Chapter 5
Evaluation of Environmental Education Activities

**Rosana Louro Ferreira Silva, Natalia Pirani Ghilardi-Lopes,
Sabrina Gonçalves Raimundo, and Suzana Ursi**

Abstract In this chapter, we will discuss why and how to evaluate environmental education (EE) activities. Currently, EE activities have been used as a tool for many programs and projects aiming at specifics goals, being fundamental to evaluate them properly and continuously, comparing the results obtained in relation to the proposed aims, verifying the difficulties, redirecting the work, and, finally, measuring the quality of learning. So, evaluation can subsidize both the learner in its development and the educator in the re-dimensioning of its pedagogical practice. A good evaluation begins with the planning phase and continues throughout the application phase. The use of proper methods is essential, either qualitative or quantitative ones, depending on the focus of the questions and evaluation objectives. For that, a evaluation design must consider which method of data collection is going to be used, why it is going to be used, and how to properly analyze the data obtained. In Brazil, there are still a few cases of evaluation of Coastal and Marine EE actions when compared to initiatives in land environments. One of these experiences is described in this chapter: the case study of the Underwater Marine Trail Project (Southeast coast of Brazil).

Keywords Evaluation · Method · Teaching and learning · Pedagogical practice

R. L. F. Silva (✉)
Biosciences Institute, Zoology Department, University of São Paulo (USP),
São Paulo, São Paulo, Brazil
e-mail: rosanas@usp.br

S. G. Raimundo · S. Ursi
Biosciences Institute, Botany Department, University of São Paulo (USP),
São Paulo, São Paulo, Brazil
e-mail: sa.goncalves@usp.br; suzanaursi@usp.br

N. P. Ghilardi-Lopes
Center for Natural and Human Sciences, Federal University of ABC (UFABC),
São Bernardo do Campo, São Paulo, Brazil
e-mail: natalia.lopes@ufabc.edu.br

5.1   Reflecting About Evaluation Processes

5.1.1   Why Is It Important to Evaluate Environmental Education Activities?

It is plausible to think that every time someone takes time to plan, to develop, and to apply an environmental education (EE) activity, some pedagogical/educational goals might be considered. According to the Belgrade Charter (UNEP, 1975):

> The goal of environmental education is to develop a world population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations, and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones.

These aims can be detailed in numerous specific objectives. In this context, it is fundamental that the evaluation process of environmental education activities occurs continuously, initiating since the planning phase (Bennet 1989; Catani and Gallego 2009), aiming to boost the process of teaching and learning, in which educator and learner verify and analyze, in a constant process, the meaning of the methods, explanations, and actions in search of knowledge (Justina and Ferraz 2009). Through the evaluation process, the results that are obtained during the joint work of the educator and learners are compared with the objectives proposed to verify progress, difficulties, and redirect the work to the necessary corrections (Libâneo 2017). Moreover, evaluation is one of the most important tools available to educators to measure the quality of learning and offer alternatives for improvement, being an instrument that will subsidize both the learner in its development and the educator in the re-dimensioning of its pedagogical practice (Bennet 1989; Aquino 1997; Stokking et al. 1999; Régnier 2002). Once the educator feels more confident about the difficulties which will be encountered in the teaching and learning process in the educational space, it becomes possible to think more objectively about re-planning environmental actions by taking these difficulties into account.

However, in Brazil and worldwide, the initiatives in environmental education which are accompanied by continuous evaluation are still rare (Guanabara et al. 2009). This fact is worrying, since lack of planning, continuous assessment, and adaptive measures can lead to undesirable results, such as environmental degradation, for instance, as well as misuse of public resources which are destined to carry out these actions.

5.1.2   What Is the Significance of Evaluation in Environmental Education Research?

As well placed in the title of the work of Depresbiteris (2001) called "evaluation in EE: a very delicate relationship," the evaluation process in the field of EE is not simple. Given the complexity of EE and its highlighted objectives, this process

needs to incorporate the identification of Awareness, Attitudes, Skills, and Participation, as well as Knowledge, i.e., not only the final results but also the quality of the learning process. The process also involves social, historical, political, and economic aspects, based on human relationships and the grounds of the environmental problems that these aspects reveal, which means that we have multiple perspectives for analysis.

Although the major concern is generally related to evaluation instruments, it is also necessary for the project team to address the following issues: Why evaluate? What to assess? How to evaluate? After the agents of the educational process answer these questions, they will need to think about the appropriate tools to carry out the evaluation.

According to Alba and Gaudiano (1997), the evaluation process is contextualized by three basic characteristics, which break with the traditional notion of the control measures: (1) evaluation is a source of information that allows understanding the pedagogical practice, (2) evaluation is a moment of learning, and (3) evaluation makes it possible to investigate the scope of the process. Although the evaluation also has control objectives (not only of the subjects of the educational action but also of the proponents, materials, and others), it is important that this control be carried out collectively and through democratic structures that allow the participation.

