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The Effects of Out-Of-Class Learning on Students' Interest in Science and Scientific Attitudes: The Case of School Garden

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Abstract

This study aims to reveal the effects of out-of-class learning activities conducted in the school garden on students' interest in science and their scientific attitudes. Research designed as a pretest-posttest control group quasi-experimental design of quantitative research methods. The research group of the study consists of 37, 7th grade students enrolled in a public school in Turkiye. Reproduction, growth and development in plants were conducted through school garden-based science activities for seven weeks. The research data were collected using Science Interest Scale and Scientific Attitude Scale. The study findings showed that garden-based activities have a moderate and close to moderate effect on students' interests in science and scientific attitudes. As per these findings, we can say that school gardens are out-of-class learning environments that can be used to help increase students' interest and attitudes toward science.

Keywords: Out-Of-Class Learning, School Garden, Scientific Interests, Scientific Attitudes, Science Education

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Introduction

Nowadays, science and technology are developing at an unprecedented pace. Changes that take place naturally affect the needs of societies, characteristics that individuals should have, and the structure of education. Current educational approaches focus on the acquisition of characteristics such as producing knowledge, making functional use of knowledge, problem-solving, critical thinking, research inquiry, entrepreneurship, creativity, and effective communication. Educators often mention the limitation of the learning mode realized only inside the classroom walls to have students acquire these characteristics (Akçalı, 2015). At this point, learning environments, where students can have first-hand experiences, see, practice, and feel the real-life equivalents of knowledge gain significance. These learning environments could be within or beyond the classroom walls. As Lieverman states, "For a more effective education reform, teachers should free children from classrooms" (as cited in Louv, 2017). According to these facts, the notion of conducting teaching activities not only in the classroom environment but also using out-of-class environments is increasingly gaining significance. The out-of-school or out-of-class learning environments are generally referred to as "outdoor learning/education", "out-of-school learning/education", and "out-of-class learning/education". In this study, out-of-class learning, was adopted in line with the research content.

Out-of-Class Learning

Out-of-class learning can be defined as children learning about people, their heritage, and natural environments through playing and other first-hand experiences in various settings beyond the classroom. Among other things, out-of-class learning can help students (Grigg & Lewis, 2016):

- Acquire knowledge about the environment
- Develop personal and social skills
- Learn about how things work and link together
- Think critically and creatively when they solve problems in real-world contexts
- Foster open-mindedness and caring responsible attitudes towards their environment.

Out-of-class learning is not the same as outdoor learning because out-of-class contexts include indoor settings such as museums, galleries, archives, science centers, as well as virtual worlds and the home environment (Grigg & Lewis, 2016). Outdoor learning can take place in any outdoor setting, from a schoolyard to remote wilderness settings, such as swamps, meadows, forests, shores, and so forth. Outdoor education can take place through walking around the block, or visiting a cemetery, a gravel pit, or an urban renewal project. It could happen in the playground, weeds of a vacant lot, a sewage treatment plant, a zoo, a forest trail, or in a national park. Such places are offer first-hand learning experiences, having direct connection with the topic and fostering interaction and socialization (Ford, 1986).

Priest (1986, p. 13) defines outdoor education as “an experiential method of learning by doing, which takes place primarily through exposure to the out-of-doors.” The actual "outdoor education" is conducted "outdoors". This is because outdoor education encourages interaction between the students and the outdoor setting (Priest, 1986). Outdoor education can be described as integrating the learning activities with real-life in outdoor settings beyond the school and classroom walls.

Another term including learning environments beyond the classroom and school walls is out-of-school learning. Out-of-class learning is not the same as out-of-school learning, despite sharing common features and similarities. Out-of-school learning encompasses many activities from living areas to virtual environments beyond the school boundaries (Eshach, 2007). Informal daily informal experiences in visual, print, and digital media and informal settings such as science centers, museums, zoos, industrial sites, aquariums, botanical gardens, library visits, and programs such as science festivals, camps, or after-school activities are examples of out-of-school learning education (Falk & Dierking, 2000). As such, outdoor education encompasses a multi-dimensional process, which links outdoor settings and learning activities. Out-of-school learning comprises learning environments that integrate outdoor or indoor settings outside the school with learning activities. However, out-of-class learning involves a comprehensive process, which integrates the outdoor or indoor settings beyond the classroom walls with learning activities. According to these definitions, as stated before, the term, out-of-class learning, was adopted.

