Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi
Cilt 17, Sayı 1, Haziran 2023, sayfa 26-45. ISSN: 1307-6086
Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education
Vol. 17, Issue 1, June 2023, pp. 26-45. ISSN: 1307-6086

Review

Educational Capacity of Botanical Gardens: What do the research results say?*

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Received : 23.05.2023 Accepted : 29.06.2023
https://doi.org/10.17522/balikesirnef.1301444

Abstract – Considering that they have been visited by more than 750 million people each year (BGCI, 2023), botanical gardens can play an important role in solving the global problems we face such as climate change, food security, and loss of biodiversity. To achieve this, it is recommended to strengthen the educational role of botanical gardens, review the research results made so far in this field, and support new research. Within the scope of this study, it is aimed to review the scientific research on the education and public awareness role of botanical gardens. Within the scope of this research, scientific studies published in peer-reviewed scientific journals on educational aspects of botanical gardens were reviewed. Thirty-two studies were reached as a result of the literature review carried out in accordance with the determined criteria. With the content analysis, the educational role of botanical gardens was systematically analyzed and interpreted according to research findings.

Key words: botanical gardens, education, content analysis

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*Note: This study is an expanded version of the presentation named "The Educational and Public Awareness Enhancement Capacity of the Botanical Gardens: What do the research results say?" that was presented as an oral presentation at the 3rd National Botanical Gardens Arboretums Herbariums and Botanical Museums Workshop held in Gaziantep, Turkey on March 23-25, 2022.

Introduction

Many scientists argue that we have entered the sixth great mass extinction and that anthropogenic climate change is one of the greatest threats to global biodiversity (Maclean &

Wilson 2011). It is seen that plant biodiversity also faces this threat. About one-third of the world's vascular plant species are threatened with extinction due to overharvesting, destructive agricultural and forestry practices, urbanization, environmental pollution, land use changes, various destructive activities including exotic invasive species, and global climate change (Chen & Sun, 2018).

One of the important steps in the protection of plant biodiversity is the "Global Plant Conservation Strategy-Global Strategy for Plant Conservation" (GSPC, 2011) adopted on 19 April 2002. The strategy, which was unanimously adopted by 187 countries including Turkey, has committed to achieving 16 goals by 2010. Goal 14 emphasizes the importance inclusion of plant diversity and the need to protect these plant diversity topics in education programs. Mounce and his colleagues (2017) argue that the role of botanical gardens is extremely important in the future conservation of biodiversity and in preventing extinction through integrated conservation action. Similarly, Williams and her colleagues (2015) highlight the value and importance of botanical gardens as catalysts that positively influence visitors' environmental attitudes.

Botanical gardens, by definition, are multidimensional institutions that house collections of living plants for scientific research, conservation, display, and education (Jackson, 1999). One of the most important functions of the first botanical gardens established in Europe was to maintain a scientific plant collection for the education of medical students (Heywood, 1991; Willison & Green, 1994). When we look at the establishment purposes of these premier institutions, it is seen that education is a priority, but they are especially focused on adult education. From the first half of the 20th century, however, some notable examples of botanical garden education programs have emerged. For example, the Brooklyn Botanic Garden, which was made available to the public in 1910, has focused on developing educational programs from its earliest years (Avery, 1971). Educational programs implemented in this garden have been developed to include young children and teachers. The International Botanical Gardens Conservation Organization (BGCI) was established in 1987, and this institution played a role in establishing the educational goals of botanical gardens. BGCI sees environmental education, and especially education for sustainable development, as the main responsibility of botanical gardens (Willison 2006; Willison & Green 1994). In 1990, an educational journal called 'Roots', affiliated with BGCI started to be published. This journal has pioneered the sharing of projects and studies carried out in botanical gardens in different parts of the world. Since 1991, under the leadership of BGCI, the Education Congress in the International Botanical Gardens has

started to be organized. All these processes have brought the educational role of botanical gardens to the forefront. Today, besides plant protection, research, and recreation, education is one of the functions of botanical gardens (Galbraith, 2003). In a survey conducted by Kneebone (2006) with more than 120 representatives of 117 botanical gardens, it is seen that 91% of today's botanical gardens have education among their targets.