Zint (2012) stresses that "evaluative thinking is essential for supporting the continuous improvement of the environmental education programs". This author did a systematic review of evaluations of EE programs, published in peer-reviewed journals. First, it was noted that the articles were not explicit about their research methodologies, ideologies, or the evaluation approaches in which they were based on. It is important to remember that there are, at least, 15 currents of EE (Sauvé 2010), which have approaches that are very different in aims and values. Another analyzed aspect was that most of the identified articles describe results from evaluations of knowledge (specially concepts) of the participants, although some assessments of attitudes, skills, and behaviors have also been found.

Another important aspect for reflection is the moment of evaluation. There is a consensus that evaluation should permeate all stages of the educational process in environmental education. However, considering that environmental education presents changing as a goal not only at the end of the process but throughout life, authors have mapped research that evaluated the long-term impacts of the projects (Liddicoat and Krasny 2013). In these researches, the evaluation was conducted after months or, in some cases, years of an influential experience. According to Liddicoat and Krasny (2013), there are two possible approaches in this sense: "significant life experiences" and "long-term memory theory." Although the present chapter will not show Brazilian experiences with these characteristics, we emphasize that some behaviors are only expressed years later, "*as a result of supportive and political structures, social norms that differ with age cohort, cumulative experiences and other factors*" (Liddicoat and Krasny 2013 p. 295).

5.1.3 What Can Be Evaluated in Environmental Education Activities?

Since environmental education actions presuppose the interaction between human beings and the environment, we can think that their evaluation can focus on: (1) the subjects or the interaction among the subjects before/during/after the action, (2) the action itself, or (3) the interaction between the subjects and the environment before/during/after the action. We detail each of these focuses ahead.

5.1.3.1 The Subjects or the Interaction Among the Subjects Before/During/After the Action

In this case, the aim is to evaluate the outcomes of the action, or the benefits of the action for the participant's cognitive learning, perception, sensitivity, thinking skills, action skills, attitudes, behaviors, or values, for example. In this matter, it is important that evaluation allows for the identification of unanticipated outcomes (Bennet 1989).

5.1.3.2 The Action Itself

Here, the goal is to verify: (1) the planning—e.g., the adequacy of the objectives regarding the target public, the chosen methodology, the staff involved, and the time available for the implementation; (2) the execution—e.g., if the staff followed the initial planning, if the participants understood the functioning of the action, and if the action was performed within the expected period of time; (3) the outputs—for instance, how many people participated in the action; and (4) the impacts of the action—which changes promoted by the action will be in the long run.

5.1.3.3 The Interaction Between the Subjects and the Environment Before/During/After the Action

The objective here is to evaluate the possible environmental impacts caused by the interaction of the participants with the environment where the action took place.

5.2 Approaches and Methodologies

To understand how to evaluate EE programs or projects and then choose appropriate approaches and methodologies, it is first necessary to know that evaluation process demands the gathering of data to describe what is happening in the program, how it

is working, and how well it is going on. With this data available, it is important to learn from them and think how to address the possible problems highlighted by the evaluation.

5.2.1 Is There a Better Approach to Evaluate Environmental Education Experiences?

As in other educational processes, qualitative, quantitative, and mixed approaches can be utilized on EE assessments. We can reflect about the discussions that have been carried out about research approaches and apply them to EE evaluation situations. In this perspective, we can consider that, historically, qualitative and quantitative evaluations have been considered opposite approaches. In addition, qualitative methods were developed, many times, in the context of a critique of quantitative strategies. It is true that these approaches possess different epistemology, and, by consequence, the instruments and findings have different origins and natures. However, as postulated by Flick (2014), we can see that both approaches are separate but parallel, with their applicability dependent on the issue and the question to be investigated.

If the evaluators are more concerned with understanding individuals' perception of the word, they probably will choose qualitative approach. In this context, evaluators doubt whether social "facts" exist and question whether a "scientific" approach can be used when dealing with human beings. Qualitative approach not only uses nonnumerical and unstructured data but also, typically, deals with questions and methods which are more general at the start, and become more focused as the evaluation progresses (Bell and Waters 2014). It is important to highlight that qualitative evaluations are not homogeneous.

On the other hand, evaluators are going to use quantitative approaches if their focus is on collecting facts and studying the relationship of one set of facts to another. They use numerical data and, typically, structured and predetermined questions of evaluation, conceptual frameworks, and designs (Bell and Waters 2014). Nowadays, statistical analysis is widely used as an important element of quantitative evaluations.

Mixed approaches can be an appropriate choice in many cases of EE evaluation. For example, evaluators can first conduct a big survey using a questionnaire with multiple choice questions to check short time changes in marine environmental perception after a scuba activity. The answers need to be analyzed by statistical tests. However, the evaluators may would like to carry on a second step of investigation, analyzing long time changes of only a few number of participants. This new goal can be conducted by a case study with qualitative approach, using a variety of methods, like periodic interviews and observations (Flick 2014).

Zint (2012), in her systematic review, stressed that seven studies (the majority in her study) used quantitative evaluative strategies, two used qualitative, and only one

used the mixed method. She and other authors emphasize the need to use mixed methods to evaluate the results of environmental education programs, since it better represents the process and results obtained from the actions.