The document, Learning Outside the Classroom Manifesto, argues that learning outside the classroom can offer students direct experiences that provide powerful contexts for learning plus deepen and enrich the classroom learning (DfEs, 2006). Out-of-class learning has no fixed boundaries. It can include cultural visits, environmental education, fieldwork in science and geography, outdoor and adventurous group activities, learning through outdoor play, visits to museums, galleries, and heritage sites. However, considering the convenience of curriculum planning, out-of-class activities may cover three main areas: the schoolyard, the immediate neighborhood, and remote areas requiring transportation (Grigg & Lewis, 2016). Of out-of-class learning environments, this study focuses on the school garden.

School Gardens as Out-of-Class Learning Environments

Educators can no longer teach the scientific concepts using course books alone. They have to employ hands-on and minds-on science techniques. School gardens are used as immediate learning environments suitable for these techniques and convenient contexts for pupils to see natural processes and cycles in person (Blair, 2009). The purposes of school gardens are named as academic, behavioral, entertainment, social, political, and environmental. Students not only will acquire knowledge from school garden experiences but also may begin to appreciate the natural resources in the environment and adopt a sustainable way of thinking and behavior (Blair, 2009).

A school garden gives students a chance to discover plant life cycles and provides a practical learning environment for teaching many skills in various disciplines such as science, mathematics, social studies, language arts, health, and visual arts. School gardens can inform students about collaboration, nature, science, creativity, and social services. In addition, gardens can help teachers to address various needs and interest areas of students. Integrating the course topics into the garden can fulfill other curricular objectives (Bundschu-Mooney, 2003). A classroom garden may also offer interdisciplinary project-based activities. Creating a school garden habitat where various small theme gardens can be developed is persuasive and students can obtain information about local ecology, bio-diversity, and gardening. Apart from developing an increasing appreciation for the natural world, these outdoor classrooms create an environment where students can plan and implement private projects on nutrition, environmental consciousness, and beautifying society (Bundschu-Mooney, 2003).

At present, generally, the educational practices related to school gardens are approached together with nutrition education (Gardner-Burt & Koch, 2017; Cotugna, Manning, & DiDomenico, 2012, Morgan, Warren, Lubans, Saunders, Quick, & Collins, 2010), agricultural practices (Duncan, Collins, Fuhrman, Knauft, & Berle, 2016), environmental education (Blair, 2009; Fisher-Maltese & Zimmerman, 2015), food preferences/behaviors (Cairns, 2016; Blair, 2009; Ratcliffe, Merrigan, Rogers, & Goldberg, 2009; Morgan, Warren, Lubans, Saunders, Quick, & Collins, 2010), Health education (Greer, Rainville, Knausenberger, & Sandolo, 2019), and science education. When studies on school gardens in science education are examined, they mostly focus on academic outcomes/achievement or scientific knowledge (Camasso & Jagannathan, 2018; Klemmer, Waliczek & Zajicek, 2005; Ürey & Çepni, 2015; Berezowitz, Andrea, Bontrager, & Schoeller, 2015). A meta-analysis study of 48 studies (1990-2010) in the United States reported the positive effects of garden-based learning programs on students' academic achievement in science, math, and language arts and the indirect effects of emotions and behaviors, supporting academic achievement (Williams & Dixon, 2013). In addition to their academic skills, students' affective skills are also of great importance during the educational process. Stimulating students' interests and attitudes toward science is one of the major objectives of teaching. The fact that how science courses are structured is important for students who are interested in scientific issues, investigate, inquire, conduct experiments and observations, discuss, and have positive scientific attitudes.

Planned educational practices developed in school gardens are reported to offer an interdisciplinary active learning environment and have positive effects on students' academic achievement and attitudes (Stoecklin, 2009).

Research Problem and Research Focus

Using of out-of-class learning environments in science teaching is endorse changing the learning environment, fuel interest in science, and increase students' science achievement. (Dori & Tall, 2000).

Research shows that teachers welcome learning in out-of-school settings, but do not often prefer these environments (Carrier, 2009; Köseoğlu & Türkmen, 2020). Dillon et al. (2006) grouped the barriers to the implementation of out-of-school education into two categories: external and personal factors. External factors were listed as teachers' fears and concerns about the health and safety of their students, self-efficacy concerns towards out-of-school teaching, and lack of resources, time and support. Personal factors were listed as students' age, previous knowledge and experience, fears and phobias, learning styles and preferences, and students with special educational needs (Tatar & Bağrıyanık, 2015). At this point, school gardens stand out as more practical alternative learning environments. As educators, we can claim that school gardens are our immediate out-of-class learning environments.

