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Learning Ecological Concepts Before-After Tracking In Environmental Trail

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LEARNING ECOLOGICAL CONCEPTS BEFORE-AFTER TRACKING IN ENVIRONMENTAL TRAIL

APRENDIZAGEM DE CONCEITOS ECOLÓGICOS ANTES-DEPOIS DE CAMINHADA EM TRILHA AMBIENTAL

APRENDIZAJE DE CONCEPTOS ECOLOGICOS ANTES-DESPUÉS DE CAMINATA EN SENDERO AMBIENTAL

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ABSTRACT: *environmental-science education has aimed to educate about environmental aspects with theoretical and practical science-based activities involving both trails and laboratory activities. Here we assessed the effectiveness of using environmental trail in an Atlantic Forest fragment to improve ecological and biological concepts learning. The hypotheses tested were that there is biological and ecological concepts acquisition following the visit to the trail and that the activity increases the comprehension about the multiple functions of species and ecosystem processes. Eight groups of undergraduates and teachers from public schools (N = 161 people) participated of a three-step activity by: i) answering a questionnaire (pre-test); ii) discussing ecological subjects and observe scientific experiments while walking by trail; and iii) answering the questionnaire after the visit (post-test). Results showed significant difference between the pre-test and the post-test for all groups (p = 0.000), indicating that the use of trails increased the understanding of ecological and biological concepts. Furthermore, scores in multiple choices questions were always higher in the post-test showing that participants understood the multiple functions of ecosystem's elements, enhancing their view and comprehension of ecosystem as a whole. The use of ecological restoration experiments seemed to be a new valuable approach to achieve these outcomes.*
Key words: *Environmental education; science education; Atlantic Forest; ecological restoration; conservation.*

RESUMO: *a educação científica-ambiental tem visado a aprendizagem de aspectos ambientais com atividades científicas teóricas e práticas em trilhas e laboratórios. Seguindo esta tendência, esse estudo avaliou a eficácia do uso de uma trilha ambiental em fragmento de Mata Atlântica para melhorar a aprendizagem de conceitos ecológicos e biológicos. As hipóteses testadas foram que há aquisição de conceitos biológicos e ecológicos após a visita à trilha e que esta aumenta a compreensão sobre as múltiplas funções de espécies e processos ecossistêmicos. Oito grupos de graduandos e professores de escolas públicas (N= 161 pessoas) participaram de uma atividade em três etapas: i) responder um questionário (pré-teste); ii) caminhar na trilha para discutir assuntos ecológicos e observar experimentos científicos sobre questões ecológicas previamente abordadas no questionário; iii) responder ao questionário após a visita à trilha (pós-teste). Os resultados mostraram diferenças significativas entre o pré e pós-teste para todos os grupos visitantes (p= 0,000), demonstrando que o uso de trilhas para educação científica-ambiental aumenta a compreensão de conceitos biológicos e ecológicos. Ademais, o uso de experimentos de restauração ecológica pareceu ser uma nova abordagem valiosa para alcançar esses resultados, possibilitando aos visitantes aumentar sua visão e compreensão do ecossistema como um todo.*
Palavras-chave: *Educação ambiental; educação científica; Mata Atlântica; restauração ecológica; conservação.*

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10.5216/teri.v9i1.51982

RESUMEN: *este estudio evaluó la eficacia del uso de uno sendero ambiental en fragmento de mata atlántica para mejorar el aprendizaje de conceptos ecológicos y biológicos. Las hipótesis probadas fueron que hay adquisición de conceptos biológicos y ecológicos después de la visita al sendero y que la actividad aumenta la comprensión sobre las múltiples funciones de especies y procesos ecosistémicos. Ocho grupos de universitarios y profesores de escuelas públicas (N = 161 personas) participaron en una actividad en tres etapas: i) responder al cuestionario (pre-test); ii) visitar el sendero discutiendo asuntos ecológicos y observando experimentos científicos; y iii) responder al cuestionario después de la visita (post-test). Los resultados mostraron diferencias significativas entre el pre-test y post-test para todos los grupos de visitantes (p = 0,000), indicando que el uso de técnicas de educación científica-ambiental en senderos aumentó la comprensión de conceptos biológicos y ecológicos. Además, las puntuaciones para las preguntas con múltiple elección siempre fueron mayores en el post-test, indicando que los participantes entendieron las múltiples funciones de los elementos de los ecosistemas, aumentando su visión y comprensión del ecosistema como un todo. El uso de experimentos de restauración ecológica pareció ser un nuevo enfoque valioso para alcanzar estos resultados.*
Palabras clave: *Educación ambiental; educación científica; Mata Atlántica; restauración ecológica; conservación.*