5.2.2 How Can We Measure Outcomes?

It is often difficult to measure the outcomes of an educational activity. For this, projects need be clear about indicators, tools, and means of analysis.

5.2.2.1 Indicators

Indicators can be envisioned as the "flags" that let us know whether we are on the correct path, being the measurable, observable ways of defining our outcomes (Thomson and Hoffman 2017). According to Loureiro (2013), the indicators refer to "a measure, qualitative or quantitative, which informs something specific about a certain aspect of reality." Indicators contribute to the process of evaluation of socio-environmental actions and may vary in accordance with the nature and objectives of the proposed action. Therefore, they can be quantitative (when we want to measure the results objectively and pragmatically, linking goals straightly to the results observed) or qualitative (reflecting those results which are difficult to measure numerically, to better understand process, values, or behaviors, for example). The quantitative representations result in comparable magnitudes and the data numerically provide information about different stages of the teaching–learning process. The qualitative attributes refer to perceptions, representations, values, and behaviors. Indicators are a way of knowing the events that express the parameters adopted in projects, programs, and public policies, allowing an evaluation of the process (Loureiro 2013, p 235). For each outcome, there can be more than one indicator and a different way to design the evaluation (São Paulo 2005).

Indicators should always be articulated to the goals of a project and can be of different types, objective or subjective, and simple (analytical) or complex (synthetic). The objective indicators refer to the quantification of frequency of facts and activities observable in the empirical social reality. On the other hand, the subjective indicators are the descriptions of individuals about their personal and collective perceptions, feelings, wishes, and expectations in relation to certain aspects of reality. Besides, simple (analytical) indicators describe a specific aspect that we wish to measure, without aggregating different sources of information, whereas complex (synthetic) indicators are the synthesis of several simple indicators that express different dimensions of reality (Loureiro 2013). When we think about EE assessment, these indicators can be obtained using evaluation tools, which allow us to identify learning and process elements.

5.2.2.2 Evaluation Tools

There are a variety of instruments that can be used on evaluation processes. We describe some of them below:

a. Observation—an important element of EE assessment. According to Depresbiteris (2001), it can be classified as systematic, in which the observer has predefined objectives and knows which are the aspects that will be evaluated; or unsystematic, identifying casual experiences, registering the largest possible number of information and relating them later, with clear and defined objectives. Some important tools for organizing observation are the field diary, videos, and photographs.

b. Life history—a strategy that invites the different social actors of the process to narrate their experiences throughout life and the process of intervention experienced, indicating not only acquired knowledge but also feelings and engagements regarding participation in the project.

c. Portfolio—in a long process, it is an interesting instrument because it will comprise, for each social actor involved, the set of activities carried out, including annotations, summaries, photos, reports, and reflective essays, among others, allowing to identify reference interpretations.

d. Virtual mural—it has recently been possible to use the support of new technologies for evaluation processes in EE, such as described in Faustino et al. (2017) using the padlet tool. Padlet is a free online platform for digital mural construction available, which can be used free of charge (https://pt.br.padlet.com). In this study, Faustino et al. (2017) used this tool to explain, analyze, and relate the meanings on biodiversity constructed in an individual and collective way in a proposal of continuous education of environmental education.

e. Conceptual map—diagram that represents relationships that a person establishes between concepts, making it possible to identify in what way they structure their knowledge.

f. Questionnaire—a very common instrument in educational research, they may consist of multiple choice, Likert scale (Albaum 1997), or open questions. An instrument that uses more than one type of question is also possible. The instruments need to be validated before their use. Additionally, for a greater dialogue with the international literature, it is desirable to base the contents on relevant theories or approaches, e.g., the Coastal Environment Questionnaire (CEQ—Ursi and Towata 2018), which was specially developed to marine and coastal ecosystems based on Wiseman and Bogner's Model of Ecological Values (Wiseman and Bogner 2003).

g. Interview—an important instrument to educational research and an evaluation tool, which can be structured, semi-structured, or open.

h. Drawing or other artistic production—especially when working with children, drawing is a powerful tool and has been used to evaluate representations of different environmental elements (Schwarz et al. 2007; Pedrini et al. 2010a).

i. Self-assessment—in this process, participation has a central role. The reflective process of the learner immersed in the situation of learning that is happening brings a formative perspective by itself, besides indicating to the educators the relationships that each subject established with the process and how they used or intend to use the elements learned for the daily performance.

Regardless of the instrument or, more appropriately, the set of instruments to be used, the evaluation should be an integral part of the educational process, being formative and not only informative, and used during the whole process, and not just at the end of it. That is why, the directions to develop the instruments to be used might be clear, being part of the design, turning the instruments valid and reliable (Bennet 1989). After knowing the goals, defining indicators, designing how to measure, and developing an appropriate tool to collect data, it is still necessary to analyze the results. Depending on each kind of tool and data, a proper method is indicated.