Botanical gardens provide stimulating learning environments by documenting plant collections, conducting scientific activities on plant and animal life, and providing educational opportunities. These features make botanical gardens excellent informal learning institutions that attract many people to visit, learn, and have fun in the physical environment. However, the number of studies examining the effectiveness of the training conducted in the botanical garden and its effects on visitors is quite limited. Within the scope of this study, it is aimed to review scientific studies on the educational role of botanical gardens.

Method

Research Design

This study is a qualitative research aiming to review the findings of studies evaluating the educational capacity of botanical gardens. The publications about the educational capacity of botanical gardens were examined by the content analysis method. The content analysis aims to give a holistic, in-depth, and detailed description of the situation (Fraenkel et al., 2011). The method is based on the systematic analysis and interpretation of what is stated in the documents examined.

Literature Review

To provide a comprehensive literature review, several terms and phrases related to botanical gardens were searched in the widely used “ScienceDirect” online database. Identified terms and word sets include: “botanical garden”, “botanical garden education”, and “botanical education”. The search was extended by scanning the references of the accessed articles. Since there is limited research published in peer-reviewed journals on the educational role of botanical gardens, the search was not limited in terms of publication date. However, it was limited to publications in peer-reviewed journals, in English and Turkish languages so that the researcher could review them. At this stage, only articles that present results on the educational capacity of botanical gardens were selected.

Following these criteria, 32 studies were obtained. The publication year interval of these studies varies between 2001 and 2023. Considering the publication languages, it is seen that all the selected publications were published in English. In terms of country of publication, 7 of the studies were in England, 5 in Germany, 3 in America, 3 in Turkey, 3 in Australia, 2 in Taiwan, 1 in Canada, 1 in Greece, 1 in Italy, 1 in China, 1 in South Africa, 1 in Ethiopia, 1 in Malaysia 1 in Portugal, and 1 research was conducted at international level.

Analysis

The analysis of selected studies was carried out in two stages. In the first phase, three key aspects of all the studies included in the review were summarized: (1) participants (2) research focus (3) results. Accordingly, the studies are divided into adult, teacher, family and child, students, and non-participant research (document analysis, applications, etc.) according to their participant characteristics. Afterward, each category was examined in itself depending on the research focus and results. Research results in which there was more than one publication and research focus and results differed were categorized within themselves. For example, research with visitors was categorized as (1) adult visitor opinions of botanical gardens, (2) the effects of adult visits to botanical gardens, and (3) the effects of adult education programs conducted in botanical gardens, and they were analyzed and interpreted depending on the results.

Findings and Discussions

Thirty-two studies which were reached as a result of the literature review and carried out in accordance with the determined criteria, were examined by content analysis method in accordance with the criteria described above, and the results are presented in this section.

Studies with Adult Visitors

13 different studies were procured with adult visitors of botanical gardens. The list of these studies is shown in Table 1.

Table 1 Studies with Adult Visitors

	Authors	Publication Year	Number of Participants	Age Group	Country
1	Ballantyne et al.	2008	150	30-60 and above	Australia
2	Murray et al.	2007	319	15 and above	Australia
3	Ward et al.	2010	336	30-59 (>%50)	S. Africa
4	He & Chen	2012	1865	<20->50	China
5	Vergou & Willison	2014	-	-	England
6	Williams et al.	2015	1054	46 and above (%60)	England
7	Wassenberg et al.	2015	83	18-78	USA
8	Razak et al.	2016	518	-	Malaysia
9	Zelenika et al.	2018	196+119	39-40 (ave.)	Canada
10	Catahan & Woodruffe-Burton	2019	582*	-	England
11	Salvarci & Aylan	2021	211*	-	Turkey
12	Funsten et al.	2022	276	19-50 (%63)	Italy
13	Truong et al.	2022	42	59 (ave.)	Australia

The majority of research with adults appears to be about adult views on visits (8 publications), the effects of adult visits to botanical gardens (2 publications), and studies (3 publications) examining the effects of adult education programs conducted in botanical gardens.