INTRODUCTION

The rise of environmental problems in the last years has enhanced the use of environmental education as a tool to warn and educate people about the risks of pollution and ecosystem degradation (Ribeiro **et al.**, 2012; Karatas & Karatas, 2016). The main goal of environmental education is provide knowledge, values and skills to the promotion of protection and conservation of the environment (Peter & Cheruto, 2013). However, somehow, environmental education arose as a **stimulus response** (sensu Jensen **et al.**, 2007) in which environmental education is used to solve each environmental problem. Educators have been questioning such approach (Jensen & Finley, 1996) and new trends have been gradually inserted on environmental education studies. In late 80´s science education expanded the action and goals of environmental education including the focus on science understanding and science concepts learning (Durant **et al.**, 1989; Chi **et al.**, 1994; Duit & Treagust, 2003). Since that, Science Education has been used to promote the learning of ecological concepts using consistent methodology to meet the nature's objects, forms, characteristics and process, as well as to determine the dynamics of these objects, establishing qualitative and quantitative relationships on ecosystem knowledge (Bellini, 1993). Recently, environmental-science education projects have been used aiming to educate about environmental aspects with theoretical and practical science-based activities involving both outdoor actions (such as trails, as in Todorov **et al.**, 2016; Mette **et al.**, 2010; Carvalho **et al.**, 2011), indoor's activities in laboratory (Curado & Angelini, 2006; Angelini **et al.**, 2011) or activities in the school environment (such as workshops, as in Nunes **et al.**, 2017). An approach more interactive and constructivist in learning process has been the use of outdoor activities through the contact with nature and may provide a greater comprehension of the ecosystems and of the environment impacts occasioned by man (Kostova, 2013). Following such trends, views on environmental education have been extended through assessable techniques which allow estimate and monitor the outcomes from programs on environmental education (Pádua, 1994; Pádua & Tabanez, 1997).

Trails in natural areas such as parks, experimental stations, reserves, forest fragments or other natural areas are often used as a tool for environmental education (Saito 2000; Pádua & Tabanez, 1997; Carvalho **et al.**, 2011; Risso e Pascoeto, 2016; Nascimento **et al.**, 2017). However, the use of trail as instrument for environmental education could diverge among different aspects related to experience, perception and environmental interpretation (Guimarães, 2006). The goals of using

trails for environmental-scientific education have been criticized by the exclusion of issues such as ecological process that determine biodiversity and conservation (Bride, 2006) and consequently for its low contribution to people understandings on conservation (Wyner & Desalle, 2010), biological diversity and the benefits of biological restoration (Bizerril, 2004; Randler **et al.**, 2005).

Recent approaches have dealt with this constraints by combining trails and laboratory activities to enhance and fix ecological concepts, improve knowledge about the importance of ecosystem services and increase interaction between people and environment (see Curado & Angelini, 2006; Angelini **et al.**, 2011). The goal of this paper was to develop an environmental-science education investigation through visits in a trail coupled to scientific experiments performed in the field, along the trail surroundings. The trail is into an Atlantic Forest fragment which is under constant anthropogenic pressure and that has been restored by scientific projects, offering proper scenarios to exemplify themes such as biodiversity and conservation. The intent was investigate if i) there was difference on understanding of biological and ecological concepts related to conservation after visiting the trail, and if ii) the visit changed people linear view increasing the understanding about multiple functions of species and ecological process. The fragment of Atlantic Forest was chosen mainly given to its small size, local scenario of pressure and because the Atlantic Forest is the most endangered ecosystem in Brazil, and in the region of study, it is virtually disappearing.

