Attitudes toward Plants: Comparing the Impact of Instruction through Writing & through a Botanical Garden Trip

**ABSTRACT**

We designed and implemented two instructional approaches to plant education, with the intention of supporting positive attitudes toward plants among sixth-grade students (11–13 years old). In one instructional approach, students prepared a book about plants that have interesting characteristics. In the other approach, students visited a botanical garden. The purpose of the study was to compare the effects of these approaches on students’ attitudes toward plants. A matched-pairs experimental design was used in the research. A total of 56 students (28 in each group) participated in the study. Data were gathered by using the Plant Attitude Questionnaire. This instrument consisted of 28 items using a five-point Likert scale and included four dimensions of attitudes toward plants: importance, urban trees, interest, and utilization. Our results indicate that instruction via writing a book about plants with interesting characteristics is a good way to support students’ positive attitudes toward plants; this approach was especially effective in the dimensions of interest and utilization. The botanical garden trip was also effective, though in a more limited way, in supporting students’ positive attitudes toward plants; this approach was most effective in the dimension of urban trees.

**Key Words:** out-of-school learning; botanical garden trip; writing a book; student-centered, learning environments.

**Introduction**

Biodiversity has been under serious threat for many reasons, mainly growing populations and the increasing resource needs of humans. In the most recent update of the IUCN Red List of Threatened Species (dated July 18, 2019), a total of 105,732 species were evaluated, 28,338 of which are considered endangered. It has been found that plants are the kingdom with the most species on the Red List (IUCN, 2009).

We all have a duty and responsibility to help conserve plant diversity, and individuals’ attitudes toward plants are very important in this regard (Allen, 2003; Fančovičová & Prokop, 2011). An individual who has a positive attitude toward an organism will have a tendency to behave positively toward it and a readiness to sympathize, support, and help it (Adesoji, 2008). Individuals with positive attitudes toward plants protect, love, and respect them. They realize their importance for people and the environment and thus establish a bond with the plant world (Fančovičová & Prokop, 2010).

Although plants are commonly found in our environment, most people do not notice them (Wandersee & Schussler, 1999). Therefore, we need methods for introducing plants into students’ conscious perception. Species with interesting characteristics draw students’ attention (Tunncliffe & Reiss, 2000) and can be used effectively in plant education (Kinchin, 1999; Hoekstra, 2000; Strgar, 2007; Schussler & Olzak, 2008; Nantawanit et al., 2011; Pany, 2014).

It is important that students observe plants in their natural habitats, smelling and touching them. However, there can be difficulties in observing and handling some plants. For example, poisonous plants draw students’ attention (Hoekstra, 2000), but direct contact with them is dangerous. And it is usually difficult to observe a variety of plants with interesting characteristics in one place; typically, such plants are found in diverse habitats spread over a wide geographic area. With these problems in mind, we designed and implemented two instructional approaches to support positive attitudes toward plants among students. In one approach, students prepared a book about interesting plants; in the other, students visited a botanical garden.

Developing their own picture books gives students an opportunity to think twice, produce a unique study, construct their own knowledge, and learn the content (DeFauw & Saad, 2014). Hence, we thought that writing books about interesting plants would be an effective way to implement plant education within the classroom. On the other hand, trips to out-of-school settings are considered one of the most effective approaches to plant education (Kavak et al., 2006; Franks & Vore, 2010; Fančovičová & Prokop, 2011). However, financial restrictions, worries about lack of discipline during such trips, and the difficulties of organizing a trip, including the need to obtain the informed consent of students’ families and the
school administration, often prevent teachers from employing this approach (DeWitt & Storksdieck, 2008; Behrendt & Franklin, 2014).