Studies examining the opinions of visitors in different parts of the world show that visitors focus less on the educational role of botanical gardens. For example, in Malaysia (Razak et al., 2016), Italy (Funsten, et al., 2022), and South Africa (Ward et al., 2010), the results of the studies showed that recreational purposes are more important for botanical garden visitors. Catahan and Woodruffe-Burton (2019) analyzed TripAdvisor reviews of two botanical gardens in England using Leximancer software. Reviews show that visitors clearly place greater emphasis on garden aesthetics, facilities, and services, supporting previous studies. Similarly, Ballantyne, Packer, and Hughes (2007) found that visitors to botanical gardens showed relatively low interest in conservation issues. The most important reasons for visiting the botanical gardens are having fun, admiring the landscape of the garden; spending quality time with family or friends; and enjoying being outdoors/in nature. It was seen that the participants of the research conducted by Wassenberg, Goldenberg, and Soule (2015) also emphasize learning experiences. Participants stated that visits to botanical gardens provide new experiences and learning for them, provide relief from stress and increase their quality of life. The analysis revealed no significant differences between men and women. Murray, Price, and Crilley (2007) studied a sample of 319 visitors to an Australian botanical garden in one study.

It was determined that a component of the service quality in the botanical garden is educational services. The provision of learning environments related to education and the presence of information boards are the items under the education factor. Salvarci and Aylan (2021) who investigated the opinions of adult visitors in Turkey found that, similar to the results of studies conducted abroad, visitors' opinions about their visit to botanical gardens contain very limited information about the flora. The study data were obtained from 81 visitor reviews on the TripAdvisor website for "Ankara Botanical Park", "Atatürk Botanical Park", "Gaziantep Botanical Park", "Karaca Arboretum", and "Nezahat Gökyiğit Botanical Garden" in Turkey between May 2014 and November 2020. When the visitor comments were evaluated in the research, it was concluded that the comments about the botanical parks and gardens consisted of the codes of panoramic, peaceful/relaxing, lush green place, nostalgic, natural wonder, and tree museum. In addition to these, it was concluded that in these parks and gardens, activities such as walking and sports, picnics, taking pictures, watching the scenery, resting, and getting information about the flora can be done by the visitors.

In addition to the studies examining visitor opinions, research results examining the effects of visits on visitors were revealed. For instance, Williams and her colleagues (2015) investigated whether visits to botanical gardens changed visitors' ecological knowledge and environmental attitudes. Within the scope of this research, the use of information boards by visitors in botanical gardens was examined. A survey of 1054 visitors was conducted at five UK botanical gardens (Cambridge, Birmingham, Edinburgh, Kew, and Eden), half of whom were interviewed at the entrance and half at the departure. Research results show that there was a strong positive relationship between knowledge and attitudes. Botanical garden visits were found to have little effect on knowledge, but positive increases in environmental attitudes among those who left the botanical garden. This study provides quantitative evidence that botanical gardens can positively influence visitors' environmental attitudes. The research was conducted at five botanical gardens with visitor education centers in mainland China and found that these centers were highly functional (He & Chen 2012). In all five botanical gardens studied, those who visited the visitor education centers showed that they believed they had acquired significantly more information than those who did not visit these centers.