MATERIAL AND METHODS

STUDY AREA

The Brazilian Atlantic Forest is a hotspot and a priority for conservation (Galindo-Leal & Câmara, 2005) given that only 11,7% remains from its original area of 1.481.946 km² (Ribeiro **et al.**, 2009). This biome is complex and has a high index of diversity and endemism, averaging nearly 50% overall, and as high as 95% for some groups (Brown & Brown, 1992). The Atlantic Forest is formed by two major vegetation types: the coastal forest, or Atlantic Rain Forest, which extended along the coastline from southern to northeastern Brazil, and the tropical seasonal forest or Atlantic Semi-deciduous forest, which has extended across the plateau into the center and inner southeastern of the country (Leitão-Filho & Morellato, 1997; Oliveira-Filho & Fontes, 2000). Currently, the decrease of the Brazilian Atlantic Forest is one of the most alarming conservation problems in the world (Viana **et al.**, 1997). Thus, many Atlantic Forest fragments have been arose along time and it is reasonable to suppose that many species already have gone extinct before they were described and that many others will soon disappear (Morellato & Haddad, 2000).

The study was conducted in a trail into a Brazilian Atlantic Forest fragment located at the campus of Federal University of Rio Grande do Norte (Natal, Brazil), the **Mata dos Saguis** (i.e. Sagui's Wood). The trail, called **Saguis trail** (sagui, or marmoset in English, is the small primate **Callithrix jacchus**) is about 450m long (Figure 1). The fragment has 15.500m² and its flora is composed by typical species from the Brazilian Atlantic Forest, the northeastern Brazilian savanna and the arboreal and shrub vegetation named restinga, such as Ipês [**Handroanthus impetiginosus** (Mart. ex DC.) Matos and **Tabebuia roseoalba** (Ridl.) Sandwith], Ubaia [**Eugenia luschnathiana** (O. Berg)

10.5216/teri.v9i1.51982

10.5216/teri.v9i1.51982

Klotzsch ex B.D. Jacks] and Mangaba (**Hancornia speciosa** Gomes). The area presents high of plant and animal species richness. Among the animals, there are terrestrial animals as Sagui (**Callithrix jacchus** Linnaeus), Iguana (**Iguana iguana** Linnaeus), Timbú (**Didelphis albiventris** Lund), Raposa or cachorro-do-mato (**Cerdocyons thous** Linnaeus), Lagartixa or Calango (**Tropidurus hispidus**), Perereca-de-banheiro (**Scinax x-signatus**), Gafanhoto-soldado (**Chromacris speciosa**) and several species of aerial animals, such as Anu-branco (**Guira guira** Leach), Anu-preto (**Crotophaga nai** Linnaeus), Galo-de-campina (**Paroaria dominicana** Linnaeus), Bem-te-vi (**Pitangus sulfuratus**), Lavadeira-de-praia (**Fluvicola nengeta**) and coruja-buraqueira (**Athene cunicularia**).

The fragment is somehow degraded, being partly covered by grasses and shrub areas instead of the natural forest (Figure 1). Currently, a project undertaken in the fragment called **La.Na. Mata dos Saguis** (Natural Laboratory Mata dos Saguis) aims to aplly activities of revitalization, restoration and scientific-environmental education and seeks to formalize it as a natural laboratory.

Seven undergoing ecological restoration experiments in the area were used to explore scientific concepts and ecological process. These experiments include the use of perches aiming to investigating seed dispersion (as carried out by Ganade & Zanini, 2005 and Melo **et al.**, 2000); the use of Pau-brasil (**Caesalphinea echinata**) as nurse-plant (as done by Lindig-Cisneros **et al.**, 2011; Corbin & Holl, 2012); two experiments testing seed germination of dune species (**Ipomea sp.** and **Canavalia sp.**) under different treatments (as in Neto **et al.**, 2004); two experiments testing the surviving and growth of Pau-brasil seedlings under different treatments; and experiments of fertilization on Mangaba (**Hancornia speciosa**) seedlings. The public who visited the trail was each undergraduate students or teachers from public schools.