Recognizing the need for affordable and effective instructional methods that teachers can implement in plant education, we designed a study to compare a classroom book-writing approach and a field-trip approach to support positive attitudes toward plants among sixth-grade students (11–13 years old). One group of students wrote a book about plants with interesting characteristics, another group of students visited a botanical garden to experience a variety of plants, and we evaluated and compared the effects of these two instructional approaches on the students’ attitudes toward plants. Our goal was to answer the following questions:

1. Does writing a book about plants with interesting characteristics support students’ positive attitudes toward plants?
2. Does instruction through a botanical garden trip support students’ positive attitudes toward plants?
3. Are there any differences between these two approaches in their effects on students’ attitudes toward plants?

Methods

Research Design

We used a matched-pairs experimental design, in which participants are not assigned randomly but are matched in terms of variables like gender, academic achievement score, and attitude score. The matched pairs are then randomly assigned to the different treatment conditions (Büyüköztürk et al., 2008). In our study, the students were randomly assigned to two groups after being matched in terms of variables that are likely to have an effect on attitudes toward plants.

Participants

The age range of 11–13 years has been found to be most appropriate for educational efforts that aim to develop awareness of plants and enhance attitudes toward them (Tunncliffe & Reiss, 2000; Tunncliffe, 2001; Strgar, 2007; Fančovičová & Prokop, 2011). Therefore, we carried out this study with sixth-graders (11–13 years old) in a state school located in Germencik, Aydın, in the Aegean region of Turkey. The instructional activities described below occurred outside the normal curriculum and classroom hours of the school. Hence, the student participants were volunteers. We assigned the students to two groups, which were matched in terms of the following variables that have been shown to affect attitudes toward plants: the environment where students live (Tunncliffe & Reiss, 2000; Fančovičová & Prokop, 2011), gender (Tunncliffe, 2001; Fančovičová & Prokop, 2011; Ozel et al., 2013), and cognitive factors (Fančovičová & Prokop, 2011). The characteristics of the groups are presented in Table 1.

The students in the book-writing group had no previous experience with writing a book. Before writing their own book, they studied the “Nature Cards: Trees” and “Nature Cards: Flowers” developed by the Scientific and Technological Research Council of Turkey, known as TUBITAK. Moreover, they examined a textbook as well as different types of science picture books they chose themselves. The students who participated in the botanical garden trip had not visited a botanical garden before. However, they had been on forest and park trips organized by the school.

Instructional Approaches

During design of our two instructional approaches, we first reviewed the literature, gathering information about the features required for teaching of science via writing a book and in out-of-school settings, the problems that might be encountered, and solutions to those problems. We then developed drafts of lesson plans based on these approaches and presented them to a team of six experts for review. Three of these experts are researchers in the field of science education, two are science teachers, and one is a teacher of Turkish. The teachers tried out the two sets of lessons with students on a pilot basis, and we used their feedback to revise the lesson plans before their implementation in the present study. The two sets of lessons each required the same amount of instructional time and occurred over a period of four weeks.

Writing a Book about Plants with Interesting Characteristics

The students in this group each wrote a book, for their peers, about a plant with interesting characteristics. When deciding which plants to include in this assignment, we reviewed the literature to determine which plants people have found interesting and why they found them interesting. According to Pany (2014), children find useful plants interesting. He classified useful plants into six subgroups, including edible plants, spice plants, medicinal plants, stimulant herbal plants, ornamental plants, and plants used directly in daily life. Among these subgroups, he concluded, medicinal plants and plants used in daily life are the most interesting. Hence, we decided that the student-written books would include medicinal plants and plants used in daily life. Pany also suggested that plants with distinctive morphological characteristics should be used in plant education, so we decided that the books would include plants with interesting shapes. Hoekstra (2000) advised increasing people’s interest in plants by using poisonous plants, so we included this plant type. Hershey (1996) suggested that teachers draw interest in carnivorous plants, giant plants, and plants with extraordinary characteristics. Hence, we decided to include carnivorous, giant, and smelly plants. We included red and black plants as well, because

| Table 1. Demographic description of the study groups |
|-----------------------------------------------|
| **Group** | **Gender** | **Where They Live** | **Science Achievement Score** |
|-----------|------------|---------------------|-------------------------------|
| Book-writing | Female (n) | Male (n) | City | 82.75 |
| Botanical-garden | 16 | 12 | City | 82.25 |
| Book-writing | 17 | 11 | City | 82.25 |
Lev Yadun and Gould (2007) reported that they drew people’s interest. During the piloting process mentioned above, it was observed that plants that move rapidly had drawn students’ interest. Considering this, it was decided that the book assignment would include plants that could react rapidly “live” during instruction.

