The Systemic Impacts of a Large-Scale Socio-Environmental Educational Program

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ABSTRACT

In this article we present our findings regarding the systemic impacts of the Environmental Education for the Communities (ECOA) program, an educational program sponsored by the Alcoa Institute. The program, which was developed from 2014 to 2016 in Brazil, involved one corporation (Alcoa Institute), one educational consulting firm (Evoluir), seven Municipal Departments of Education and 30 schools and its surrounding communities. The program promoted environmental awareness following a project-based learning approach: first the students became aware of certain socio-environmental problems in their areas, and then they developed projects to address these problems with support of local communities and guidance from teachers and Evoluir's educators. Our research objective was to understand the impacts of the program. We followed a qualitative research approach, collecting data by means of document analysis and interviews, unveiling the recurrent themes and analyzing the connections between them by means of a systemic analysis. Our main findings were: 1) The use of the PBL approach, involving schools and communities in joint planning and execution processes, promoted environmental awareness and strengthened the ties between the schools and local communities. 2) The PBL approach challenged the students to solve real-life problems, improving their critical thinking, their communications and problem-solving skills, leading to the improvement of their self-confidence and in their interest in learning. 3) The PBL approach empowered the teachers, motivating them to study and to make connections with community partners, thus changing the ways the courses were conducted and the relationships between school and local communities.

Keywords: Environmental Awareness; Project-Based Learning; Systemic Analysis; Social-Ecological Change.

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The ECOA program was designed by the Alcoa Institute, an educational outreach program which is affiliated to the Alcoa Company, one the world's largest aluminum producers. In this article we will discuss how the program was conceived and designed, who the stakeholders were, which projects were accomplished, to what extent the program had an impact on students, schools and the communities involved. We discuss our findings by means of a systemic analysis that reveals the reciprocal effects of this program on students, schools, and communities.

BACKGROUND

THE REASONS FOR THE PROGRAM

The goal of the Alcoa Institute is to promote positive changes in the locations where Alcoa operates (Instituto Alcoa 2016). The institute develops several programs in order to foster community participation in the construction of sustainable societies: the ECOA program is one of those programs. Sustainable societies can be understood as those that are focused on the well-being of its citizens (Viederman 1993). In these societies, citizens take actions to preserve the environment, not only for themselves, but also for future generations.

THE ECOA PROGRAM GOALS

The ECOA program aims to connect the schools and its communities (parents, students, educators, employees) with the nearby neighborhoods by means of educational projects that promote environmental awareness and reflections about citizenship. Its goal is to promote environmental-friendly habits and actions (Instituto Alcoa 2018).

THE STAKEHOLDERS AND THEIR ROLES

There were 39 organizations involved in the ECOA program: the Alcoa Institute, the Evoluir educational consulting firm, 7 Municipal Departments of Education and 30 public schools.

The Alcoa Institute defined the program goals, created the partnerships, and provided the financial resources for the development of the program.

Evoluir is an educational consulting firm located in São Paulo that develops educational methodologies and educational tools for public and private schools. Evoluir was hired to provide the overall program planning and to define the educational approach to be followed (Project-based learning, thereafter PBL). Evoluir was also in charge of providing educators and sending them to the local schools. Evoluir's educators were in charge of supporting the schoolteachers during the development of the projects.

The Municipal Departments of Education are the Brazilian public organizations in charge of managing the public schools. They helped the ECOA program contact the public schools located in the cities where Alcoa operates and invite them to participate in the program.

The thirty K-12 public schools that volunteered to participate (Appendix 1) were located all over the Brazilian country, in North States (State of Pará, in Jurity City and State of Maranhão, in São Luis City), in Northeast States (State of Pernambuco, in Igarassu and Itapissuma Cities), in Southeast States (State of Minas Gerais, in Poços de Caldas City and State of São Paulo, in Santo André City), and South States (State of Santa Catarina, in Tubarão City). On average, each school participating in the ECOA program developed two projects per year, involving approximately 20 students in each grade. The majority of the projects were developed by the students in grades six to eight. The ECOA program involved approximately 2,900 people (Appendix 2).

THE PROGRAM DESIGN AND DEVELOPMENT

The ECOA program was designed to develop year by year in a similar way, following a sequence of four modules (Appendix 3). Module 01, 'Project Preparation' was planned to be developed from February to May. It had four activities: 'Training the Educators', 'Engaging the Schools', 'Mapping the Community' and 'Getting Volunteers'.

TRAINING THE EDUCATORS

At the beginning of each project, usually during the month of February or March, there was a one-week intensive course, developed at Evoluir facilities in Sao Paulo, called 'Training the Educators'. The goal of this course was to teach Evoluir's educators how to identify a particular social or environmental problem, how to give support project-based learning centered courses and how to facilitate the creation of a network of community partners that could give support to school projects. After this training, Evoluir's educators were sent to the schools. Their roles were to act as mentors, giving orientation and guidance to the teachers and students for the entire year. Evoluir's educators were also responsible for collecting data on the projects, using interviews, questionnaires and focus group activities.

ENGAGING THE SCHOOLS

During the month of March and April, Evoluir's educators held workshops at the schools with teachers, directors and administrative staff aimed to motivate them to engage in the program. The representatives were informed about the goals of the program, the support material that would be

provided to the schools (course material, books etc.), the overall program schedule and the educational approach under which the projects would be carried out (the project-based learning approach).