As a result of the literature review on the topic, we can note two critical points that emerge before us. First, there is a relatively small number of studies conducted in school gardens as out-of-class learning environments in a science course. Therefore, it is thought that an increase in the number of empirical studies regarding the school garden that offer many learning opportunities as an out-of-class learning environment is imperative. Second, studies regarding science courses conducted in school gardens mostly focus on academic achievement. This study focuses on students' scientific attitudes and interest in science.

Research Aim and Research Questions

This study aims to reveal the effects of out-of-class learning activities conducted in the school garden on students' attitudes in science and their scientific attitudes. The research questions are listed below:

1. Is there a significant difference between the "Science Interest Scale" pretest scores of the experimental and control group students?

2. Is there a significant difference between the experimental and control group students' "Science Interest Scale" posttest scores?

3. Is there a significant difference between the "Science Interest Scale" pretest and posttest scores of the experimental group students?

4. Is there a significant difference between the "Science Interest Scale" pretest and posttest scores of the control group students?

5. Is there a significant difference between the "Scientific Attitude Scale" pretest scores of the experimental and control group students?

6. Is there a significant difference between the "Scientific Attitude Scale" posttest scores of the experimental and control group students?

7. Is there a significant difference between the "Scientific Attitude Scale" pretest and posttest scores of the experimental group students?

8. Is there a significant difference between the "Scientific Attitude Scale" pretest and posttest scores of the control group students?

Method

Research Model

Research designed as a pretest-posttest control group quasi-experimental design of quantitative research methods. In educational research, it is not often possible for the researchers to conduct true experiments, for instance, through a random selection and assignment of participants to control or experimental groups. In such cases, researchers employ a quasi-experimental research design. Quasi-experiments involve field experiments, outside the lab (Cohen, Manion & Morrison, 2018).

Quasi-experimental designs are used in cases when working on existing groups where the participants cannot be randomly assigned to groups. As situations requiring the use of the true experimental design could not be created and using a random sampling method was not possible, a pretest-posttest control group quasi-experimental design was used in this study.

The pretest-posttest control group quasi-experimental designs examine the effect of an experimental procedure on a dependent variable (Fraenkel, Wallen, & Hyun, 2012). In this study, the independent variable is the out-of-class learning practices, and the dependent variables comprise interest in science and scientific attitudes. In the experimental group, out-of-class learning practices were conducted in the school garden. However, in the control group, the lessons were conducted based on the existing methods foreseen in the textbook and science curriculum determined by the Ministry of National Education. The model of the research method is presented in the following table.

Table 1. The model of the research method

Groups	Pretests	Procedure	Posttests
Experimental group	Science interest scale	Conducting the lessons with out-of-class teaching activities in the school garden	Science interest scale
	Scientific attitude scale		Scientific attitude scale
Control group	Science interest scale	Conducting the lessons as foreseen in science curriculum	Science interest scale
	Scientific attitude scale		Scientific attitude scale

Study Group

The research group of the study consists of 37, 7th grade students enrolled in a public school in Antalya/Kaş, Turkey. When determining the study group, easy accessibility was used as a base. Three main factors were taken into consideration while determining the school and study group where the research would be conducted. (i) The school garden was suitable for out-of-class learning activities, (ii) the science teacher in the school was open to new educational practices and collaboration for research, (iii) the number of students in classes was small.

After reaching a consensus on the suitability of the school for this study, two scales were administered in two grade 7 intact classes and their pretests were compared to determine the study groups. As there were no significant pretest differences, these two classes were determined as the study group. The groups were assigned to experimental and control groups through a random assignment. The class consisting of 17 students was determined as an experimental group, and the class consisting of 20 students was determined as a control group.

The teacher is willing to participate in the research and has sufficient teaching experience. While planning the activities, the views and suggestions of the teacher were taken into consideration. A meeting was held with the teacher on how to apply each activity. The activities were applied by the science teacher. Researchers participated in the classes as observers.

Instruments

The research data were collected using two different scales. In order to measure the effects of out-of-class activities carried out in the school garden on students' interests in science and their scientific attitudes, the "Science Interest Scale", developed by Laçin Şimşek and Nuhoğlu (2009), and the "Scientific Attitude Scale", developed by Moore and Foy (1997) and adapted into Turkish by Demirbaş and Yağbasan (2006), were used, respectively.

The Science Interest Scale consists of 27 five-point Likert type items. Some items include positive expressions and some negative. While scoring the scale, the negative statements were reverse-scored. A minimum of 27 and a maximum of 135 scores can be obtained from the scale, where high scores indicate high interest in science subjects. The Cronbach's Alpha reliability coefficient of the scale was calculated as 0.79.