Additionally, it is seen that there are studies examining the effects of some programs developed for adults and applied in botanical gardens. Zelenika and her colleagues (2018) developed a new community-based education program to involve the public in sustainability, and the effects of the program were investigated. The content of the program consists of food

systems and choices, conservation of biodiversity, water conservation, and waste reduction. The present study examined the impact of the developed program on environmental knowledge, attitudes, and willingness to engage in pro-environmental behavior. The results showed that program participants were more knowledgeable about environmental issues after the tour than regular garden visitors who did not take the program, they were more connected to nature and showed more intention and willingness to participate in sustainability actions. The results show that interactive sustainability education in a botanical garden setting can be a useful educational model for mobilizing public participation in sustainability. Another program by Truong, Gray, and Ward (2022) investigated the effects of a horticultural program called "Community Greening" at the Royal Botanic Garden in Sydney, Australia. The narratives of respondents consulted to evaluate the program revealed themes such as gaining knowledge, connecting with nature, developing a sense of community, residents' sense of pride, and improving public perceptions of public housing. The study by Vergou and Willison (2014) presents the results of the evaluation of the results of the Communities in Nature initiative conducted by the University of Leicester Botanic Gardens (ULBG), RBGE, Westonbirt, The National Arboretum (Westonbirt) and Bristol Zoo Gardens (BZG). This study aims to provide evidence of how botanical gardens can address social roles and environmental and social inclusion issues by working with local communities. The findings are discussed for each project, and in summary, it has been revealed that environmental problems should be related to them and that the views of the groups should be included in the project in order to raise awareness and/or encourage participation in addressing environmental problems with groups facing social exclusion.

Studies with Teachers

Two publications about botanical garden education, attended by teachers, were found. The list of these studies is shown in Table 2.

Table 2 Studies with Teachers

	Authors	Publication Year	Number of Participants	Age Group	Country
1	Bayındır & Seggie	2015	149	39.8 (ave.)	Turkey
2	Tampoukou et al.	2015	154	44 (ave.)	Greece

The aim of the research conducted by Bayındır and Seggie (2015) is to determine the reasons why primary school teachers organize student trips to botanical gardens. The findings revealed that the following nine factors were effective for organizing student trips to botanical gardens. These are: to connect with the classroom curriculum, to provide students with an

overall learning experience, to encourage lifelong learning, to increase students' interest and motivation, to change the environment or routine, to have fun, to meet school expectations, to contribute to the socialization of students, and to enjoy the physical environment. In addition, a significant relationship was found between teachers' personal interests and their students' school trip experiences. Tampoukou and her colleagues (2015) conducted a survey on teachers working in Environmental Education Centers in Greece. The use of botanical gardens as an environmental education tool was investigated and the most important features of school environmental education programs were tried to be determined. The findings showed that the majority of environmental education center teachers (90.6%) did not develop environmental education programs involving the use of botanical gardens, but it was observed that botanical gardens were ranked as the most suitable among other green spaces to conduct such programs, especially for primary school students. Teachers stressed the need for botanical gardens to be designed accordingly and to provide the necessary infrastructure to facilitate teaching (eg, open spaces, gathering spaces, easy access roads, and indoor facilities). The results also found that although the majority of teachers (72.7%) knew of the existence of botanical gardens, only one-third (34.5%) visited them.

Studies with Families and Children

Two studies with the participation of families and children in botanical gardens were reached. The list of these studies is shown in Table 3.

Table 3 Studies with Families and Children

	Authors	Publication Year	Number of Participants	Age Group	Country
1	Eberbach & Crowley	2017	79 family	6-10 (child age)	A.B.D.
2	Haywood	2018	24 family	6.9 (child age ave.)	England

Eberbach and Crowley (2017) investigated two factors that may help children transition from seeing the natural world to observing the natural world. Specifically, they explored the potential roles played by differences in parental knowledge of pollination biology and differences in parental speech strategies. During a family visit to a botanical garden, the question was asked whether these factors could help children become more scientific in their observation of biological phenomena. 79 parent-child pairs with children aged 6-10 participated in a controlled study in which half of the parents used their natural speech styles and the other half were trained to use the four speech strategies during family pollination observations in a

botanical garden. The results showed that parents who received education left children with more learning from the botanical garden experience.