MAPPING THE COMMUNITY

During the month of April and May, Evoluir's educators and the school representatives conducted community mapping activities with the students, in which small groups of students and school representatives identified and assessed the socio-environmental problems in the communities located close to the schools.

The mapping activities included identifying people and institutions that could be useful in the school projects. For example, the teams walked around neighborhoods, interviewing people and collecting data about the environmental characteristics (bodies of water, mountains, forests, etc.), potential contributors (companies, grocery stores, factories, libraries, hospitals, food banks, homeless shelters, NGOs etc.) and social and environmental problems (deficient garbage collection and disposal, gang violence, lack of recreational spaces, drug dealing, water contamination, etc.). The data collected would later develop projects to address the problems identified with the mapping activities.

GETTING VOLUNTEERS

While mapping the communities, the teams searched for volunteers, people in the schools' neighborhood that had skills and manpower that could be useful to future projects. Module 2, 'Project Planning', was planned to take place from May to August. This module had just one main activity: 'Joint Planning of Projects'.

JOINT PLANNING OF PROJECTS

This planning process involved the students, the school representatives, the volunteers and Evoluir's educators. Together they ranked the most pressing environmental and social problems identified in the mapping activities and planned to develop projects in order to address these problems. Module 3, 'Project Execution´ was designed to have two major activities ('Development of the Projects' and 'Collecting Data about the Projects`) and was planned to be developed from August to October.

DEVELOPMENT OF THE PROJECTS

The projects took place over a three-month period from August to October. In the classroom, the teachers followed a PBL approach: the students first learned about the concept of sustainability. After that, they worked in teams, identifying a problem to work on in their project and defining the project's deliverables. Then they developed the projects, researching practical ways of addressing

environmental problems. The teachers acted as facilitators, showing students the connections between what they had learned in previous regular curriculum courses and the actions they could take to address the problems. Finally, the students executed their plans.

During the projects, the teachers promoted several focus group activities for students to reflect on their learning. A variety of socio-environmental projects were undertaken by the students. The projects led to the creation of simple products/services or multiple products/services. In a typical project, the students and teachers would first map the school's neighborhood to identify socio-environmental problems. Then they would choose one of these problems and develop a project in order to address it.

For example, in 2014, 20 students and four teachers of the School Maria da Silva Pereira (Jurity City, Pará) identified a problem with improperly discarded garbage in the school's neighborhood. To address this problem, the students organized a campaign in order to make the neighborhood and the school community aware of the problem. They hoped the project would lead to the development of a joint effort to clean the area, involving people from school neighborhood, bringing in dumpsters and at places where garbage had accumulated. During the project, the teachers, with the support of Evoluir's educators, followed a project-based learning approach. Teachers of Portuguese gave guidance to the students to create banners for the campaign, Mathematics teachers worked with students on the calculation of the size and shape of the dumpsters; Science teachers discussed with the students the environmental consequences of discarding garbage irregularly, particularly in terms of its impact on groundwater; and History and Geography teachers contributed with knowledge of the area's history and topography.

COLLECTING DATA ABOUT THE PROJECT

The Evoluir educators collected data on the scope of the projects, the disciplines involved, the actions taken, and the results achieved. They collected data in several different ways: they observed and took notes about the behavior of the students and the school representatives; they took pictures of the activities accomplished and the products/services created; they sent questionnaires to all the parties involved asking questions about their perceptions of the projects and performed individual interviews and focus group activities. All data collected was sent to Evoluir's office in Sao Paulo. The second author then compiled all data, interviewed Evoluir's educators and, after that, created project reports (Evoluir & Instituto Alcoa 2014, 2015, 2016; Evoluir FBF Cultural 2014, 2015, 2016). The project reports contained very detailed information about each project, with pictures and quotes from the

people involved in the projects. Module 4, 'Project Closure' was designed to have one major activity, 'Reflecting on Projects' Achievements,' and was planned to take place from November to December.

REFLECTING EN THE PROJECTS' ACHIEVEMENTS

During the months of November and December, the students presented the results of their projects in several different ways. Sometimes they organized workshops involving the students, school representatives and community members. In other occasions they performed plays or radio programs. The main goal was to promote a deep reflection about what was learned during the academic year and the impacts the projects brought to all involved.

LITERATURE REVIEW

The increase of the human population in the last 100 years (Bartlett et al. 2004; Ehrlich and Ehrlich 1990) associated with the increase of human activities such as mechanized agriculture (Boserup 2017; Gilland 2002; Godfray et al. 2010), intensive animal farming (Burkholder et al. 2007; Mallin 2000), overproduction of goods and services (Leonard 2010; Meadows, Meadows, and Randers 1992), over-exploitation of natural resources (Hartmann 2009; Hawken 1993), increase in waste production (Hoornweg, Bhada-Tata, and Kennedy 2013) and pollution (Huesemann 2001; Mage et al. 1996) have all contributed to the degradation of the world environment (Dorst 1970; Leonard 2010; Martenson 2011).

The majority of the world's ecosystems are in danger: the forests have been destroyed (Geist and Lambin 2002; Malingreau and Tucker 1988; Morton et al. 2006), the fisheries are overexploited (Allan et al. 2005; Clover 2008; Jackson 2001), the freshwater sources are under risk of depletion (Rogers 2008; Wyman 2013), the oceans are flooded with garbage (Gabrielides et al. 1991), chemicals (Michael Beman, Arrigo, and Matson 2005) and plastic (Jambeck et al. 2015) and the soil has been degraded (Oldeman, Hakkeling, and Sombroek 1991). Researchers have been warning that, if the society continues to deplete the environmental resources at this rate, the consequences could be disastrous, and collapse may happen (Brown 2011; Martenson 2011).