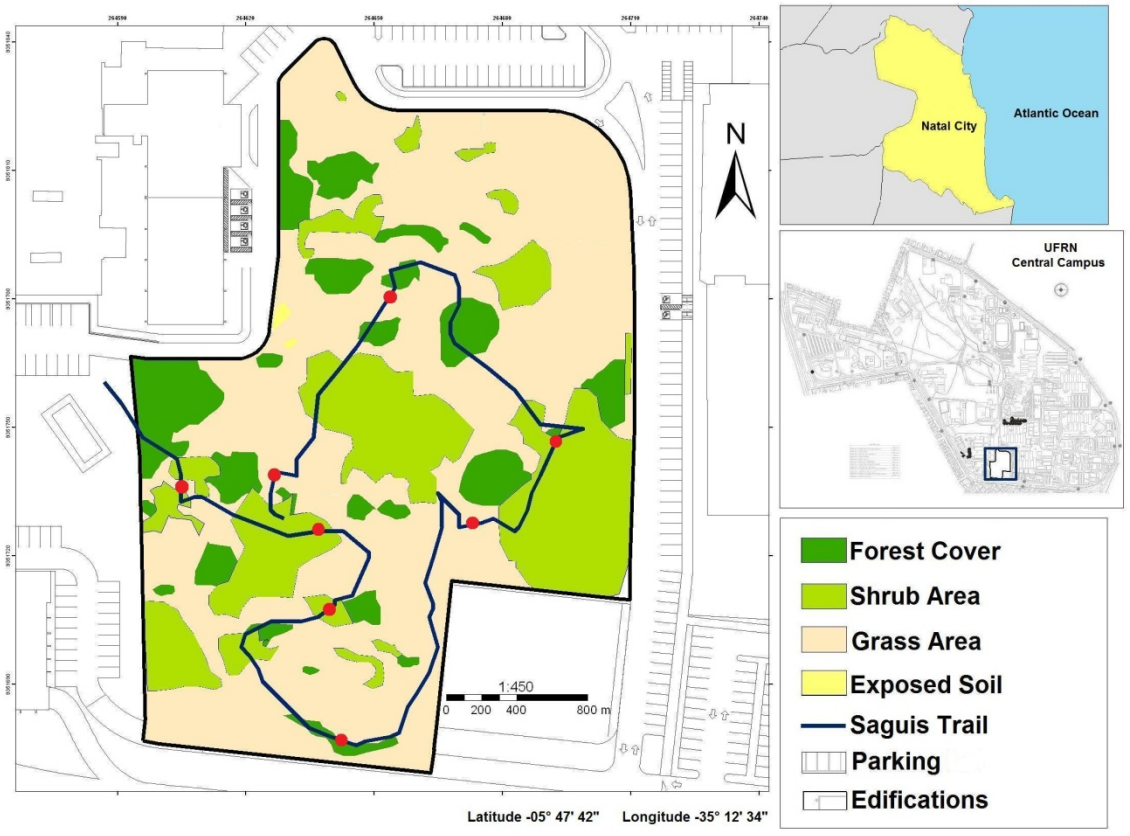

Figure 1 – Location of the Atlantic Forest reserve at the university campus of Federal University of Rio Grande do Norte (Blue line: trail used for Scientific and Environmental Education; red points: stop points).

DESCRIPTION OF THE ACTIVITIES

Methods applied here followed the procedures previously used and applied in (Pádua & Tabanez (1997) and in Carvalho et al. (2011) but were adapted to our scenario and situation. A three-step activity was conducted for each group in a period of a day. The first stage of the activity aimed to assess the prior knowledge of each visitor about the topics that would be addressed in the trail. Accordingly each visitor informed name, sex, age and occupation and responded 10 itens structured survey (called pre-test). In the pre-test questions addressed visitor´s view on 1) concept of endemic species; 2) original biome for Pau-brasil (**Caesalphinea echinata**); 3) understanding on seed dispersion by autocory; 4) which wild animals have potential to restore a degraded area through seeds dispersion; 5) ecological meaning for the wood debris accumulated on forest soil 6) understanding on biological diversity; 7) how soil can be naturally protected from erosion and slips 8) ecological services provided by trees; 9) ecological features from pioneer species; and 10) consequence of fragmentation for the species of small population size. In the second step, visitors were guided through the trail by two monitors. At eight points previously chosen monitors stopped and explained each experiment in accordance to the topics approached in the questionnaire. Monitors illustrated in situ the situations that could clarify the understanding for all issues. For instance, the explanations about pioneer species functions were given at a point where ecological succession could be observed. Furthermore, the ecological restoration experiments and associated hypothesis were explained and the questions of visitors were answered. Finally, at the third stage, after have walked in the trail, visitors were invited to answered the same questionnaire (called pos-test) to verify the learning of biological and ecological concepts subsequently to the visit.