5.2.2.3 Analyses

Quantitative indicators are generally chosen when the investigator wants to analyze variables (e.g., the comparison of groups considering one or more factors, such as age, schooling, geographical origin, etc.) or indicate the magnitude of outcomes. The data, in this case, can be synthesized through graphics and tables showing the counts or the absolute/relative frequencies and/or abundances of the variable under study. There are several possibilities, and the choice will depend on the nature of the data being collected (Zar 1999). To better understand the data, the calculation of sampling size and normality tests are essential. Since this kind of data allows for the calculation of averages and dispersion, it is possible to perform statistical analysis to test hypotheses of differences among groups and the probability that these differences did not occur by chance. Parametric tests, as analysis of variance (ANOVA), or nonparametric ones, such as Kruskal–Wallis test or permutational analysis of variance (PerMANOVA) (Anderson 2001), are examples of tests that can be performed in this case. Post hoc tests are also essential to properly achieve which groups are different from each other (Fig. 5.1).

On the other hand, the analysis of qualitative data aims at understanding the *big picture* and the main focus is on the process and on the deep description of the phenomenon under analysis. In general, after collecting qualitative data, qualitative evaluation will flow through summarizing and then explaining and structuring the results to get a whole interpretation of them (see review on Flick 2014). The recognition of similarities and differences between groups of data collection can also be performed, and the coding of data is important in this case for the determination of patterns or categories of data. For such, the content analysis (Bardin 2009) is widely used by researchers, in which the information is organized, through a lengthy and detailed evaluation by the researcher, into major and minor categories that represent the cores of the variable under study. Other possibilities include
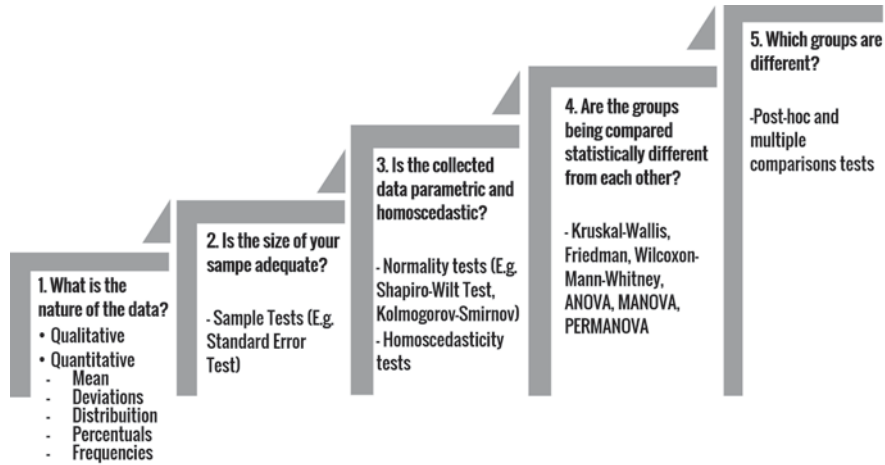
Fig. 5.1 Analysis process of quantitative data. The steps include: (1) definition of the nature of the data (qualitative or quantitative). The description of quantitative data can be done in several different ways; (2) evaluation of sample size; (3) verification of normality and homoscedasticity of data; (4) statistical comparison of the totality of groups; and (5) statistical comparisons between groups

the textual discourse analysis (Moraes 2003), discourse analysis (Gee 2014), and narrative research analysis (Lieblich et al. 1998). Additional approaches such as grounded theory, ethnomethodology, conversation analysis, ethnography, hermeneutic approaches, and many others are reviewed in Flick (2014).

It is important to consider that to obtain good results, well-planned experimental design and adequate tools to collect the data are necessary. For example, in the case of closed questionnaires with affirmatives related to scale options, Alpha Cronbach Test can be used to analyze how consistent the affirmatives are among them (Cronbach 1951). It is also necessary to validate the tools by peer reviews and previous tests. Although it is common to use the qualitative and quantitative approaches separately, both techniques can be complementary to each other. In many cases, mixed methodologies are more adequate to evaluate and achieve a holistic comprehension of the object under study, as exposed above.

5.3 Examples of EE Evaluation in Brazil

We present here examples of EE evaluations carried out within the context of the Underwater Marine Trail Project (see more details on this project in Chaps. 6 and 8). This project offers, essentially, possibilities for activities centered on marine, terrestrial, and virtual tracks, all guided by monitors and with points of interpretation (Berchez and Ghilardi-Lopes 2007). It uses as a theoretical reference the concept of EE from the National Environmental Education Program of Brazil,

based on the Treaty on Environmental Education for Sustainable Societies and Global Responsibility and the pedagogical presuppositions of the Tbilisi International Conference Declaration on Environmental Education. Therefore, the main conceptual indicators of EE sought in the Project are transformation, participation, comprehensiveness, permanence, contextualization, ethics, transdisciplinary, holistic approach, multiplication, and emancipation (Berchez and Ghilardi-Lopes 2007). The project was implemented on January 2002 at Anchieta Island State Park (São Paulo State, Southeast coast of Brazil) with the objective of developing, applying, and testing, through research projects, models of EE activities for marine ecosystems (Berchez and Ghilardi-Lopes 2007). Currently, the activities are also carried out in other protected areas in Brazil and some variations of outdoor activities (such as an exhibition of panels and ludic educational activities) held in public schools (Ursi et al. 2010).