Scholars have a good understanding of what may occur. Researchers have studied ancient civilizations that collapsed and the human actions that led to it (Diamond 1994, 2003). Others have studied the intricate relationships between human actions and the environmental consequences, following a system dynamics perspective (Bossel 2007; Ford 1999; Forrester 1971; Meadows, Richardson, and Bruckmann 1982), developing computer models in order to identify possible futures

and the limits of growth of human activities (Meadows, Randers, and Meadows 2012; Meadows, Meadows, and Randers 1992).

Scholars are now taking actions in order to promote environmental awareness, trying to change the way the people think – their so-called 'mental models' (Wind and Cook 2006; Kollmuss and Agyeman 2002). Some researchers believe that if they can influence the way the people think, people will act in a more environment-friendly way (Senge et al. 2008).

In order promote environmental awareness, scholars are following several different paths. Some have written books addressing the problems in rigorous way (Bossel 1998; Sterman 2000). Others have published articles in the press (Meadows 1991) in order to disseminate the ideas about sustainability to a broader audience. Some have preferred to address the problem with humor by means of comic books (Gonick and Outwater 1996). Others have been creating stories books for children, making them aware of environmental problems (Brynteson 2006; Ramsey 1997, 1998).

Some scholars have been using web-based software tools in order to teach systems thinking concepts and foster reflection about sustainability (Amaral and Hess 2017; Ruiz-Pérez et al. 2011; Sterman 2014). Others have developed free on-line courses about systems thinking and sustainability and making them accessible to people from all over the world (Amaral and Hess 2017). Several scholars have also integrated sustainability in their courses (Abdul-Wahab, Abdulraheem, and Hutchinson 2003; Boks and Diehl 2006; Peet, Mulder, and Bijma 2004; Tam 2007).

In addition, some scholars have pursued a different approach, challenging the students to develop real-world projects not only to promote environmental awareness (Brundiers and Wiek 2011; Wiek and Kay 2015; Wiek et al. 2014) but also to address socio-environmental communities' problems (O'Brien and Sarkis 2014; Orr and Cohen 2013).

However, it seems that there is still a lack of information about the systemic impacts of large-scale educational initiatives that aggregate corporations, schools, and communities in projects that promote environmental awareness. This article discusses the impacts of one such large-scale educational program, the ECOA program, thus addressing this gap.

RESEARCH QUESTION

Our research question then became:

What are the impacts of a large-scale educational program that involved schools, companies and communities and aimed to promote socio-environmental awareness?

METHODS

RESEARCH DESIGN

We followed a qualitative research approach, using document analysis (Bowen 2009) and interviews as our sources of evidence. We collected project data from project reports (Evoluir & Instituto Alcoa 2014, 2015, 2016; Evoluir FBF Cultural 2014, 2015, 2016) that summarized the information of all projects accomplished. We analyzed the data following the five-step analytical approach (Yin 2015), identifying the recurrent themes (thereafter RT). We discussed the connections between the recurrent themes following a systemic approach, using a systemic map.

PARTICIPANTS

The third author was one of the people responsible for designing the educational program, creating the overall plan and coordinating the work of Evoluir's educators. The second author compiled and organized all data collected from Evoluir's educators. She also interviewed the Evoluir's educators, school staff and community members and created the eight project reports that summarize all the projects accomplished. The first author analyzed the project reports, identified the recurrent themes, revealed the systemic impacts of the projects and wrote the article. All authors worked together in order to improve the article.

RESEARCH INSTRUMENT

Our research instruments were eight project reports (Evoluir & Instituto Alcoa 2014, 2015, 2016; Evoluir FBF Cultural 2014, 2015, 2016) that summarized the projects accomplished from 2014 to 2016. Each project report was organized in a similar way. Each one describes one year of the program: the planning process, the procedures and methods, the training, the engaging and mapping activities, the creation of the projects, the projects' goals, the projects' participants, the project-based learning approach followed, the contents the students studied in order to accomplish the projects and the main results. The reports also presented the results of the interviews done by the second author, the voices of all involved in the project (students, schools' representatives, community members). The project reports also bring pictures of all participants involved, all, activities accomplished, and the products and services created. Each project report was approximately 200 pages long.

DATA ANALYSIS

After reading all project reports, we analyzed the data following the five-phased qualitative method (Yin 2015). First, we compiled the data from all documents. Then we organized the data, grouping it in closely related categories. In sequence we reorganized the clusters into broader categories

that we called *recurrent themes* (RT). We then performed a systemic analysis, using a causal loop diagram as a tool to draw the interrelationships and the interconnections between the recurrent themes. Finally, we drew conclusions about the systemic impacts of the ECOA program.

FINDINGS

THE QUANTITATIVE DATA: THE PROJECTS ACCOMPLISHED

The 30 schools developed 88 projects in 2014, 81 projects in 2015 and 78 projects in 2016; thus, the total number of projects accomplished was 247 (Appendix 4). The projects were very diverse. Many projects were very broad, leading to creation of multiple services and products. For example, one project led to the revitalization an area within the school, creation of a sustainability awareness workshop and planting of trees. Several projects were narrow-focused, leading to the creation of just one specific product (such as planting trees). Nevertheless, even if a project led to the creation of multiple projects and services, it was possible to identify the main product created for each one (Appendix 4).