The Science Attitude Scale includes a total of 40 items. The 40 five-point likert type items in the scale are about explaining the nature of science, the working styles of scientists, and what students feel about science. Of the items included in the scale, 20 are positive and 20 negative. While scoring the scale, the negative items were reverse-scored. The highest and lowest obtainable scores from the scientific attitude scale range from 200-40, respectively. The Cronbach's Alpha reliability coefficient was 0.76, and the Spearman Brown split-half correlation was 0.84.

Procedure

Reproduction, Growth, and Development in Plants were taught to both groups for a total of seven weeks, four hours a week. In the experimental group, the instructional activities were conducted in the school garden as an out-of-class learning environment. However, in the control group, the lessons were conducted depending on existing methods in the textbook and science curriculum determined by the Ministry of National Education. The instructional activities in the control were carried out according to the textbook used in the current syllabus.

Activities conducted in the school garden were planned in such a way that would offer opportunities for students to do observations and experiments in the school garden. All activities were created based on the question "How do reproduction, growth, and development occur in plants?" During seven weeks, various out-of-class activities were conducted in the school garden for the students to observe the reproduction type, growth and development processes in plants, the factors affecting the growth and development, and to take care of a plant and report its development process. The procedure of out-of-class learning practices are summarized in the following table 2.

Table 2. The Procedure of Out-of-Class Learning Practices

Week	Topics and Concepts	Out-of-Class Learning Activities	Activity Objective
1	-Sexual and asexual reproduction -Lifecycle	-Sexually and asexually reproducing organisms in our environment -Determining a plant for lifecycle	-Understanding the lifecycle of organisms - Giving students examples from the sexually and asexually reproducing organisms by unraveling their prior knowledge on sexual and asexual reproduction -Cultivating plants in the school garden and observing the suitability of plants for growth, and deciding on plants to grow.
2	-What is the seed? -Seed germination	-What is required for germination?	-Observing the conditions required for the germination of the seed
3	-The concepts of growth and development in organisms -Factors affecting growth and development in plants	-Can there be life without water, sun, and air?	-Understanding the concepts of growth and development -Observing some factors affecting growth and development in plants
4	-Asexual types of reproduction in plants	-Reproduction of plants from the stem	-Explaining asexual types of reproduction (vegetative, cutting, grafting, and budding reproduction). -Observing the vegetative reproduction

5	-Photosynthesis	-The effect of sunlight on photosynthesis -Do plants sweat?	-Observing the effect of sunlight on photosynthesis
6	The reproduction process in plants from seed to sapling	-Let's compare the growth and development of plants.	-Observing the growth and development process of a plant
7	-Lifecycle in plants	-Reporting the reproduction, growth, and development processes in plants	-Presenting and discussing the observation notes, pictures, and graphics

Week 1

The experimental group students to work with in out-of-class learning environments were met up in the school garden. They were asked to determine the organisms by observing the environment in the school garden. By directing the question "How do the organisms that you see in your surroundings come into existence?" they were enabled to reveal their knowledge about how the organisms continue their breeds through reproduction.

By unraveling their prior knowledge of sexual and asexual reproduction, students were asked to give examples from the sexually and sexually reproducing organisms they determined in the school garden (cats, birds, pines, roses, etc.), and the organisms in their near surroundings. In line with these examples, explanations were provided about sexual and asexual reproduction. In this stage, visual materials were used.

Students were asked about what the "lifecycle" was for organisms they saw in their environment. After getting the responses, they were told that they will observe the lifecycle of a plant, providing explanations.

Decisions were made together with students that which plants to grow per the region and weather conditions. At the same time, it was decided on which plants to grow from seeds and which plants to grow from saplings. In order to make the school garden suitable for growing plants, the soil was aerated with the students and watered to moisten, with the help of school staff. For the procurement of seeds and saplings, the researchers talked to relevant people or institutions.

Week 2

The activity started by asking questions to students regarding the topic, such as "What is seed?", "How do the plants grow?", "What is germination?", and "What conditions are required for germination?" After receiving answers from students, necessary explanations were made according to the answers.

The areas where the seeds and saplings will be planted were determined together with the students, and each student planted their seeds and saplings in the soil and watered them under the guidance of the teacher. Each student was asked to follow and note down the development process of his/her seed and sapling on weekly basis. For students to note down the process healthily, a "plant development observation form" was distributed to them.

Week 3

Students were asked about the concepts of growth and development. Based on the answers obtained, the difference between the two concepts was highlighted. They were asked to determine non-living elements interacting with living creatures in the environment by observing the school garden (factors affecting the living creatures). Students gave answers such as temperature, sunlight, soil, water, and air. In this respect, factors affecting growth and development in plants, including air, water, temperature, minerals, and light factors were discussed one by one.