Haywood (2018) investigated adults' views on science learning at Kew Gardens. Participants in this study are 24 families who responded to an ad in the Kew Gardens newsletter. The findings showed that all families primarily referred to Kew's aesthetic beauty, but less accepted its function for science learning. The results showed that most families believe that no science learning takes place during unguided visits.

Studies with Students

Twelve studies conducted with students of different age groups in botanical gardens were reached. The list of these studies is shown in Table 4.

Table 4 Studies with Students

	Authors	Publication Year	Number of Participants	Age Group	Country
1	Tunnicliffe	2001	-	7-11	England
2	Bowker	2004	72	7-11	England
3	Sanders	2007	75	7-11	England
4	Chang et al.	2008	422	9-10	Taiwan
5	Morgan et al.	2009	5	9-10	A.B.D.
6	Wiegand et al.	2013	404	14.1 (ave.)	Germany
7	Sellmann & Bogner	2013	108+37	15-19	Germany
8	Sellmann & Bogner	2013	114	14-19	Germany
9	Sellmann	2014	114	14-19	Germany
10	Huang et al.	2016	21	High school	Taiwan
11	Kissi & Dreesmann	2018	192	10-12	Germany
12	Yılmaz et al.	2023	282	11-14	Turkey

Research with students seems to focus on guided tours (3 publications), evaluation of various short-term programs/activities developed for students in botanical gardens (6 publications), and examination of the effects of long-term programs conducted in botanical gardens (3 publications).

The activities most frequently attended by students in the botanical gardens are guided day school excursions. Part of the study published by Sanders (2007) involved 75 children from three primary schools who visited a botanical garden in London between 1997 and 2001. With the worksheets, both written and illustrated answers were obtained about the reasons for the children's interest in the botanical gardens or not, their favorite places in the botanical gardens, and their favorite plants. It is seen that the main factors in the visit preferences of the children

for visiting the botanical garden are entertainment and learning, and the main negative reasons are listed as only having plants and being boring. A similar study conducted in London was carried out by Tunnicliffe (2001). It was tried to determine what student groups were talking about during primary school visits to the Royal Botanic Gardens in Kew, England. The results showed that children spontaneously talked about easily observed characteristics of plants such as color, shape, and smell. When cues were given by adults or other children in the group, it was determined that the children paid attention to less obvious aspects of the plants. Another study conducted in England was conducted with a group of 7-11-year-old children guided by a teacher in the Eden Project. The aim of the study by Bowker (2004) was to reveal the most effective methods of taking a teacher-led field trip to improve children's perceptions of plants and their understanding of people's relationships with plants. Although most of the students showed interest in plants related to their lives, it was seen that most of them had low awareness about the relationships between plants, people, and resources.

It is seen that some researchers publish their studies on the programs they have developed on some special subjects. Chang, Bisgrove, and Liao (2008) conducted an empirical study to evaluate the educational effectiveness of using landscape narratives. To assess the impact of the narrative environment on students' learning efficiency and visual preferences, the views of each of the five selected theme shows were video recorded. It was found that when the content is associated and matched with the narrative setting, understanding and retention of the content increase significantly. The results of this research showed that using narrative landscapes for the design of display areas or theme gardens can increase the effectiveness of learning with appropriate information. Another program topic is climate change. Studies aiming to examine the effectiveness of the climate change education program in terms of various factors were carried out in a botanical garden in the south of Germany. Findings that combine a knowledge test, a psychometric questionnaire, and concept maps show that participants' level of knowledge has increased, their commitment to nature has increased, environmental attitudes have changed positively, and concepts related to climate change have developed towards a more scientific perspective (Sellmann & Bogner, 2013a; Sellmann & Bogner, 2013b; Sellman, 2014). It is seen that there are studies aiming to make students' visits to the botanical garden effective with technology integration. For example, Kissi and Dreesmann (2018) aimed to develop an application that combines mobile learning with plant education and to evaluate the effects of the application to positively affect students' knowledge and attitudes about plants and nature. Researchers have created an interactive treasure hunt-like quiz. Since the main topic is the

diversity of flowers, the practice is called flower hunting. In addition to understanding plant diversity, threats and protection, flower morphology and ecology, and systematics are also discussed. The results showed that students' motivation to participate was high, especially their knowledge of plant systematics. At the end of the application, although plant blindness did not disappear completely, it was determined that this application increased the environmental awareness of the students. A similar study was conducted by Huang, Chen, and Chou, (2016). Within the scope of the research, an augmented reality-based experiential learning model was developed.