The majority of projects (65 projects) led to the revitalization of school facilities or public spaces located near to the schools. These projects included painting school walls, improving school libraries, and so on. In 41 projects the students planted trees and/or improved gardens. The trees were planted sometimes in the school area, sometimes in the communities around the school. Thirty-four projects had the main goal of promoting environmental awareness, by means of promoting workshops, publishing articles in school newspapers, or developing of radio programs. Thirty-two projects had the goal of encouraging healthy habits. The students promoted workshops to make people aware of the importance of having healthy eating habits, doing physical exercises, reading, and so on. Twenty-two projects had the objective of creating bond between schools and communities. The students promoted a series of activities (such as workshops, conferences) involving students, school staff and community members with the goal of identify partnership opportunities. There were 19 projects that promoted recycling (of tires, pet bottle, plastic etc.). Nine projects promoted waste management actions, some of them within the school facilities, others in areas close to the schools. Nine projects promoted awareness of human rights in themes such as gender and race discrimination. Five projects dealt with water management issues; the students developed projects with community members in order to improve the situation of creeks and rivers near the school area. Four projects had the objective of improving the traffic condition in areas close to school. Four projects led to actions improving the safety conditions of the school, including actions against bullying and sexual harassment.

THE QUALITATIVE DATA

Five recurrent themes (RT) emerged from the analysis of the documents and interviews;

RT1: THE ECOA PROGRAM FOSTERED THE DEVELOPMENT OF PARTNERSHIPS BETWEEN SCHOOLS AND LOCAL COMMUNITIES.

The analysis of the project reports and interviews let us know that the development of partnerships between schools and local communities was very effective. However, it is clear that it took a lot of effort in order to publicize the ECOA program to the local communities and to obtain their involvement. One school director pointed the unusual approach followed by her school:

> Getting the school's people involved in the projects was not that hard, but involving the nearby community was a challenge…but we succeeded! We did a march in the streets, announcing the project with music, banners and lot of noise. In doing so, I realized that was not that difficult to get the community attention and support to our project- Director of the School Maria Lucia Nascimento (Evoluir & Instituto Alcoa 2014, 62).

The documents and interviews also revealed that the students played a very important role, connecting the staff of the schools and community members. One teacher stated:

> I have worked in this school for six years and I didn´t know about the communities near the schools. We went there with our students; they introduced us to the community members, the neighborhoods, the mangroves… - Teacher of School Hortência Pinho, São Luiz (Evoluir & Instituto Alcoa 2014, 84).

The analysis of the project reports also showed that there was an intensive knowledge sharing between the community members and school members. One group of students pointed out:

> We talked to a community member who helped us to plan the revitalization of the plaza, the only leisure space in the neighborhood. He gave us several pointers about searching for local partnerships - Harmonia Team, School Maria Oliveira dos Santos, Itapissuma (Evoluir FBF Cultural 2015, 33).

In addition to that, another student explained that the knowledge sharing process took a lot of time and effort; sometimes the students had to interview several communities' members in order to obtain the information they needed for their projects:

> We researched basic sanitation. This action put me in touch with all residents of the school neighborhood – Student (Evoluir & Instituto Alcoa 2016, 71).

The documents and interviews also exposed that on many occasions the community members helped the students obtain the necessary support to their projects. Sometimes the project involved collaborative actions involving students, their parents and community members, as one student observed:

> After the ECOA project I realized that we have to do something to help, such as keeping clean the neighborhood where we live, and not littering. My stepfather and I were able to remove

> 400 kg of plastic bottles from Itapissuma River. After that, we donated this material to a friend that work in recycling activities – Student (Evoluir & Instituto Alcoa 2015, 32).

Another student provided this example:

> We couldn´t imagine that we would have the support of so many people! The father of one student donated bricks for our gardening; another student's mother and sister helped us with the drawings and paintings. We organized a collective effort, involving students, teachers, and school workers -Ecoa em Ação Team, School Dr. João Batista Ferreira Monteiro, Poços de Caldas (Evoluir FBF Cultural 2016, 96).

RT2: THE PROJECTS MOTIVATE TEACHERS TO LEARN AND TO COLLABORATE

After reading all reports and interviews it was clear to us that the projects affected the teachers profoundly, motivating them to learn more. Several teachers pointed this out. One teacher observed:

> The ECOA program taught me several lessons that I now use in my teaching activities and my personal life. The program changed my way of thinking about everyday life situations. The program helped me to develop my creativity and use it with my students – Schoolteacher (Evoluir FBF Cultural 2016, 94).

It is clear to us that the hands-on approach of the projects motivated them to learn more. One teacher commented:

> The learning experience the project brought me was very important. I had already heard about environmental-friendly actions but to put them into practice was very difficult to me. Today I am able to work with my students in such actions and doing so it motivates me to learn even more. The students talk to me about the projects; they are motivated to develop new ones. Projects bring new learning opportunities to all - Teacher of the School Professor Zelia Rodrigues, Juriti (Evoluir & Instituto Alcoa 2014, 70).

The teachers also remarked that the theme of the projects – sustainability – forced them to connect the content of several courses they teach. One teacher stated:

> "I learned a lot about interdisciplinarity. The waste management project gave me the opportunity to connect the contents of science, mathematics and languages…I change my pedagogical practices" – Teacher of the school Otacília da Souza Silva, Itapissuma (Evoluir & Instituto Alcoa 2014, 115).