To each question correctly answered was added one point to the number of possible score (maximum score = 10). The total score of each visitor (sampling unit) in the pre and pos-test were compared using a paired t test (Zar, 1996).

RESULTS

Activities took place along 2011 and 161 people split in eight groups walked the trail and took part in this activity by answering the pre and post-test. These eight groups represented independent replicates. One group was named mixed group and was formed by undergraduate students in Biology and teachers from natural science disciplines.

Differences between means of pre and post-test were significant for all eight groups (Table 1). Higher difference in performance before and after walk the trail was observed among undergraduates of Electrical Engineering and into Pedagogia da Terra group. Pedagogia da Terra (i.e. Earth´s Pedagogy) was a group of adults older than 28 years old formed by undergraduates in pedagogy who were settled and/or worked in rural settlements.

In exception of three groups, the standard deviation in the post-test was lower than the standard deviation estimated on pre-test (Table 1).

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Table 1 – Means of pre-test (before activity in the trail) and post-test (after activity) of eight groups that walked the trail on an Atlantic Forest fragment at Federal University of Rio Grande do Norte in 2011 (s.d = standard deviation, group* composed by teachers and undergraduates; p values = 0.000; bolded – s.d. lower in post-test).

Mean score in the pre-test and post-test was higher for the group of teachers than for the group of undergraduate students (Table 2).

Group of Visitors (N)	Mean pre-test	Mean post-test	Differences between means	s.d of pre-test (and post-test)	*t*-value (P=0.000)
Biology Undergraduates (N = 26)	6.43	8.56	2.13	1.21 (**0.67**)	**8.84**
Electrical Engineering Undergraduates (N = 10)	5.81	8.12	2.31	0.90 (0.97)	8.08
Envrionmental Engineering Undergraduates (N = 10)	5.95	8.14	2.18	1.75 (**1.26**)	7.52
"Pedagogia da Terra" Undergraduates (N = 42)	5.38	7.75	2.37	1.25 (1.74)	9.03
Public School Teachers I (N = 14)	6.37	8.58	2.21	1.33 (**0.85**)	**6.48**
Public School Teachers II (N = 31)	6.43	8.65	2.22	1.18 (**0.77**)	9.48
Public School Teachers III (N = 11)	7.45	8.75	1.29	1.52 (**0.87**)	3.40
Mixed Group* (N = 17)	7.50	8.64	1.14	1.04 (1.14)	5.44
All (N = 161)	6.30	8.35	2.05	1.42 (**1.12**)	19.32

Table 2 – Mean of pre and post-test among teachers and undergraduates who visited the trail into the Atlantic Forest

Group (N)	Mean pre-test	Mean post-test	Differences between means	s.d of pre-test (and post-test)	*t*-values (p=0.000)
Teachers (N = 66)	6.77	8.67	1.90	1.32 (0.84)	12.09
Undergraduates (N = 95)	5.91	8.09	2.17	1.34 (1.23)	15.02

fragment at Federal University of Rio Grande do Norte in 2011 (s.d = standard deviation; p values = 0.000).

The percentage of right answers to all questions was always higher on post-test than in pre-test. The questions of multiple correct choices had on average lower scores to each pre and post-test. Nonetheless, the score for these questions were significant higher in the post-test, after visitors have walked in the trail (t test = 15.84; df = 160; p = 0.000; Table 3).

Table 3 – Percentage of correct answers on questions of multiple right choices on pre-test and post-test of all visitors (a –

Test assessed	Percentage of right answers at each question									
	1	2	3	4[a]	5[a]	6	7	8[a]	9[a]	10[a]
Pre-test	38.6	95.3	62.3	46.7	50	89.6	91.8	47	34.5	51.4
Post-test	98.7	98.8	91.5	80.7	61.8	94.5	98.2	62	55.3	73.3

questions of multiple right choices)

DISCUSSION

Many programs focusing on environmental warn for adults have been implemented aiming to promote social and political integration in order to avoid even more losses of Atlantic Forest biome (González Gaudiano, 2003; Marin **et al.**, 2003; Barbosa **et al.**, 2004). In the last years, new methodologies on Science Education have been tested in environmental trails to promote integration and improve knowledge about ecosystem processes and its importance (Angelini **et al.**, 2011).