Thus, the student-written books included a total of 27 plants, with three plants representing each of nine characteristics that make plants interesting to people:

- Plants of different sizes and shapes: Lithops, Euphorbia obesa, and Dracaena cinnabari
- Bad-smelling plants: Amorphophallus titanum, Stapelia grandiflora, and Dracaenula vulgaris
- Medicinal plants: Hamamelis, Aloe vera, and Salix
- Large plants: Victoria amazonica, Rafflesia, and Masa
- Red-black plants: Aeonium arboreum, Psychotria elata, and Acer rubrum
- Poisonous plants: Nerium oleander, Doronicum orientale, and Conium maculatum
- Carnivorous plants: Puya chilensis, Drosera capensis, and Nepenthes hooheriana
- Plants with industrial uses: Gossypium hirsutum, Papaver somniferum, and Linum usitatissimum
- Plants that exhibit sudden reactions: Mimosa pudica, Helianthus annuus, and Codariocalyx motorius

The instructional process for the book-writing activities consisted of four stages (adapted from DeFauw & Saad, 2014). Table 3. Pictures taken during the activities are presented in Appendix 1.

**Botanical Garden Trip**

The students in this group visited a botanical garden called the Palm Center (for detailed information about this botanical garden, see http://www.palmiyemerkezi.com). Different student-centered educational activities were done in three phases: before the trip, during the trip, and after the trip. This instructional process is presented in Table 2. Pictures taken during the activities are presented in Appendix 2.

**Measures**

Data were collected via the Plant Attitude Questionnaire, developed by Fančovičová and Prokop (2010) and adapted to Turkish by Selvi (2012). This instrument consisted of 28 items, using a five-point Likert scale, and included four dimensions of attitudes toward plants: importance, urban trees, interest, and utilization. Selvi reported the following Cronbach’s alpha reliability coefficients: 0.75 for importance, 0.58 for urban trees, 0.76 for interest, and 0.59 for utilization. Blackburn et al. (2014) stated that acceptable Cronbach alpha values range between 0.59 and 0.91. Selvi (2012) stated that the Turkish version of the scale was a reliable and valid data collection tool that could be used to measure Turkish students’ attitudes toward plants. Çil (2016) and Özel et al. (2013) used this scale in their studies.

This instrument was implemented as a pretest and posttest. The participants answered the data collection tool individually. We analyzed the data by first grading the students’ responses to each item of the questionnaire and then calculating each student’s total score.

The Shapiro-Wilk test for normality was used to determine whether the data were normally distributed. Because some data sets showed normal distribution and others did not, both parametric and nonparametric tests were used. We also determined whether the data obtained from the groups were dependent or independent by using dependent t-tests, independent t-tests, Wilcoxon signed-rank tests, and Mann-Whitney U-tests. Each of the scale’s dimensions was analyzed separately to examine in depth the students’ attitudes toward plants.

**Results**

**First Research Question**

The book-writing group participants’ pretest and posttest scores were compared using a Wilcoxon signed-rank test to find answers to our first research question. The findings obtained are presented in Table 4.

There is a statistically significant ($P < 0.05$) difference between the book-writing group participants’ scores for attitude toward plants ($z = -2.837, P < 0.05$). Considering the total rank of the difference scores reveals that this difference is in favor of positive ranks (i.e., posttest). The book-writing group participants’ scores obtained from each dimension of the scale in the pretest and posttest were compared with a Wilcoxon signed-rank test. The findings obtained are presented in Figure 1.