One theme that appears in all reports is that of collaboration. One teacher commented:

> "When we work in a network of collaboration everything becomes more productive"- Schoolteacher (Evoluir & Instituto Alcoa 2015, 31).

RT3: THE ECOA PROGRAM FOSTERED THE DEVELOPMENT OF ENVIRONMENTAL AWARENESS

The main objective of ECOA program was to foster environmental awareness. The analysis of the documents made clear that this goal was achieved.

Many students pointed out that they learned about the importance of preserving the environment. One student noted:

> I don´t want to be part of a generation that will deplete the water resources – Student (Evoluir & Instituto Alcoa 2015, 156).

Another students added:

> I learned to preserve the environment, to save water and do not harm nature - Student from School Manoel José Antunes, Tubarão (Evoluir & Instituto Alcoa 2014, 166).

The students also learned about the importance of taking environment-friendly actions in their schools and communities. One student stated:

> Our project had the goal of sensitizing the students of our school to the care that we must have towards our garden, our bathrooms, our drinking fountains and to the residues we create. Our desire is that our school and our community work together on behalf of the environment - Heróis da Natureza Team (Evoluir FBF Cultural 2016, 72).

Several students stressed that the ECOA program changed their mental models. They stressed the importance of reflecting on the actions we take on our lives and on the impacts of these actions have on environment. One student said:

> The ECOA program changed my life – actually, all our lives. We learned that it is important to preserve the environment and that we need do our activities always thinking about the impacts that they will bring to others – Student (Evoluir FBF Cultural 2016, 36).

Another student commented:

> The most important legacy of the ECOA program was to make us reflect on our individual and collective responsibilities to our communities and to the planet. I want to contribute to a better community and to a better planet – Student (Evoluir FBF Cultural 2016, 103).

RT4: THE PROJECTS EMPOWERED THE STUDENTS

Several teachers reported that the projects made the students to change their behavior. Some teacher pointed out that the students now work in a more responsible way. One teacher explained:

> The students love the project; every day they ask to do project activities. They are much more active and focused. Their behavior improved a lot: they are more organized and responsible… - Schoolteacher from School Manoel José Antunes, Tubarão (Evoluir & Instituto Alcoa 2014, 164).

Another teacher added:

> My students have evolved a lot since the beginning of the projects. They are much more active, critical and responsible. They have changed their attitudes, in different aspects. They are more concerned about the environment, and the students sometimes reprimand their parents when they do harmful environmental actions - Schoolteacher from School João Hilário de Melo, Tubarão (Evoluir & Instituto Alcoa 2014, 171).

The students also notice that the projects brought them opportunities to work in teams, learning with each other and sharing the knowledge they gained. One student stated:

> The garden project was very cool. We used recycled material…I feel really good in sharing the knowledge I got to other students, to the teachers. I teach what I know – Student (Evoluir & Instituto Alcoa 2015, 109).

RT5: THE ECOA PROGRAM IMPROVED THE RELATIONSHIPS WITHIN THE SCHOOLS' AND BETWEEN THE SCHOOLS AND ITS SURROUNDING COMMUNITIES

The analysis of several of testimonies of school directors, teachers and students made clear that the program changed the behavior of all participants in the ECOA program. One director noted:

> The ECOA program brought changes to our school. We can see that that students, teachers and community members from school's neighborhood are more interested in school's projects - Director of School (Evoluir & Instituto Alcoa 2015, 47).

Another director added:

> The program made the difference to the school; in one year, the school and the students changed. The school is now full of life, more beautiful. The students are having better relationships, the hustle and bustle decreased. The students are more responsible and well behaved. I am very happy with the 2014 results and I hope in 2015 we will do even better! - Director of the School Juscelino Kubistchek, Tubarão (Evoluir & Instituto Alcoa 2014, 182).

One school's supervisor pointed out:

> I can observe several improvements: the learning process flows naturally; the teachers are aware of their abilities, the students feel useful and valued and the school exchanges knowledge with the community... -School Supervisor (Evoluir FBF Cultural 2016, 57).

The testimonies showed that even small projects had huge impact on school's environment, on the school's culture. One teacher commented:

> Sometimes even a small action-such as you did, painting the school wall, changed the school appearance and the desire of the students to be in the school. We come to the school and see a colorful wall -- it is very good for self-esteem – Schoolteacher (Evoluir & Instituto Alcoa 2015, 61).

DISCUSSION

As we discussed earlier, Alcoa's interest in promoting environmental awareness led them to hire of the Evoluir consulting firm. Evoluir's actions of giving guidance and support to the schools to develop PBL projects led to the training of the teachers in PBL techniques and to the identification of educational opportunities in the local communities. These two fundamental actions triggered the use of PBL techniques in all schools. The RT3 ('The ECOA program fostered the development of environmental awareness') let us to understand that the more the students, teachers, and community members worked together in order to address the local environmental problems, the more they became aware of environmental problems.

As the years passed, the schools developed more and more projects (Appendix 4), increasing environmental awareness. We called this virtuous cycle 'Promoting environmental awareness' (Figure 1).