The main target audience of the project is basic and undergraduate students, high school teachers, and the protected areas' technicians. They are trained to become agents of multiplication of concepts and knowledge, promoting changing of values and attitudes towards the environment and society. These monitors are carefully trained in short-term theoretical courses, followed by practical internships in Protected Areas (Ursi et al. 2009). Visitors are monitored, consisting mostly of tourists and residents of the northern coast of São Paulo (SP) state, students and teachers of public municipal and state schools of the northern coast of SP, and assistance and recovery entities.

Several scientific works have already been carried out aiming the evaluation and improvement of the Underwater Marine Trail Project (e.g., Berchez et al. 2005, Berchez and Ghilardi-Lopes 2007; Katon et al. 2017; Pedrini and Costa 2007, Pedrini et al. 2008a, b; Savietto et al. 2014; Towata et al. 2013; Ursi et al. 2009, 2010, 2013). In this way, the project is in constant process of transformation, but always remaining faithful to the conceptual indicators of EE on which it was based since its conception. Here, we present two of these study cases.

5.3.1   Study Case on the Environmental Impact of the Tourists During an EE Action: Snorkeling Trail (Berchez et al. 2005)

In 2005, a study was conducted in Anchieta Island Park (southeast coast of Brazil) with the objective of evaluating the possible environmental impact of the participants in one of the activities of the Underwater Marine Trail Project: the snorkeling trail. This trail was installed in a 350-m stretch along of the rocky shore of the Park. It was bounded by a long line of floats running parallel to the coastline at a distance of approximately 5 m far, outlining a safety corridor for the participants of the activity.

Target public consisted of visitors of a range of ages, groups, and educational levels that arrived on the island in tourist-transport schooners. The participants were informed about the activity in a preparatory lecture, in which information was passed on regarding the park and the necessary care to reduce the impact on the biodiversity present on the island, with a view to avoiding touching any species and to come near to the bottom, which could result in touching or in the suspension of sediment. After that, the participants (in groups of five or less) were conducted to the guided interpretative snorkeling trail. All the project activities last approximately 1 h. Two guides accompanied the participants, and one of them was responsible for evaluating the snorkeling of the participants. The observations of this latter guide made it possible to identify infringements of the initial recommendations stressed during the initial lecture, such as the involuntary touching of the substrate (fins), the involuntary touching of the substrate (hands), the descent till the bottom, the wandering from the group, the lack of interest, the voluntary touching of the substrate, and the suspension of bottom sandy–muddy sediments.

The touching of fins on organisms promoted breakings (for example, in the bryozoan *Schizoporella* sp.) or removals from the substrate (for example, of the ascidian *Phallusia nigra*, the crinoid *Tropiometra carinata*, or the seaweeds *Padina gymnospora* and *Dichotomaria marginata*). After this evaluation, some alterations in the trail were implemented. For example, to reduce the wandering of the participants from the group, a rectangular format for the raft support was chosen and it was used to gather the participants during the activity (Fig. 5.2a, b). Also, new models of activities were created, focusing on people with less or no snorkeling abilities, so that no previous experience in diving was needed: (1) a monitored visit to a natural aquarium (tide pool) where organisms are observed through an underwater observation device and the participants simply walk through a trail installed in the tide pool (Fig. 5.2c, d) and (2) a self-guided indoor activity with the use of educational posters (Fig. 5.2e, f).

5.3.2   Study Case on Environmental Perception and Social Representation of Teachers in a Formative Experience During EE Actions (Katon et al. 2017)