For the "Can there be life without water, sun, and air?" activity, three equal-sized small trees were selected. One of these trees was not watered, the other was covered from sunlight, and the last one was covered with plastic and the air inside was vacuumed out. Students were asked to note the changes occurring in the three trees in subsequent days. Students explained which tree continued developing and which one did not.

Week 4

In the activity called "reproduction of plants from the stem", it was observed that plants not only can reproduce from seeds or saplings but can also reproduce from the stem through vegetative reproduction. The teacher asked students questions such as "How do plants reproduce? Do all plants reproduce with the same method?" and evaluated their answers. Based on the answers provided by students, the information on asexual reproduction was repeated and the types of asexual reproduction (reproduction through vegetative, cutting, grafting, and pudding) were explained. It was explained that plants not only can reproduce from seeds but can also reproduce through vegetative, cutting, and grafting methods. They were asked to observe the vegetative reproduction process by cultivating potatoes in the school garden and to note down their observations.

Week 5

Activities called "the effect of sunlight on photosynthesis" and "do plants sweat?" were conducted. Information about photosynthesis was provided to students. In order to examine the effect of light on photosynthesis, the leaves of the plant were covered with aluminum folio. After storing them for a few days, the folio was opened and the colors of the leaves were compared to other leaves. Tincture of iodine was dripped on a leaf and the color change in the leaf was observed. However, when it was dripped on the leaves not covered with the folio, they turned blue. The change of color indicated the presence of starch, a nutrient in the leaves. In order to observe sweating in plants together with students, the plants were covered with airtight bags and stored for two days. The bags were removed and evaluations were made together with students. As a result of the observations, it was concluded that plants sweat as a vital activity.

Week 6

The development process of the plants planted in the school garden as saplings and seeds were examined with students based on the observation forms and a general evaluation was made of the process. Students evaluated the characteristics relating to the growth and development processes of plants, such as their growth rate, height, number of leaves, number of branches, bud formation, and flowering, based on the notes they had taken. In addition, the plants cultivated as seeds and saplings were compared according to these characteristics. In the last section of the lesson, they prepared an illustration and graphic showing the school garden and the growth and development processes of their own plants to present next week.

Week 7

As in previous weeks, students met up in the school garden in the last week. The out-of-class learning activities conducted in the process were summarized. Students presented their presentations regarding the growth and development processes of their plants to their classmates. Finally, students were asked to share their feelings and ideas about the learning practices carried out in the school garden for seven weeks.

Results

Findings Regarding the First Research Question

The question "Is there a significant difference between the "Science Interest Scale" pretest scores of the experimental and control group students?" constitutes the first research question. In the analysis of the data related to this research question, the Mann Whitney U test was used. Through this test, the science interest scale pretest scores of students in the experimental and control groups were compared.

Table 3 provides the mean of ranks and the Mann Whitney U test analysis results of the interest scale administered to the experimental and control students before the intervention process.

Table 3. Mann Whitney U Results for Science Interest Scale Pretest Scores of Experimental and Control Groups

Groups	N	Mean Rank	Sum of Ranks	U	Z	*p*
Experiment	17	22.32	379.50	113.5	-1.723	.085
Control	20	16.18	323.50			
Total	37					

According to the results in Table 3, the Mann Whitney U test yielded no significant difference between the Science Interest Scale pretest scores of the experimental and control group students (Z = -

1.723; *p* = .085 > .05). It shows that the level of interest of the experimental and control groups in science was relatively close to each other before starting the research.

Findings Regarding the Second Research Question

As the second research question in the study, an answer was sought to the question "Is there a significant difference between the "Science Interest Scale" posttest scores of the experimental and control group students?" At the end of out-of-class learning practices, the Science Interest Scale was administered to both groups, and the collected data were analyzed using the Mann Whitney U test. Through this test, the Science Interest Scale posttest scores of students in the experimental and control groups were compared. Table 4 shows the resultant findings.

Table 4. Mann Whitney U Results for Science Interest Scale Posttest Scores of Experimental and Control Groups

Groups	*N*	Mean Rank	Sum of Ranks	U	Z	*p*	*r*
Experiment	17	26.79	455.50	37.500	-4.042	.000	0.66
Control	20	12.38	247.50				
Total	37						

When Table 4, showing the results of the Mann Whitney test conducted to compare the Science Interest Scale posttest scores of the experiment and control groups, is examined, there is a statistically significant post-experiment difference between the groups at a $p < .05$ level, favoring the experimental group ($Z = -4.042$; $p = .000 < .05$). While the mean rank of the posttest scores of students in the experimental group was 26.79, the mean rank of the posttest scores of students in the control was 12.38. The results of this analysis showed that the Science Interest Scale scores of students in the experimental group were higher after out-of-class learning practices than those of students in the control. Considering the effect size value ($r = 0.66$), the effect size of this between-group difference is at a moderate level.