In a field experiment in a botanical garden, 21 secondary school students formed three groups and participated in a learning activity using different learning types and environments. The quantitative results show that the technology-assisted model elicits positive emotions and improved learning outcomes among students when compared to the human guidance model alone. The authors interpreted the results as suggesting that the use of attractive technologies not only increases students' willingness to learn more about the environment but also to develop a more positive emotional bond with the environment.

Apart from daily visits, the effects of longer-term programs were also examined. For example, Wiegand, Kubisch, and Heyne (2013) compared teacher-centered and student-centered learning programs on plants and water heads. The effects of these programs on students' motivation and knowledge levels were investigated. Working together in small groups of 3-5 people, the students decided in what order they would attend the six compulsory learning stations. The subjects of the six learning stations are water absorption from root hairs, water transport in vein strips, root pressure, transpiration, succulence, and adaptation to the “pond” habitat. According to the results, the positive and negative effects of the two teaching approaches applied balanced each other, leading to equal knowledge gain for short-term and long-term learning outcomes. In addition, it was concluded that the internal motivation of the students was similar and high. Morgan, Hamilton, Bentley, and Myrie (2009) investigated the effects of the Brooklyn Botanic Garden's Green Reach Project. In this study, the authors used field observations, document analysis, and past participant interviews to document the impact of the program on urban youth. The effects of the program were revealed through seven themes. These are; the program offers participants the chance to get away from the challenging home and school environments, changes in academic and interdisciplinary skills, changes in science and horticulture skills, increased environmental awareness, social and personal development, a positive life experience, and cultural significance of the program. The findings of a study

conducted in Turkey by Yılmaz, Vural, and Yılmaz (2023), on the other hand, showed that environmental education conducted in a natural environment is more effective than education given in a classroom environment. The study investigated the differences that indoor and outdoor educational environments reveal in students' emotional, behavioral, and cognitive approaches. The story was read in two different environments, one in the closed classroom and the other in the botanical garden. Significant differences were found in the emotional, behavioral, and cognitive approaches of students in these two environments. These differences are in favor of children who listen to stories in a botanical garden setting. It was found that the negative emotions of the students studying in the botanical garden were lower, the environmental awareness and sensitivity levels were higher than the children participating in the indoor practice, and the behaviors indicating the value of not harming natural processes and living in harmony with nature were higher.

Studies Without a Participant Group

The related studies, whose participant group characteristics could not be determined, were examined under the general title since they also differ in focus. Three studies were examined under this title. The list of these studies is shown in Table 5.

Table 5 Studies Without a Participant Group

	Authors	Publication Year	Country
1	Argaw	2015	Ethiopia
2	Gaio-Oliveira et al.	2017	International
3	Postolache et al.	2022	Portugal

Within the scope of the research conducted by Gaio-Oliveira, Delicado, and Martins-Loução in 2017, 938 botanical gardens were contacted and 206 of these gardens (22% of the total) answered the questionnaire. More than half of the 206 botanical gardens studied have a teaching staff. It was observed that the vast majority (75%) of the botanical gardens that answered the questionnaire had interpretation boards for educational purposes apart from the scientific name and geographical distribution of the plants and the classical labels. Biodiversity and plant identification are the most discussed themes among both school visitors and the public. Endangered species, climate change, and pollution were the least mentioned themes. When the different types of visitors were examined, it was seen that in almost all botanical gardens, students made up less than half of the total visitors. While guided tours are the most

preferred type of visit by school visitors, it has been observed that the visitor people prefer to travel by themselves.