One of the difficulties to protect natural environments relies in the differences in perceptions of the values and importance of those between individuals of different cultures or different groups. We consider that understanding Environmental Perception of local population is an important step towards biodiversity conservation. We understand environmental perception as the relationship that people establish with the environment in which they are inserted, which occurs through perceptual and cognitive mechanisms (Whyte 1977). Some authors (e.g., Ghilardi-Lopes et al. 2015) highlighted the strong relationship between Environmental Perception and Social Representations as well.
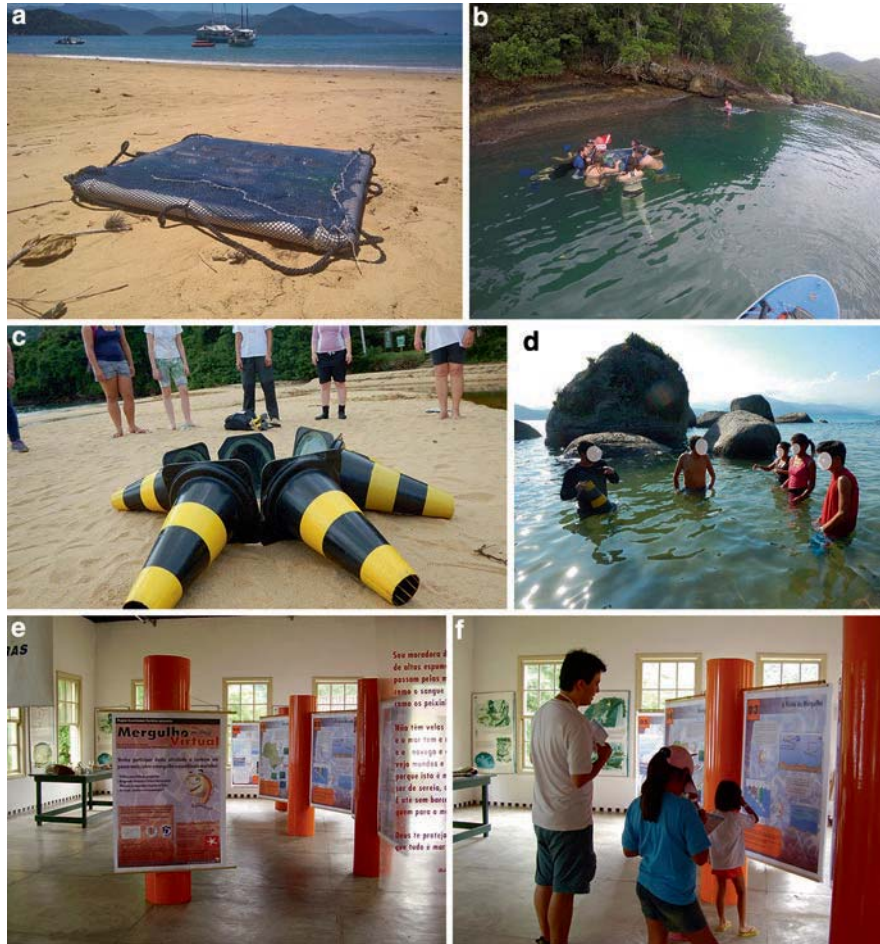
Fig. 5.2 (**a/b**) Rectangular raft for support of participants during the Underwater Marine Trail (snorkeling model), (**c**) observation device created for those participants of the Underwater Marine Trail with no snorkeling abilities, (**d**) use of observation device in the natural aquarium (participants simply walk into the water and use the device to observe the environment), (**e**) indoor activity simulating the Underwater Marine Trail with the use of educational posters, and (**f**) children performing the indoor activity with educational posters. Photos by: Natalia P. Ghilardi-Lopes

In 2012, a study was conducted aiming to investigate the environmental perception of a group of 11 teachers from a public school (located in Ubatuba city, Southeast coast of Brazil) who participated in a formative experience in environmental education activities. This study presented as specifics goals: (1) to verify

whether and how the participation in educational activities influenced the environmental perception of such teachers, and (2) to investigate the conceptions that teachers have about the possibilities and challenges of teaching practice in addressing marine and coastal environment from the subsidies provided by the training experience.

The teachers participated in a variety of Underwater Trail Project activities that were developed along 2 days at Serra do Mar State Park and at Ilha Anchieta State Park, both in Ubatuba city. Different data collection tools were applied at the beginning and at the end of the experience (such as questionnaires and writing of texts), besides the transcripts of the audiovisual material related to collective reflections made at the end of each day. The evaluation of the data collected was done by open categorization and Bardin's Content Analysis technique (Bardin 2009).

We noticed that the participation on environmental education activities influenced, even subtly, teacher's environmental perception. This effect was more evident in specific aspects, such as, for example, in relation to the notion of the biodiversity of these environments. Although not all the teachers expressed the perception in relation to negative impacts on the environment during the activities, when such impacts were perceived, they were closely related to the rocky shore organisms, specifically to their trampling. We also found interesting aspects about the social representations of those teachers which, even after participating in the experience, remained anthropocentric. About the possibilities and challenges of teaching practice in addressing marine and coastal environments, we noticed that for subject teachers of this research, field activities are the most significant to work with such a theme. In addition, we have noticed the great importance that the exchange of experiences among peers, as provided by the experience, present in the composition of teaching practices.

5.4 Final Considerations

According to Zint (2012), "evaluative thinking is essential for supporting the continuous improvement of the environmental education programs that are so desperately needed to help address environmental challenges." In this chapter, we intended to show the complexity of the evaluation in environmental education and to guide educators on its different dimensions, which were synthesized in Fig. 5.3.

We would like to encourage the educators and researchers in environmental education to think about these different dimensions of evaluation as a key part of their programs. We presented two examples to explore some practical possibilities of evaluations in marine environmental education programs. However, we emphasize the need for further studies using long-term assessments.
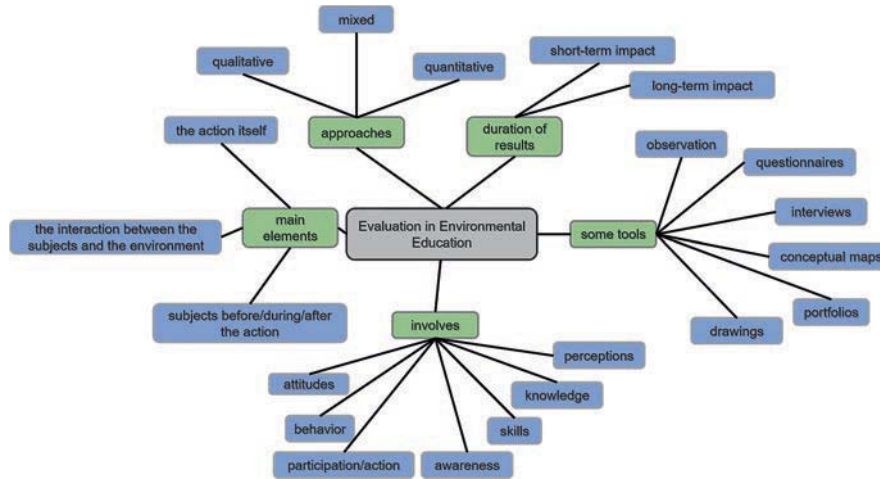
Fig. 5.3 Conceptual map representing the different dimensions of the evaluation process that need to be incorporated in environmental education (using Lucidchart—https://www.lucidchart.com/pages/pt/criador-de-mapas-conceituais)