Figure 1. The systemic impacts of the projects.
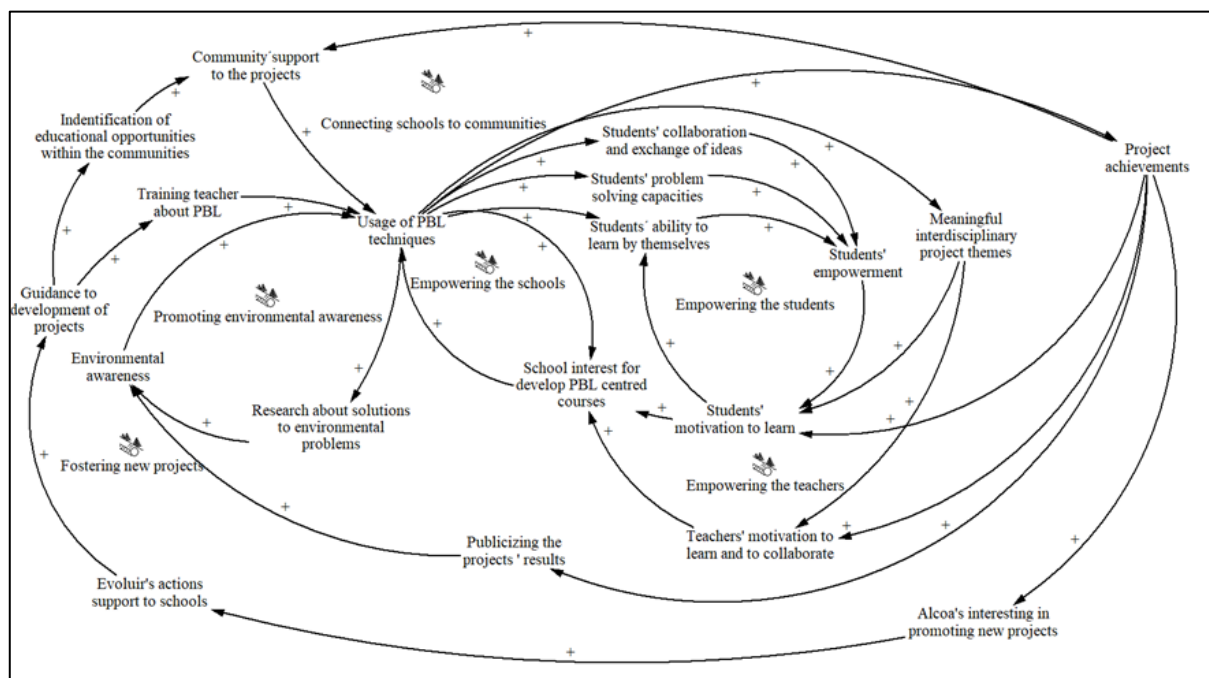
Source: Authors.

The 247 projects (Appendix 4) were developed following a project-based learning approach. Following this educational approach, the students, teachers and school staff worked closely with the community, exchanging knowledge and resources. The RT1 ("The ECOA program fostered the development of partnerships between schools and local communities") let us to understand that as the years passed and the number of joint projects increased, the partnership between and schools strengthened. Therefore, we may affirm that there is a virtuous cycle, a positive feedback loop that we have named 'Connecting Schools to Communities (Figure 1).

This led us to our first finding: The use of the PBL approach, involving schools and communities in joint planning and execution processes, promoted environmental awareness and strengthened the ties between the schools and local communities.

This finding is aligned with the findings of other researchers (Ballantyne, Fien, and Packer 2001; Fisman 2005; Hart 2013) who pointed the educational benefits of involving students and communities in environmental actions.

Each school followed a PBL instructional approach. Therefore, the students were challenged to work in teams, with guidance of the professor and with the support of community partners. They were thus required to communicate each other and with the community partners, to solve real-life problems and to reflect about their learning. RT4 ('The projects empowered the students') let us understand that this educational approach indeed empowered the students, making them become more motivated to learn and to further develop their abilities. It created another virtuous cycle, a positive feedback loop that we have named 'Empowering the Students' (Figure 1).

This led us to our second finding: The PBL approach challenged the students to solve real-life problems, improving their critical thinking, their communications and problem-solving skills, leading to the improvement of their self-confidence and their interest in learning. This finding is in accordance with the findings of (Bender 2012; Markham, Larmer, and Ravitz 2003) who have shown that solving real-life projects indeed contributes to the development of the students' skills and motivates them to learn (Blumenfeld et al. 1991; Hung, Hwang, and Huang 2012).

However, the project-based learning approach not only empowered the students, it empowered the teachers as well. RT2 ('The projects motivate teachers to learn and to collaborate') let us understand that the interdisciplinary nature of the projects forced the teachers to connect the contents of different disciplines, to collaborate with each other, and to learn more about active learning techniques. In so doing, the teachers become more motivated to learn and collaborate with other teachers and community members, which led to them to search for new educational opportunities in the communities for the following years' projects. This led to the strengthening the partnerships between the communities and the schools, creating another virtuous cycle that we have named 'Empowering the teachers' (Figure 1). RT5 ('The ECOA program improved the relationships within the schools' and between the schools and its surrounding communities') let us understand that as the teachers and the students become more empowered, the schools changed. The schools become more interested in continue the partnerships with the surroundings communities in the following years, creating another virtuous cycle that we named as 'Empowering the schools'.