Argaw (2015) compared the education programs of a botanical garden in Ethiopia with the general education curriculum. 1-4, 5-8, and 9-12 according to analysis. 18.0 percent, 24.1 percent, and 19.3 percent of grade curricula were found to be related to botanical garden programs, respectively. The study by Postolache and his colleagues (2022) aimed to systematize a set of requirements that should be considered in the development of augmented reality applications that can be used by botanical garden visitors. It has been demonstrated that in the development of such applications, four elements should be identified, categorized as objectives, content, enabling technology, and other non-functional requirements. Since the data related to this application is limited, visitor opinions about the application are not included.

Conclusions and Suggestions

Connecting with nature, changing people's values and attitudes towards environmental issues, and focusing on ecosystem-centered rather than human-centered understandings of natural resource use can help them gain knowledge and develop nature-friendly attitudes on issues such as sustainability and global climate change. Botanical gardens are suitable places for people living in cities to connect with nature, and these features make botanical gardens important informal learning centers. The fact that they are located close to the cities, that their physical structures provide the advantage of attracting visitors, and that there are millions of people visiting the botanical gardens all over the world every year reveal the educational importance of these places. The plant collections of botanical gardens make it possible to share information with people about the plants on which life on Earth depends, plant biodiversity, ecosystems, the economic, cultural, and aesthetic importance of plants, and the relations between plants and local people (Willison, 2004). Although plant protection is the primary aim of botanical gardens, this aim evidently cannot be achieved without educational activities.

It is seen that 91% of today's botanical gardens rank education among their targets, and only a few botanical gardens have evaluated the effectiveness of the programs carried out in a comprehensive or experimental way (Kneebone, 2006). To evaluate learning outcomes, it is essential to evaluate the educational programs implemented in botanical gardens (Stern et al., 2008; Willison & Green 1994). However, many environmental education programs lack a systematic evaluation approach (Carleton-Hug & Hug 2010). Each botanical garden is of a different nature and exhibits different plant species, but often offers similar facilities and

amenities. For this reason, it may be recommended to determine the educational practices to be applied in botanical gardens and the evaluation standards for these practices. Botanical gardens are evaluated in the category of museums by the International Council of Museums. For this reason, the literature on museum education can guide those concerned in the evaluation of educational activities and activities to be carried out in botanical gardens. For example, Falk and Dierking (2000) developed a learning model called the Contextual Learning Model, which enables the examination of museum learning.

As stated above, botanical gardens are regarded as museums due to their structural and functional organization. However, botanical gardens, including the world-famous Kew Gardens, often have less informational content than other museums. The presentation of information is probably limited to preserve the beauty of the garden. Haywood (2018) considers this as a missed opportunity to support science learning. It is clear that research on information content and methods and their effects is limited and new research is needed. In particular, as the results of the research examined during this review study show, the interest of the young population in plants can be increased by technology integration.

Botanical gardens have a valuable and distinctive mix of staff skills, including people who do scientific studies, grow plants, and communicate about plants (Blackmore et al., 2011). It is essential that this capacity be used to enhance the educational role of gardens. However, to meet this role, it is necessary to employ experts with pedagogical knowledge in the gardens. One of the challenges faced by botanical gardens is that most staff working in botanical garden education are not professionally trained educators or teachers (Willison, 2004). Within the scope of the study by Zhai (2012), guided tours conducted by two educators in two botanical gardens in two different cities in England were observed, and they found that the processes took place as a structured, narrative-style and educator-oriented experience in which students and teachers act together as a whole. Bowker (2004) emphasized the importance of the educator guiding the group during the visit by asking quality questions that will attract the attention of the children to facilitate the understanding of plants and human society's relationship with plants. It seems that botanical garden educators should be given adequate opportunities to continuously improve their subject knowledge and pedagogical skills. Botanical gardens can establish a collaborative partnership with teacher training institutes to enable botanical garden educators to achieve continuing professional development. Teacher training can be organized in the gardens (Willison, 1993). Additionally, networking opportunities can make it easier for these educators to share their teaching experiences and thus reflect on their own practice.