There is a statistically significant difference between the pretest and posttest scores of the attitudes toward plants with regard to the interest ($z = -2.589, P = 0.010$) and utilization ($z = -2.584, P = 0.010$) dimensions. When the total mean scores are examined, it is revealed that this difference is in favor of the posttest.

**Second Research Question**

The botanical-garden group participants’ pretest and posttest scores were compared using a dependent t-test to find answers to our second research question. The findings obtained are presented in Table 5.

There is not a statistically significant difference between the pretest and posttest scores of the botanical-garden group participants’ attitudes toward plants ($t_{27} = -1.332, P > 0.05$). When the data for each dimension of the attitudes toward plants were analyzed, a dependent t-test was used in the interest dimension. In the other dimensions, a Wilcoxon signed-rank test was used. The data obtained are presented in Figure 2.

In terms of the urban trees dimension ($z = -4.634, P = 0.000$), there is a statistically significant difference between the pretest and posttest scores. When the total mean scores are examined, it is revealed that this difference is in favor of the posttest.

**Third Research Question**

The pretest scores of the book-writing group and the botanical-garden group were compared using a Mann-Whitney U-test to find answers to our third research question. The findings obtained are presented in Table 6.

There is not a statistically significant difference between the pretest scores of the book-writing and the botanical-garden groups’ attitudes toward plants ($U = 345,500, P > 0.05$). The book-writing and the botanical-garden group participants’ posttest scores were
Table 2. Instructional process for writing a book about plants with interesting characteristics.

| Instructional Stage | Implementation                                                                                                                                                                                                 | Duration (minutes) |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| Prewriting          | The teacher chose a plant for each student by drawing lots. She prepared a picture book about the plants and guided students to examine this book. She prepared the instructions that would guide students during their research about the plants. She prepared separate instructions for each of the nine characteristics of plants that draw people’s attention (see text). These instructions consisted of questions, drawings, explanations, and so on, to enable students to do their research and prepare their book pages. The students then began researching their plants. | 120               |
| Drafting            | During their research, the students took notes and saved pictures of their plants. Using the collected information, they prepared book pages using size A4 paper. They drew pictures of their plants based on photographs. They showed on a map where the plant grows in the world. They also specified whether or not the plant grows in Turkey. They wrote the plant’s common name and scientific name. They wrote about the plant’s interesting characteristics, the growing conditions necessary for its survival, and how and by whom it was discovered. They did research about whether the plant was included among the extinct or endangered plant species and gave information about this topic in their book. Each student prepared a front cover, preface, content, and back cover for their book. | 160               |
| Revision and editing| The teacher gave feedback about the draft book pages. She identified any false or incomplete knowledge and guided the students to do more research where needed.                                                                                                                                                 | 120               |
| Publishing          | Each student presented their book’s front cover, preface, contents, and back cover to their peers. The students as a group then chose the best front cover, preface, contents, and back cover. Each student made presentations about their plant, using their book pages. The students examined the bound copies of each other’s books.                                                                                                                                                     | 80                |

Table 3. Instructional process for the botanical garden trip.