Findings Regarding the Third Research Question

As the third research question in the study, an answer was sought to the question "Is there a significant difference between the "Science Interest Scale" pretest and posttest scores of the experimental group students?" In order to compare the pretest and posttest scores that the experimental group students obtained from the Science Interest Scale, the Wilcoxon Signed Ranks Test was applied. Table 5 shows the resultant findings.

Table 5. Wilcoxon Signed Ranks Results for Science Interest Scale Pretest-Posttest Scores of Experimental Group

Pretest-Posttest	*N*	Mean Rank	Sum of Ranks	Z	*p*	*r*
Negative Rank	4	4.63	18.50	-2.747	.006	0.45
Positive Rank	13	10.35	134.50			
Total	17					

Table 5 shows that there is a significant difference between the pretest and posttest scores obtained by the experimental group students from the Science Interest Scale (Z = 2.747, p = .006 < .5). When we examine the sum of ranks of difference scores, the difference favors the positive ranks, showing that the posttest scores are in favor of the experimental group. According to these findings, the out-of-class learning practices conducted in the school garden may have significantly increased the experimental group student's interest in science subjects. Considering the effect size value (r = 0.45), the effect size of this between-group difference is small but close to moderate.

Findings Regarding the Fourth Research Question

As the last research question relating to the interest scale in the study, an answer was sought to the question "Is there a significant difference between the "Science Interest Scale" pretest and posttest scores of the control group students?" In order to compare the pretest and posttest scores that the control group students obtained from the Science Interest Scale the Wilcoxon Signed Ranks Test was applied. The resultant findings are shown in Table 6.

Table 6. Wilcoxon Signed Ranks Results for Science Interest Scale Pretest-Posttest Scores of Control Group

Pretest-Posttest	*N*	Mean Rank	Sum of Ranks	Z	*p*
Negative Rank	13	11.88	154.50	-1.851	.064
Positive Rank	7	7.93	55.50		
Total	20				

As seen in Table 6, there is no significant difference between the pretest and posttest scores obtained by the control group students from the Science Interest Scale (Z = 1.851, p = .064 > .5). According to these findings, the learning practices carried out in the control group did not lead to a significant difference in students' interests in science subjects.

Findings Regarding the Fifth Research Question

The question "Is there a significant difference between the "Scientific Attitude Scale" pretest scores of the experimental and control group students?" constitutes the fifth research question of the study. The Mann Whitney U test was used in analyzing the data collected regarding this research question. Using this test, the Scientific Attitude Scale pretest scores of students in the experimental and control groups were compared. Table 7 provides the analyses results for the Scientific Attitude Scale administered to the experimental and control students before conducting the out-of-class learning practices.

Table 7. Mann Whitney U Results for Scientific Attitude Scale Pretest Scores of Experimental and Control Groups

Groups	N	Mean Rank	Sum of Ranks	U	Z	*p*
Experiment	17	16.21	275.50	122.50	-1.449	.149
Control	20	21.38	427.50			
Total	37					

As shown in Table 7, no statistically significant difference exists between the Scientific Attitude Scale pretest scores of students in the experimental and control groups ($Z = -1.449$; $p = .149 > .05$). Therefore, one could say that the level of scientific attitude of students in the experimental and control groups was somewhat close to each other before starting the research.

Findings Regarding the Sixth Research Question

As the sixth research question in the study, an answer was sought to the question "Is there a significant difference between the "Scientific Attitude Scale" posttest scores of the experimental and control group students?" At the end of the out-of-class learning practices, the Scientific Attitude Scale was administered to both groups, and the collected data were analyzed using the Mann Whitney U test. Through this test, the Scientific Attitude Scale post-test scores of the students in the experimental and control groups were compared. The results are shown in Table 8.

Table 8. Mann Whitney U Results for Scientific Attitude Scale Posttest Scores of Experimental and Control Groups

Groups	N	Mean Rank	Sum of Ranks	U	Z	*p*	*r*
Experiment	17	23.85	405.50	87.50	-2.516	.011	0.41
Control	20	14.88	297.50				
Total	37						

As seen in Table 8, there is a statistically significant between-group difference at a $p < .05$ level, favoring the experimental group ($Z = -2.516$; $p = .011 < .05$). The mean rank of the posttest scores of the experimental group students was 23.85, and the mean rank of the control group students was 14.88. As a result of this analysis, the Scientific Attitude Scale scores of the experimental group students were higher than those of the control group students after the out-of-class learning practices. When we examine the effect size value ($r = 0.41$), the effect size of this between-group difference is small but close to moderate.