The methodology developed in **Saguis Trail** indicated that the knowledge acquired during the activity increased for all groups. The higher difference between pre and post-test was to **Pedagogia da Terra** undergraduates, indicating that this group showed the most significant acquisition of concepts after visiting the trail. Since **Pedagogia da Terra** was a group of students established and/or working in rural settlements, it is likely that the daily contact with natural environment has enhanced their interest, enabling a faster association between the technical knowledge addressed during the trail and the local situation in which they live. In spite of this, they might also have been more willing for the activity since they have few opportunities of be involved in discussions on ecological subjects and to understand how scientific experiments on ecological issues are performed in natural environments.

The difference between pre and post-test was also large in the group formed by undergraduates on Electrical Engineer and on that formed Environmental Engineer students. Probably this was a consequence of the focus on math sciences in their undergraduate courses. Even students in Environmental Engineering were focused on mathematical studies, since they were at the first year of specialization on environmental engineering and have had few or none natural sciences classes. As a result, despite the upgrading, subjects addressed during the activity seemed to be completely new for most of them.

The Mixed Group had the best score even before walking the trail. This group was composed by 67% of undergraduates on Biology, which influenced positively the results on the pre-test since they were all from the final term of the course. However, the Biology undergraduates group itself did not show the best performance if compared to the other groups, probably because Biology undergraduates group was composed by students from the first grade.

Scores were similar among teachers from public schools at groups I, II, and III. Differences of knowledge within each group decreased after the activity, indicating the tendency of homogenize the knowledge into the group (standard deviation lower in post-test). The assembling of all teachers in one single group revealed that most of them have graduated in Biology Sciences (53%) and Pedagogy (32%) and thus, they are often responsible for disciplines such as Science, Biology and/or Environmental Education. It implies that their wisdom on ecological issues has to be updated to allow the teaching on these matters. Consequently, teachers had a better performance when compared to the group formed by all undergraduates.

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Standard deviation of post-test also decreased when all visitors were analyzed together in one single group, also indicating that the information became more uniform among all of them after the activity. Differences reduced among those who had prior knowledge about ecological and biological concepts and among those who previously knew little or nothing about the issues addressed during the activity in the trail. Only the group of undergraduates of Electrical Engineering did not show difference between the standard deviation before and after the activity. However mean score showed in post-test were higher than in the pre-test indicating that, in general they gained in the learning of ecological concepts before had visited the trail.

The concepts previously most known by the visitors were the ones that focused on subjects such as Atlantic Forest, Pau-brasil tree (**Caesalphinea echinata**), biodiversity and soil erosion. However, questions of multiple correct choices had the lowest scores because the visitors always choose only one of the alternatives in the pre-test even if warned on the likely multiple correct choices available. It may have occurred because people tend to understanding ecosystem and its interactions as detached elements and seldom comprehend multiple natural processes that connect and interact in dynamic ways to form a whole (Sterling **et al.**, 2010). This shows that, in general, visitors had a linear view of ecosystem and they considered that one single species is related with only one another species or process.

Despite ecosystem elements and processes are connected and interact dynamically (Li, 2000; O'Neill, 2001) and are understood and studied by science in a systemic way (Sterling **et al.**, 2010), people, in general, follow a one-dimensional and disconnected interpretation about its elements. This misunderstanding may be one of the causes of many current environmental problems, since it drives people to do not relate a negative impact with a chain of negative events, but only with one single isolated undesirable event. Biodiversity conservation requires an understanding of multiple issues including causes and effects (Sterling **et al.**, 2010) and this gap is likely to be filled with Scientific Education actions. The activity developed here enhanced the systemic view of visitors on ecosystem, given that questions of multiple choice had much more correct answers in post-test (67%) than in pre-test (46%).