| Instructional Stage | Activity                | Implementation                                                                                                                                                                                                 | Duration (minutes) |
|---------------------|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| Previsit            | Introducing botanical gardens | The teacher prepared a PowerPoint presentation about botanical gardens: what they are, their importance, and famous botanical gardens in Turkey and the world. The students were asked to share their own experiences of botanical gardens, if they had any, with their peers.                                   | 40                |
|                     | Research on the trip site | The teacher prepared questions about the botanical garden that was visited. The students made online research about these questions. They shared the results of their research with their peers.                                                                                                           | 80                |
|                     | Planning the trip       | The trip day was planned in detail. The itinerary for the trip day was distributed to the students.                                                                                                                                                                      | 20                |
|                     | Rules for the trip      | The rules to obey in the Botanical Garden were presented to the students.                                                                                                                                                                                              | 20                |
| Instructional Stage | Activity                                      | Implementation                                                                                                                                                                                                 | Duration (minutes) |
|---------------------|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| During the visit    | Introduction of the Palm Center and its sections | Short information was given about the garden via PowerPoint presentation by the attendants of the botanical garden. The students asked questions about the botanical garden.                                      | 40                |
|                     | Worksheet                                      | The teacher distributed a worksheet to the students that consisted of short-answer questions, drawings, verbal narration, and multiple-choice questions. The students completed the worksheet in pairs. While completing the worksheet, they could ask the attendants for help. | 80                |
|                     | Clip art                                       | Working in pairs, the students created clip art by following steps given in the instruction. Each pair created clip art of a plant in the botanical garden. The plant for the clip art was chosen by the students.          | 40                |
|                     | Mask art                                       | Each student made a mask following the instructions given. Each mask represented a plant in the botanical garden. The students wore the masks they made and told the three characteristics of the plant aloud to their peers.                        | 40                |
| After the visit     | What I think and feel                          | The students wrote about what they had learned and how they felt during the botanical garden trip.                                                                                                                                                     | 40                |
|                     | Clover leaf                                    | A diagram of a four-leaf clover was used in this activity. The names of the sections in the botanical garden were written on the leaves of the clover. Pictures of plants present in the botanical garden were shown at the bottom of the activity sheet. The students cut the plant pictures and glued them to the relevant clover leaf. In addition, they wrote the name of each plant and its common characteristics in the clover leaf. Finally, they wrote the feature(s) that distinguish each section from the other sections in the botanical garden. | 40                |
|                     | Acrostics                                      | Each student wrote an acrostic poem with the name of a plant in the botanical garden. The students presented their poems to their peers.                                                                                         | 40                |

Table 4. Comparison of pretest and posttest scores of the book-writing group ($P < 0.05$ considered significant).

| Pretest–Posttest     | $n$  | Mean Rank | Total Rank | $z$     | $P$   |
|----------------------|------|-----------|------------|---------|-------|
| Negative rank        | 8    | 8.88      | 71.00      | −2.837<sup>a</sup> | 0.005 |
| Positive rank        | 19   | 16.16     | 307.00     |         |       |
| Equal                |      |           |            |         |       |

<sup>a</sup> Based on positive ranks.

Table 5. Comparison of pretest and posttest scores of the botanical-garden group ($P < 0.05$ considered significant).

| Tests     | Mean       | $n$  | SD          | df  | $t$   | $P$ |
|-----------|------------|-----|-------------|-----|-------|-----|
| Pretest   | 113.8571   | 28  | 10.48355    | 27  | −1.332| 0.194|
| Posttest  | 116.0714   |     | 9.3305      |     |       |     |
compared using an independent *t*-test. The findings obtained are presented in Table 7.

There is not a statistically significant difference between the book-writing and the botanical-garden group participants’ attitude scores toward plants obtained in the posttest (*t* = 0.926, *P* > 0.05). Mann-Whitney *U*-test and independent *t*-test were used to compare the scores obtained in each dimension of the plant attitudes by the book-writing and the botanical-garden group participants in the pretest and posttest. The findings obtained are presented in Figure 3.

There is a statistically significant difference in the book-writing and the botanical-garden group participants’ posttest scores of the urban trees dimension (*U* = 0, *P* = 0.000).