Findings Regarding the Seventh Research Question

The question "Is there a significant difference between the "Scientific Attitude Scale" pretest and posttest scores of the experimental group students?" is the seventh research question of the study. The Wilcoxon Signed Rank test was conducted to compare the pretest and posttest scores of the experimental group groups from the Scientific Attitude Scale. The results are shown in Table 9.

Table 9. Wilcoxon Signed Ranks Results for Scientific Attitude Scale Pretest-Posttest Scores of Experimental Group

Pretest-Posttest	*N*	Mean Rank	Sum of Ranks	Z	*p*	*r*
Negative Rank	1	1.00	1.00	-3.577	.00	0.58
Positive Rank	16	9.50	152.00			
Total	17					

When table 9 is examined, there is a significant difference between the pretest and posttest scores of the experimental group students from the Scientific Attitude Scale (Z = -3.577, p = .00 < .05). When the sum of ranks of the Scientific Attitude Scale difference scores of the experimental group students are examined, the difference favors the positive ranks; that is, in favor of the posttest scores of the experimental group. According to these findings, one can argue that the out-of-class learning practices carried out in the school garden have increased the scientific attitude levels of students in the experimental group. When the effect size value is examined (r = 0.58), the effect size of this between-group difference is at a moderate level.

Findings Regarding the Eighth Research Question

As the last research question in the study, an answer was sought to the question “Is there a significant difference between the “Scientific Attitude Scale” pretest and posttest scores of the control group students?” The Wilcoxon Signed Rank test was conducted to compare the pretest and posttest scores of the control group students from the Scientific Attitude Scale. The results are provided in Table 10.

Table 10. Wilcoxon Signed Ranks Results for Scientific Attitude Scale Pretest-Posttest Scores of Control Group

Pretest-Posttest	*N*	Mean Rank	Sum of Ranks	Z	*p*
Negative Rank	9	11.78	106.00	-.443	.658
Positive Rank	10	8.40	84.00		
Equal	1				
Total	20				

Table 10 shows that there is no significant difference between the pretest and posttest scores of the control group students from the Scientific Attitude Scale (Z = -.443, p = .658 > .05). According to these findings, the educational practices carried out in the control group did not lead to a significant difference in scientific attitude levels of students.

Discussion, Conclusion and Recommendations

This study investigated the effects of out-of-class learning activities conducted in the school garden on students’ interests in science and their scientific attitudes. For this purpose, various science activities were conducted with the students in the school garden for seven weeks. Through the scales administered to students before and after the intervention, the effects of the school garden intervention on students' interests in science and scientific attitudes were evaluated.

In line with past research findings on positive outcomes offered by school gardens (Williams & Dixon 2013), the present study demonstrated that garden-based science learning activities can increase student interest in science and their scientific attitudes. The study findings showed that garden-based activities have a moderate and close to moderate effect on students' interests in science and scientific attitudes. As per these findings, we can say that school gardens are out-of-class learning environments that can be used to help increase students' interest and attitudes toward science. Studies with similar results are also available in the literature.

Williams, Brule, Kelley and Skinner (2018) examined the science engagement, learning, achievement, and identity of ethnically diverse grade 6 students in two low-income urban middle schools participating in the Science in the Learning Gardens (SciLG) program. The researchers conducted garden-based practices within the scope of units such as Growth and Development of Organisms, Organization for Matter and Energy Flow in Organisms, and Cycle of Matter and Energy Transfer in Ecosystems for one year. They applied a nine-item scale to reveal students' science identity. The scale included items such as "I am the kind of person who belongs in science," "People like me do not get jobs in science," "I am the kind of person who can succeed in science", and "I would like to have a job that uses science." Students stated that they will be someone capable and accepted in science, showing increased interest in pursuing a science career or receiving further science education. At the end of the study, the researchers revealed that students who participated in the Science in the Learning Gardens (SciLG) program reported a stronger science identity.

As a result of their experimental study, Dirks and Orvis (2005) applied the school garden program to primary school third-grade students (N=277) in 14 different classes and revealed that the program had a positive effect on students' attitudes towards science, environment, and gardening. In addition, the evaluations of teachers who applied the program to the students were examined. Teachers highlighted the positive changes in student behaviors and stated that students were excited during the school garden activities and their interest increased in learning science.