The perception of more than one correct alternative for these questions shows that the visitors understood multiple functions of the same element in the ecosystem, increasing their vision and comprehension of ecosystem as a whole. This awareness is important as a tool to provide reflection and leads people to possible changes in views and attitudes (Bezerra **et al.**, 2008). The development of ecological restoration experiments along the trail provided an illustrative way to understand the role of science to produce environmental knowledge and to be aware on the systemic ecosystem dynamics. Experiments on use of artificial perches to seed dispersion, on role of wood debris to soil moisture and fertility and to provide shelter to microfauna (even amphibians) and those testing whose trees operate as nursery plants or facilitate seedling establishment were helpful to enlarge ecological understanding among visitants. The use of restoration experiments in the field represented an additional approach, since environmental science education programs as a rule use walks on trails (Padua, 1994), guided visit on trials (Curado and Angelini, 2006) or the visit to guided trails followed by activities and/or experiments in the laboratory (Angelini **et al.**, 2011).

Activities of scientific-environmental education performed on trails, especially at Universities, are frequently an extension activity to elementary and high school undergraduates (Pasqualetto & Emair, 2007; Matarezi **et al.**, 2002; Nunes **et al.**, 2017). Differently, in this study, the visitants were undergraduates from university and teachers of elementary and high public schools and despite being an extension program, it also was part of scientific experiments used for didactic purposes beyond those aimed by the activity in the trail.

The program developed in this study provided the integration among academic community, teachers from public schools and students from other universities with the Atlantic Forest fragment and allows this public to notice and understand ecological processes that occur around. The study was also an opportunity to update themes such as conservation, restoration and ecological processes for teachers that were apart from the university. Even though we did not quantify participants comments, at the end of the activity many participants approached the monitors to express their astonishment for have learned so many concepts and process in such a small fragment and to declare how the activity facilitated the understanding on concepts previously read on questionnaire and discussed on the trail.

However, the methodology used has the limitation of do not assessing if concepts learned were retained. To access such information the same participants should be contacted in the future to investigate whether the knowledge acquired was cognitively incorporated, as done by Curado & Angelini (2006), Farmer **et al.** (2007) or Liddicoat & Krasny (2014). Furthermore, there are recent evidences that the differences quantified by scores in activities of scientific-environmental education increase progressively when activities are repeated and continued by more than one day activity (e.g. Angelini **et al.**, 2011).

Our methodology does not allow the use of these methods, but these will be future developments to certainly be included. Nevertheless, many other studies in different areas have demonstrated the effectiveness of results even when activities were conducted in one single visit (e.g. Sharp & Kuerbis, 2006; Smith-Sebasto & Cavern, 2006). Another commonly criticism is that often the developed programs are a simple diffusion of information about local ecosystem, decreasing trails effectiveness as a tool for Environmental Education (Tullio, 2005). For this reason, ecological processes and concepts have to be addressed in a systemic view, addressing the trail and the ecosystem under visitation as a way to understand ecosystem processes in general.

CONCLUSION

The approach applied here differ from others by the use of experiments in the natural environment to test if by walking through a trail, the participant could improve learning and clarify the multiple functions and interactions into the ecosystem. Results indicated that the use of scientific-environmental education techniques in trails increased the understanding of ecological and biological concepts and the understanding of multiple functions of ecosystem elements.

Visitors changed their ecosystem comprehension from a one-dimensional and linear view

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to a systemic interpretation. The use of ecological restoration experiments seemed to be a new valuable approach to change the participant´s view on ecosystem and to illustrate concepts and ecological processes. Activities such as this are fundamental to raising awareness about growing social and ecological problems, as the views of the various populations are often more linear and do not encompass the complexity of ecological processes.

Although the methodology used does not allow the assessment of the cognitive incorporation of concepts through time, the activity developed in one single day produced satisfactory results indicating that visitors learned on ecosystem concepts and functioning, providing reflections and hopefully changes in attitude. We believe that if additional tests were performed with the same groups of visitors in the future, results can be even better. Then, the activity is likely to be unfolded in a Program of two or three visits that would be complementary and, therefore, developed in two or three days. Also, is crucial to carry out new studies in ecological trails or in other natural areas to ameliorate the methods used in this study and adapted the procedures for different situations.

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