References

Alba A, González Gaudiano E (1997) Evaluación de Programas de educación ambiental: experiencias en America Latina y el Caribe. Universidad Nacional Autónoma de México, Coyoacán

Albaum G (1997) The likert scale revisited. Mark Res Soc J 39(2):1–21. https://doi.org/10.1177/147078539703900202

Anderson MJ (2001) A new method for non-parametric multivariate analysis of variance. Aust Ecol 26:32–46. https://doi.org/10.1111/j.1442-9993.2001.01070.pp.x

Aquino JG (1997) Erro e fracasso na escola: alternativas teóricas e práticas. Summus, São Paulo

Bardin L (2009) Análise de conteúdo. Edições 70, Lisboa

Bell J, Waters S (eds) (2014) Doing your research project: a guide for first-time researchers. McGraw-Hill Education, New York

Bennet D (1989) Four steps to evaluating environmental education learning experiences. J Environ Educ 20(2):14–21. https://doi.org/10.1080/00958964.1989.9943026

Berchez F, Carvalhal F, Robim MJ (2005) Underwater interpretative trail: guidance to improve education and decrease ecological damage. Int J Environ Sustain Dev 4(2):128–139. https://doi.org/10.1504/IJESD.2005.007235

Berchez F, Ghilardi-Lopes NP (2007) Projeto Trilha Subaquática: sugestão de diretrizes para a criação de modelos de Educação Ambiental em unidades de conservação ligadas a ecossistemas marinhos. OLAM Ciência & Tecnologia 7:181–209

Catani DB, Gallego RC (2009) Avaliação. UNESP, São Paulo

Cronbach LJ (1951) Coefficient alpha and the internal structure of tests. Psychometrika 16:297–334. https://doi.org/10.1007/BF02310555

Depresbiteris L (2001) Avaliação da Aprendizagem na Educação Ambiental: uma relação muito delicada. In: Sato M, Santos JE (eds) A Contribuição da Educação Ambiental à Esperança de Pandora. RIMA, São Carlos, pp 531–557

Faustino MT, Roberto ECO, Silva RLF (2017) Utilizando um mural digital para investigar significados da biodiversidade apresentados por professores(as). Ensenanza de las ciencias (nº Extraordinario):3467–3471

Flick U (ed) (2014) An introduction to qualitative research. Sage, London

Gee JP (ed) (2014) An introduction to discourse analysis: theory and method. Routledge, London

Ghilardi-Lopes NP, Turra A, Buckeridge MS et al (2015) On the perceptions and conceptions of tourists with regard to global environmental changes and their consequences for coastal and marine environments: a case study of the northern São Paulo state coast, Brazil. Mar Policy 57:85–92. https://doi.org/10.1016/j.marpol.2015.03.005

Guanabara R, Gama T, Eigenheer EM (2009) Contribuições para a construção de uma matriz para avaliação de projetos de educação ambiental. Educação e Pesquisa, São Paulo 35(2):399–411. https://doi.org/10.1590/S1517-97022009000200012

Justina LAD, Ferraz DF (2009) A Prática Avaliativa no Contexto do Ensino de Biologia. In: Caldeira AMA, Araujo ESNN (eds) Introdução à didática da Biologia. Editora Escrituras, São Paulo, pp 233–246

Katon GF, Towata N et al (2017) Social representation of marine and coastal environments: a perspective of teachers from southeast coast of Brazil. Conexão Ci 12(2):298–304

Libâneo JC (2017) Didática. Cortez Editora, São Paulo

Liddicoat K, Krasny M (2013) Research on the long-term impacts of environmental education. In: Stevenson RB, Brody M, Dillon J, Wals AEJ (eds) International handbook of research in environmental education. Routledge, New York, pp 289–297

Lieblich A, Tuval-Mashiach R, Zilber T (eds) (1998) Narrative research: reading, analysis, and interpretation. Applied social research methods series. SAGE, Thousand Oaks

Loureiro CFB (2013) Indicadores - Meios para a avaliação de projetos, programas e políticas públicas em educação ambiental. In: Ferraro Junior LA (ed) Encontros e Caminhos: Formação de Educadoras(es) Ambientais e Coletivos Educadores – Volume 3. MMA/DEA, Brasília, pp 235–243