A study examining three afterschool indoor gardening programs in low-income urban schools determined that the program significantly improved students' desires to engage in scientific activities, reduced their anxiety when engaging in or thinking about science, and improved their self-concepts in science (Patchen & Barnett, 2016).

Jagannathan, Camasso and Delacalle (2018) studied low-income primary and secondary school students in experimental and control groups for six years and employed Singleton's (2015) model via a place-based nature and garden studies program to enhance student performance and interest in STEM careers. Their study showed significant improvement in students' science grades, interest in science, and science knowledge. School gardens proved to be an evitable part of the program to bolster the curriculum topics, establish a connection with the real life outside of the classroom, and stimulate interests in science.

The common point of the results of these studies indicated that participation in school garden activities is promising in supporting students' affective characteristics such as motivation, interest, and attitude towards science or science lessons. According to Passy (2014), since children enjoy the time spent outside, participating in school garden activities can provide emotional and motivational benefits to them. In a similar vein, Maltese and Zimmerman (2015) stated in their study that school gardens can increase students' willingness to participate more in such activities and their interest in science by providing an enjoyable learning opportunity. In our study, these can be noted as reasons behind the changes in students' interests and attitudes. In addition, seeing the topics and concepts in science lessons in their own environment may have positively affected students' interests and attitudes. Based on all these findings, we can say that school gardens have the potential to support students' cognitive and affective characteristics.

To sum up, when the results obtained in this study were examined it was determined that garden-based activities have an effect on students' interests in science and scientific attitudes. According the results, we can say that school gardens are out-of-class learning environments that can be used to help increase students' interest and attitudes toward science. School gardens can be used to increase students' affective characteristics for lessons. As mentioned in the significance of research, school gardens are practical and useful learning environments as an out-of-class learning environment. As educators, we can claim that school gardens are our immediate out-of-class learning environments.

The limitation of this study is that the data were collected using only scales. It is of great significance to support the data collected through scales with different data collection tools such as observation and interview. Maltese and Zimmerman (2015) worked with primary school second graders seeking an answer to the question, "Do students' attitudes toward the environment shift over the course of their engagement in a school garden curriculum?" As a result of the study, quantitative research data showed no statistically significant change in attitudes, but contrary to the survey data, the data collected from the pre/posttests, interviews, and student conversations revealed that students have a more empathetic view of nature and demonstrated positive changes in their environmental attitudes. Researchers emphasize collecting different types of data and developing better measurement tools. Therefore, researchers can be recommended to carry out well-planned and practical school garden activities, using mixed-research approaches.

Policy Implications

In today's education programs, approaches that support the use of out-of-class environments are adopted. In the Science Curriculum in Turkiye, it is emphasized to conduct lessons in learning environments based on student-centered methods. In this context, informal learning environments such as school gardens, science centers, museums, planetariums, zoos, and botanical gardens should be used in science lessons (Turkish Ministry of National Education [MoNE], 2018).

Although the importance of informal learning environments is emphasized, the curriculum mostly include activities and goals that can be applied in the classroom. Among informal learning environments, school gardens are easily accessible teaching environments for teachers. Especially due to the nature of many subjects in science lessons, school gardens can be used as a laboratory. Their use can be expanded to increase students' interest and attitudes towards science and contribute to their academic development.

In order for school gardens to be used in science lessons, it is important to first determine the conditions of school gardens and to carry out studies to improve them. In addition, teachers can be encouraged to use these learning environments through trainings on how they can make arrangements to integrate school gardens into science lessons within their current conditions. Science curriculum can include learning outcomes and activities that can be carried out in school gardens.

On the other hand, in school, gardens could be integrated into the curriculum to teach children not only about plants, nature, and outdoor settings but also about other subjects. Gardens could provide information about the history, poetry, mathematics, and scientific studies to children. In order to teach students an idea about a specific field, teachers can base the school garden on a theme, concept, or issue. Theme gardens provide an agenda, as plants are directly related to a general theme. Fields include an interdisciplinary approach to the garden. Curriculum or classroom interest areas may provide direction to the theme (Bundschu-Mooney, 2003).

Increasing the number of academic studies on the use of school gardens in other courses that are not related to natural sciences such as language, history, and mathematics can be encouraged. In the light of the results of these studies, explanations and instructions on how school gardens can be used as a learning environment in these courses can be added to the curriculum.

Credit Author Statement

The authors contributed equally to this research.

Conflict of Interest

No potential conflict of interest was declared by the authors.

Ethical Statement

This research was carried out with the approval of Kilis 7 Aralık University Scientific Ethics Evaluation Committee dated 13.12.2022 and numbered 03.

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