**Discussion**

Based on the findings of this study, it can be stated that instruction through writing a book about plants with interesting characteristics can be an effective way to promote positive attitudes toward plants. This result supports the opinions of researchers who argue that plants with interesting characteristics should be considered and/or focused on when teaching about plants (Kinchin, 1999; Hoekstra, 2000; Strgar, 2007; Schussler & Olzak, 2008; Nantawanit et al., 2011; Pany, 2014). One of the reasons for this result is that the process of book writing could lead students to establish emotional bonds with the plants. It is reported in the literature that an individual who has a positive attitude toward an object can feel sympathy and establish an emotional bond with it (Adesoji, 2008). The students did research on a plant for a month during the instructional process via book writing. The students studied the plant’s scientific and common name, where it grows, whether or not it is endemic and an endangered species, what makes it interesting and distinctive, what it needs to grow and develop, what it looks like, and what each of its organs looks like. They examined photographs of the plant and drew pictures of it. The pages prepared by each student were pieced together to compose a book. Moreover, each student prepared a preface and a back cover for the book. While preparing the writing pieces for the preface and the back cover, the students could express their feelings and ideas freely. This process may have caused students to establish emotional bonds, mainly with the plants they researched and then with all of them. During the writing and drawing process, the participants had an opportunity to question, explain, and construct their feelings and ideas. Writing not only records events or activities but also seeks to explain them (Demirel, 2011; DeFauw & Saad, 2014).

Our results for the four dimensions of attitudes toward plants indicate that the book-writing activities had more positive effects on the interest and utilization dimensions. The main reason for this finding with regard to interest could be that the book involved plants with interesting characteristics. Discovering those interesting and distinctive characteristics may have increased students’ interest in the plants (Strgar, 2007; Pany, 2014). The main reason for this finding with regard to utilization could be that the book included plants used in industry and medicine. During the instructional process, we observed that the participants studied the medicinal plants differently from the other ones involved in the book. The participants stated that such plants as sage, linseed, and rosemary were used by their parents as home remedies. We also observed that the participants made a list of the plants that existed in their surroundings and those used in medicine and industry. In addition, we observed that the participants were surprised to learn that the olive tree, which they encounter frequently in their environment, has many uses. However, our results for the four dimensions indicate that the book-writing activities did not have an effect on the urban trees dimension. One reason is that the plants we selected for the book include only five trees, whose characteristics are still being researched. Moreover, the plants’ contributions to city aesthetics, noise pollution prevention, and natural disaster prevention were not researched.

Our results indicate that the botanical garden trip had limited effects on the participants’ attitudes toward plants. This result is not similar to the results we have read in the literature (Fančovičová & Prokop, 2011). One probable reason for this situation is that the participants encountered a frog and a turtle in the wetland section of the botanical garden and a cat and a dog in the palmetum (one of the sections of the botanical garden); thus, the participants’ attention may have been more focused on these nonplant creatures. We also found that the botanical garden positively affected the urban trees dimension. A probable reason for this finding is that the participants encountered many tree species in the botanical garden. Another likely reason is that the palm trees in the palmetum drew...
Table 6. Comparison of pretest scores of the book-writing group and the botanical-garden group (P < 0.05 considered significant).

| Groups         | n  | Mean Rank | Total Rank | U   | P   |
|----------------|----|-----------|------------|-----|-----|
| Experimental   | 28 | 26.84     | 751.50     | 345,500 | 0.446 |
| Control        | 28 | 30.16     | 844.50     |      |     |

Table 7. Comparison of posttest scores of the book-writing group and the botanical-garden group (P < 0.05 considered significant).

| Groups         | Mean | n  | SD    | df | t    | P   |
|----------------|------|----|-------|----|------|-----|
| Experimental   | 118.2143 | 28 | 7.92258 | 54 | 0.926 | 0.358 |
| Control        | 116.0714 | 28 | 9.33305 | |     |     |

The interest of participants, who mentioned that they frequently see palms in the places where they live. Yet another reason could be the story of a Ravenala, or traveller’s palm, presented in the palmetum. This palm was carried to different cities in the world for various reasons. We observed during the trip that the students were interested in the life story of this palm.

Our findings indicate that both instructional approaches had positive, though somewhat different, effects on students’ attitudes toward plants.

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Appendix 1: Pictures Taken during the Book-Writing Activities

Preparing pages about plants with interesting characteristics.
Presentation and examination.

Appendix 2: Pictures Taken during the Botanical Garden Trip

Botanical garden visit and filling in the worksheets.

Clip art activity.