Although botanical gardens around the world run several educational and community programs, research shows that most of them only appeal to a certain segment of the population, a large proportion of the population does not visit botanical gardens, and some often view them as privileged and elite institutions (Dodd & Jones, 2010). It is suggested that botanical gardens identify strategies to reach various segments of society. In particular, widespread effects can be increased by reaching socio-economically disadvantaged individuals who benefit the least from educational opportunities in general.

The main limitations of this research are that it is limited to 32 scientific articles selected depending on the determined criteria, and the three main aspects of all the studies included in the review are (1) the participants (2) the research focus (3) the results and the application of the content analysis method. Different studies addressing the educational aspect of botanical gardens can also be reviewed in sources other than peer-reviewed journals. For example, books or book chapters written on this subject (e.g., Michener & Schultz, 2002; Zhai, 2012), oral presentation papers (e.g., Stewart, 2002), and unpublished thesis (e.g., Vergou, 2010) can be analyzed by content analysis. During this content analysis study, it is seen that research on the educational role of botanical gardens has been published by experts from different disciplines. For this reason, facts such as the language of publication and the method used differed, which made the content analysis difficult. As discussed above, establishing, and following certain standards for research in this field can increase the widespread impact both academically and practically.

Compliance with Ethical Standards

Disclosure of potential conflicts of interest

No conflict of interest.

Funding

None.

CRediT author statement

The study was single authored and the whole process was carried out by the corresponding author.

Research involving Human Participants and/or Animals

The study is a review study.

Botanik Bahçelerinin Eğitsel Kapasitesi: Araştırma sonuçları ne söylüyor?*

Özet:

Dünya genelinde botanik bahçelerinin, her yıl 750 milyondan fazla kişi tarafından ziyaret edildiği (BGCI, 2023) düşünüldüğünde, botanik bahçeleri iklim değişikliği, gıda güvenliği ve biyolojik çeşitlilik kaybı gibi karşı karşıya olduğumuz küresel sorunların çözümünde önemli bir rol oynayabilir. Bunu başarabilmek için botanik bahçelerinin eğitim rolünün güçlendirilmesi, bu alanda bugüne kadar yapılmış araştırma sonuçların derlenmesi ve yeni yapılacak araştırmaların desteklenmesi önerilmektedir. Bu çalışma kapsamında, botanik bahçelerinin eğitim ve kamu bilinci geliştirme rolü ile ilgili yapılmış bilimsel araştırmalar hakkında derleme yapılması amaçlanmıştır. Araştırma kapsamında, botanik bahçelerinin eğitsel yönünü ele alan hakemli bilimsel dergilerde yayınlanan bilimsel çalışmalar derlenmiştir. Belirlenen ölçütlere uygun şekilde yapılan literatür taraması sonucu, otuz iki araştırmaya ulaşılmıştır. Yapılan içerik analizi ile botanik bahçelerinin eğitsel rolü, araştırmaların sonuçlarına göre sistematik olarak analiz edilmiş ve yorumlanmıştır.

Anahtar kelimeler: botanik bahçeleri, eğitim, içerik analizi

*Not: Bu derleme çalışması, 23-25 Mart 2022 tarihlerinde, Gaziantep, Türkiye'de düzenlenen 3. Ulusal Botanik Bahçeleri Arboretumlar Herbaryumlar ve Botanik Müzeleri Çalıştayı'nda sözlü bildiri olarak sunulan "Botanik Bahçelerinin Eğitim ve Kamu Bilincini Geliştirme Kapasitesi: Araştırma sonuçları ne söylüyor?" adlı çalışmanın genişletilmiş şeklidir.

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