences*, 37(165), 275–292.

Carol-Ann Burke, L. E. (2020). Informal science educators and children in a low-income community describe how children relate to out-of-school science education. *International Journal of Science Education*, 42(10), 1673–1696.

Çepni, S., Taş, E., & Köse, S. (2006). The effects of computer-assisted material on students’ cognitive levels, misconceptions and attitudes towards science. *Computers & Education*, 46(2), 192–205.

Children’s University. (2019). *What we do and why*. Retrieved July 20, 2019, from https://www.childrensuniversity.co.uk/about-us/what-we-do-and-why/

Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education* (6th ed.). Routledge Falmer.

Crall, A. W., Jordan, R., Holfelder, K., Newman, G. J., Graham, J., & Waller, D. M. (2013). The impacts of an invasive species citizen science training program on participant attitudes, behavior, and science literacy. *Public Understanding of Science*, 22(6), 745–764. https://doi.org/10.1177/0963662511434894

Creswell, J. W. (1999). Mixed-method research: Introduction and application. In G. J. Cizek (Ed.), *Handbook of educational policy* (pp. 455–472). Academic press.

Creswell, J. W. (2009). *Qualitative inquiry and research design: Choosing among five approaches*. SAGE Publishing.
Osborne, J., Simon, S., & Collins, S. (2003). Attitudes towards science: A review of the literature and its implications. *International Journal of Science Education, 25*(9), 1049–1079.

Overton, D. T. (2010). Formation of a Children’s University: Formative issues and initial concerns. *Procedia – Social and Behavioral Sciences, 2*(2), 3876–3882.

Öztürk, N., & Bozkurt-Altan, E. (2019). An out-of-school learning environment: Sinop children’s university. *The International Journal of Humanities Education, 5*(10), 370–381.

Pedder, D. (2006). Are small classes better? Understanding relationships between class size, classroom processes and pupils’ learning. *Oxford Review of Education, 32*(2), 213–234.

Petrova, M., Popova, L., & Dejniak, D. (2020). Children’s University activities as implementation of the third mission of higher education institution. *Strategies for Policy in Science and Education, 28*(2), 161–171.

Sağlam, M., & Aral, N. (2015). The study of determine pre-school teachers’ ideas about science education. *İnönü University Journal of the Faculty of Education, 16*(3), 87–102.

Schiefer, J., Golle, J., Tibus, M., Herbein, E., Gindele, V., Trautwein, U., & Oesch, K. (2020). Effects of an extracurricular science intervention on elementary school children’s epistemic beliefs: A randomized controlled trial. *British Journal of Educational Psychology, 90*(2), 382–402.

Schwab, J. (1960). Enquiry, the science teacher, and the educator. *Science Teacher, 27*, 6–11.

Seow, P.-S., & Pan, G. (2014). A literature review of the impact of extracurricular activities participation on students’ academic performance. *Journal of Education for Business, 89*(7), 361–366.

Shulruf, B., Tumen, S., & Tolley, H. (2008). Extracurricular activities in school, do they matter? *Children and Youth Services Review, 30*(4), 418–426.

Skukan, R., Borrell, Y. J., Ordás, J. M. R., & Miralles, L. (2020). *Find invasive seaweed: An outdoor game to engage children in science activities that detect marine biological invasion*. *The Journal of Environmental Education, 51*(5), 335–346.

Stringer, K., Mace, K., Clark, T., & Donahue, T. (2020). STEM focused extracurricular programs: Who’s in them and do they change STEM identity and motivation? *Research in Science & Technological Education, 38*(4), 507–522.

Tamayo, M., Rebollo, J., & Besoaín-Saldaña, A. (2017). Monitoring inclusive education in Chile: Differences between urban and rural areas. *International Journal of Educational Development, 53*, 110–116.

Taşar, M. F. (2007). Taking science to school: Learning and teaching science in grades K-8. *Eurasia Journal of Mathematics Science and Technology Education, 3*(2), 103–166.

Tekerci, H., & Kandır, A. (2017). Effects of the sense – based science education program on scientific process skills of children aged 60 - 66 months. *Eurasian Journal of Educational Research, 17*, 241–256.

Timur, B., & Kincal, R. Y. (2010). İlköğretim 7. sınıf fen bilgisi dersinde sorgulama öğretimin (inquiry teaching) öğrenci başarısına etkisi. *Türk Eğitim Bilimleri Dergisi, 8*(1), 41–65.

Tisza, G., Papavlasopoulou, S., Christidou, D., Ivari, N., Kimula, M., & Voulgari, I. (2020). Patterns in informal and non-formal science learning activities for children–A Europe-wide survey study. *International Journal of Child-Computer Interaction, 25*, 1–11.

Tokuc, H., & Aral, N. (2020). Mathematics education in early childhood: What is early mathematics, why is it important, how is it acquired? In H. Bekir, V. Bayraktar, & Ş. N. Karaçelik (Eds.), *Development and education studies* (pp. 97–127). Hiperlink Education Communication.

Tymms, P. (2004). Are standards rising in English primary schools?. *British Educational Research Journal, 30*(4), 477–494.

Ünal, M., & Aral, N. (2014). An investigation on the effects of experiment based education program on Six Years olds’ problem solving skills. *Education Sciences, 39*(176), 279–291.

UNESCO. (2011). Regional Education System on Students with Disabilities (SIRED). Santiago, Chile: UNESCO Press. Retrieved September 14, 2020, from http://uis.unesco.org/sites/default/files/documents/regionaleducation-system-on-students-with-disabilities-sired-methodological-proposal-en_2.pdf.

Walan, S., & Gericke, N. (2021). Factors from informal learning contributing to the children’s interest in STEM – Experiences from the out-of-school activity called children’s university. *Research in Science & Technological Education, 39*(2), 185–205.

Weinburgh, M. (1995). Gender differences in student attitudes toward science: A meta-analysis of the literature from 1970 to 1991. *Journal of Research in Science Teaching, 32*(4), 387–398.

Yeniay Üsküplü, Z. D. (2019). 21st century skills in the aspect of educational sociology – Children’s university model in Turkey [unpublished doctoral dissertation]. Istanbul University, Graduate School of Social Sciences.

Yücelyigit, S., & Aral, N. (2021). Children’s sophisticated use of digital technology. *Cumhuriyet International Journal of Education, 10*(2), 781–798.