This led us to our third finding: The PBL approach empowered the teachers, motivating them to study and to make connections with community partners, therefore also changing the ways the courses were conducted and the relationships between school and local communities. This finding is aligned with the findings of other researchers (Lam, Cheng, and Choy 2010) who pointed out that the use of PBL motivates teachers to learn and to make connections with community partners (Amaral 2018). It is also aligned with researchers who point out that projects involving schools and

communities may ultimately lead to changes in the ways the schools work (Anderson-Butcher 2004; Jacoby 2014).

CONCLUSIONS

In conclusion, we may say that the Alcoa Institute's actions of promoting environmental awareness achieved far more than it had anticipated. The actions triggered the connection between schools and local communities, led to the empowerment of the students, the teachers and consequently to the empowerment of the schools. It is fair to say that the 247 projects, involving hundreds of students and teachers, 30 schools and their local communities, led not only to increased environmental awareness but also to a revolution in the educational practices in all schools involved in the program. In addition, the projects brought benefits to the schools and local communities.

The question remains as to whether those benefits will remain after the ECOA program ends. This is an issue that will be the focus of our future research.

REFERENCES

Abdul-Wahab, Sabah A., Mahmood Y. Abdulraheem, and Melanie Hutchinson. 2003. "The Need for Inclusion of Environmental Education in Undergraduate Engineering Curricula." *International Journal of Sustainability in Higher Education* 4 (2): 126–37. https://doi.org/10.1108/14676370310467140.

Allan, J. David, Robin Abell, Zeb Hogan, Carmen Revenga, Brad W. Taylor, Robin L. Welcomme, and Kirk Winemiller. 2005. "Overfishing of Inland Waters." *BioScience* 55 (12): 1041–51. https://doi.org/https://doi.org/10.1641/0006-3568(2005)055[1041:OOIW]2.0.CO.

Amaral, João Alberto Arantes do. 2018. "Reflections On Thirteen Years Directing Community-Based Learning Projects." *Collaborations: A Journal of Community-Based Research and Practice* 2 (1).

Amaral, João Alberto Arantes do, and Aurélio Hess. 2017. "What Drives the Viewership of an On-Line Video-Lecture Course? A Case Study." *Anatolian Journal of Education* 2 (1): 21–33.

Anderson-Butcher, Dawn. 2004. "Transforming Schools into 21st Century Community Learning Centers." *Children & Schools* 26 (4): 248–52.

Ballantyne, Roy, John Fien, and Jan Packer. 2001. "School Environmental Education Programme Impacts upon Student and Family Learning: A Case Study Analysis." *Environmental Education Research* 7 (1): 23–37. https://doi.org/10.1080/13504620124123.

Bartlett, Albert A., Robert G. Fuller, Vicki L. Plano Clark, and John A. Rogers. 2004. *The Essential Exponential!: For the Future of Our Planet*. Lincon: University of Nebraska.

Bender, William N. 2012. *Project-Based Learning: Differentiating Instruction for the 21st Century*. Thousand Oaks: Corwin,Press.

Blumenfeld, Phyllis C., Elliot Soloway, Ronald W. Marx, Joseph S. Krajcik, Mark Guzdial, and

Annemarie Palincsar. 1991. "Motivating Project-Based Learning: Sustaining the Doing, Supporting the Learning." *Educational Psychologist* 26 (3–4): 369–98. https://doi.org/10.1080/00461520.1991.9653139.

Boks, Casper, and Jan Carel Diehl. 2006. "Integration of Sustainability in Regular Courses: Experiences in Industrial Design Engineering." *Journal of Cleaner Production* 14 (9–11): 932–39. https://doi.org/10.1016/j.jclepro.2005.11.038.

Boserup, Ester. 2017. *The Conditions of Agricultural Growth: The Economics of Agrarian Change under Population Pressure*. London: Routledge.

Bossel, Hartmut. 1998. *Earth at a Crossroads: Paths to a Sustainable Future*. London: Cambridge University Press.

———. 2007. *Systems and Models: Complexity, Dynamics, Evolution, Sustainability*. Norderstedt, Germany: Books on Demand Gmbh.

Bowen, Glenn A. 2009. "Document Analysis as a Qualitative Research Method." *Qualitative Research Journal* 9 (2): 27–40. https://doi.org/10.3316/QRJ0902027.

Brown, Lester R. 2011. *World on the Edge: How to Prevent Environmental and Economic Collapse*. New York: Earth Policy Institute.

Brundiers, Katja, and Arnim Wiek. 2011. "Educating Students in Real-World Sustainability Research: Vision and Implementation." *Innovative Higher Education* 36 (2): 107–24. https://doi.org/10.1007/s10755-010-9161-9.

Brynteson, Richard. 2006. *Once upon a Complex Time: Using Stories to Understand Systems*. Farmington: Sparrow Media Group.

Burkholder, JoAnn, Bob Libra, Peter Weyer, Susan Heathcote, Dana Kolpin, Peter S. Thorne, and Michael Wichman. 2007. "Impacts of Waste from Concentrated Animal Feeding Operations on Water Quality." *Environmental Health Perspectives* 115 (2): 308–12. https://doi.org/10.1289/ehp.8839.

Clover, Charles. 2008. *The End of the Line: How Overfishing Is Changing the World and What We Eat*. London: EburyPress.

Diamond, Jared. 1994. "Ecological Collapses of Past Civilizations." *Proceedings of the American Philosophical Society* 138 (3): 363–70.

———. 2003. "The Last Americans: Environmental Collapse and the End of Civilization." *Harper's Magazine Foundation*, 2003. https://www.thefreelibrary.com/The+last+Americans%3A+environmental+collapse+and+the+end+of+...-a0103124295.