Moraes R (2003) Uma tempestade de luz: a compreensão possibilitada pela análise textual discursiva. Ciência & Educação 9:191–211. https://doi.org/10.1590/S1516-73132003000200004

Pedrini A, Costa EA, Ghilardi N (2010a) Socially vulnerable children and pre-adolescents environmental perceptions in education projects. Ciência & Educação 16(1):163–179. https://doi.org/10.1590/S1516-73132010000100010

Pedrini AG, Costa C (2007) Efeitos ambientais da visitação turística em áreas protegidas marinhas: estudo de caso na Piscina Natural Marinha, Parque Estadual da Ilha Anchieta, Ubatuba, São Paulo, Brasil. OLAM Ciência & Tecnologia 7:678–696

Pedrini AG, Costa C, Silva VG et al (2008b) Gestão de áreas protegidas e efeitos da visitação ecoturística pelo mergulho com snorkel: o caso do Parque Estadual de Ilha Anchieta (PEIA), São Paulo, Brasil. Revista Eletrônica do Mestrado em Educação Ambiental 20:1–20

Pedrini AG, Dutra D, Robim MJ, Martins SL (2008a) Gestão de Áreas Protegidas e Avaliação da Educação Ambiental no Ecoturismo: Estudo de Caso com o Projeto Trilha Subaquática - Educação Ambiental nos Ecossistemas Marinhos no Parque Estadual da Ilha Anchieta, São Paulo. OLAM Ciência & Tecnologia 8:31–55

Pedrini AG, Messas T, Pereira ES et al (2010b) Educação Ambiental pelo Ecoturismo numa trilha marinha no Parque Estadual da Ilha Anchieta, Ubatuba (SP). Revista Brasileira de Ecoturismo 3:428–459

Régnier JC (2002) A Auto-avaliação na Prática Pedagógica. Rev Dia Educacional 3(6):1–16

São Paulo (2005) Manual para Elaboração, Administração e Avaliação de Projetos Socioambientais. Secretaria do Meio Ambiente (SMA/CPLEA), São Paulo

Sauvé L (2010) Educación científica y educación ambiental: un cruce fecundo. Enseñanza de las Ciencias 28(1):5–18

Savietto SF, Katon GF, Towata N et al (2014) Ambientes Marinhos e Costeiros: qual a percepção de estudantes de escolas do litoral norte de São Paulo. Revista da SBEnBio 7:6746–6757

Schwarz ML, Sevegnani L, Andre P (2007) Representações da mata atlântica e de sua biodiversidade por meio dos desenhos infantis. Ciência & Educação 13(3):369–388. https://doi.org/10.1590/S1516-73132007000300007

Stokking K, van Aert L, Meijberg W, Kaskens A (1999) Evaluating environmental education. IUCN, Cambridge

Thomson G, Hoffman J (2017) Measuring the success of environmental education programs. Canadian Parks and Wilderness Society, Ottawa

Towata N, Katon GF, Berchez FAS, Ursi S (2013) Ambiente marinho, sua preservação e relação com o cotidiano: influência de uma exposição interativa sobre as concepções de estudantes do Ensino Fundamental. Enseñanza de las Ciencias (volume extra): 3554–3559

Ursi S, Ghilardi-Lopes NP, Amancio CE et al (2010) Projeto Trilha Subaquática virtual nas escolas: proposta de uma atividade didática sobre o ambiente marinho e sua biodiversidade. Revista da SBEnBIO 3:3821–3829

Ursi S, Towata N (2018) Environmental perception about marine and costal ecosystems: evaluation through a research instrument based on model of ecological values. Problems of education in the 21st century 76(3): 393–405

Ursi S, Towata N, Katon GF, Berchez FS (2013) Influência de exposição interativa sobre ambiente marinho e sua biodiversidade nas concepções de meio ambiente de estudantes do Ensino Fundamental. Enseñanza de las Ciencias (volume extra): 3575–3580

Ursi S, Towata N, et al (2009) Concepções sobre Educação Ambiental em curso de Formação para educadores do projeto Ecossistemas Costeiros (Instituto de Biociências - USP). In: Anais do VII Encontro Nacional de Pesquisa em Educação em Ciências, Universidade Federal de Santa Catarina, Florianópolis, pp 8–13

UNEP (1975) The Belgrade Charter: a framework for environmental education. In: International Workshop on Environmental Education, Belgrade, 1975. 4p.

Whyte AVT (1977) Guidelines for fields studies in environmental perception. UNESCO/MAB, Paris

Wiseman M, Bogner FX (2003) A higher-order model of ecological values and its relationship to personality. Personal Individ Differ 34:783–794. https://doi.org/10.1016/S0191-8869(02)00071-5

Zar JH (ed) (1999) Biostatistical analysis. Prentice-Hall, Upper Saddle River

Zint M (2012) Advancing environmental education programs: insights from a review of behavioral outcome evaluations. In: Brody M, Dillon J et al (eds) International handbook of research in environmental education. Routledge, New York, pp 298–309