Dorst, Jean. 1970. *Before Nature Dies*. New York: Houghton Mifflin Co.

Ehrlich, Paul R., and Anne H. Ehrlich. 1990. *The Population Explosion*. New York: Simon and Schuster.

Evoluir & Instituto Alcoa. 2014. "Programa ECOA Educação Comunitária Ambiental Relatório 2014."

São Paulo.

———. 2015. "Programa ECOA Educação Comunitária Ambiental Relatório 2015." São Paulo.

———. 2016. "Programa ECOA Educação Comunitária Ambiental Relatório 2016." São Paulo.

Evoluir FBF Cultural. 2014. "Missões Ecoa 2014: Juntos Pela Transformação." São Paulo.

———. 2015. "Missões Ecoa 2015: Juntos Pela Transformação." São Paulo.

———. 2016. "Missões Ecoa 2016: Juntos Pela Transformação." São Paulo.

Fisman, Lianne. 2005. "The Effects of Local Learning on Environmental Awareness in Children: An Empirical Investigation." *The Journal of Environmental Education* 36 (3): 39–50. https://doi.org/10.3200/JOEE.36.3.39-50.

Ford, Frederick Andrew. 1999. *Modeling the Environment: An Introduction to System Dynamics Models of Environmental Systems*. Washington: DCIsland press.

Forrester, Jay W. 1971. *World Dynamics*. Cambridge: Wright-Allen Press.

Gabrielides, G.P., A. Golik, L. Loizides, M.G. Marino, F. Bingel, and M.V. Torregrossa. 1991. "Man-Made Garbage Pollution on the Mediterranean Coastline." *Marine Pollution Bulletin* 23 (January): 437–41. https://doi.org/10.1016/0025-326X(91)90713-3.

Geist, Helmut J., and Eric F. Lambin. 2002. "Proximate Causes and Underlying Driving Forces of Tropical Deforestation: Tropical Forests Are Disappearing as the Result of Many Pressures, Both Local and Regional, Acting in Various Combinations in Different Geographical Locations." *BioScience* 52 (2): 143–50. https://doi.org/https://doi.org/10.1641/0006-3568(2002)052[0143:PCAUDF]2.0.CO;2.

Gilland, Bernard. 2002. "World Population and Food Supply." *Food Policy* 27 (1): 47–63. https://doi.org/10.1016/S0306-9192(02)00002-7.

Godfray, H. C. J., J. R. Beddington, I. R. Crute, L. Haddad, D. Lawrence, J. F. Muir, J. Pretty, S. Robinson, S. M. Thomas, and C. Toulmin. 2010. "Food Security: The Challenge of Feeding 9 Billion People." *Science* 327 (5967): 812–18. https://doi.org/10.1126/science.1185383.

Gonick, Larry, and Alice Outwater. 1996. *The Cartoon Guide to the Environment*. New York: Happer Collins.

Hart, Roger A. 2013. *Children's Participation: The Theory and Practice of Involving Young Citizens in Community Development and Environmental Care*. New York: Earthscan Publications Ltd.

Hartmann, Thom. 2009. *The Last Hours of Ancient Sunlight: Waking up to Personal and Global Transformation*. New York: Three Rivers Press.

Hawken, Paul. 1993. *The Ecology of Commerce a Declaration of Sustainability*. New York: Harper.

Hoornweg, Daniel, Perinaz Bhada-Tata, and Chris Kennedy. 2013. "Environment: Waste Production Must Peak This Century." *Nature* 502 (7473): 615–17. https://doi.org/10.1038/502615a.

Huesemann, Michael H. 2001. "Can Pollution Problems Be Effectively Solved by Environmental Science and Technology? An Analysis of Critical Limitations." *Ecological Economics* 37 (2): 271–87. https://doi.org/10.1016/S0921-8009(00)00283-4.

Hung, Chun-Ming, Gwo-Jen Hwang, and Iwen Huang. 2012. "A Project-Based Digital Storytelling Approach for Improving Students' Learning Motivation, Problem-Solving Competence and Learning Achievement." *Educational Technology & Society* 15 (4): 368–79.

Instituto Alcoa. 2016. "Balanço Instituto Alcoa 2016." https://www.alcoa.com/brasil/pt/pdf/balanco-ia-2016.pdf.

———. 2018. "Programa ECOA 2018." Alcoa.Com. 2018. www.alcoa.com/brasil/pt/ecoa.asp.

Jackson, J. B. C. 2001. "Historical Overfishing and the Recent Collapse of Coastal Ecosystems." *Science* 293 (5530): 629–37. https://doi.org/10.1126/science.1059199.

Jacoby, Barbara. 2014. *Service-Learning Essentials: Questions, Answers, and Lessons Learned.* San Francisco: Jossey-Bass.

Jambeck, J. R., R. Geyer, C. Wilcox, T. R. Siegler, M. Perryman, A. Andrady, R. Narayan, and K. L. Law. 2015. "Plastic Waste Inputs from Land into the Ocean." *Science* 347 (6223): 768–71. https://doi.org/10.1126/science.1260352.

Kollmuss, Anja, and Julian Agyeman. 2002. "Mind the Gap: Why Do People Act Environmentally and What Are the Barriers to pro-Environmental Behavior?" *Environmental Education Research* 8 (3): 239–60. https://doi.org/10.1080/13504620220145401.

Lam, Shui-fong, Rebecca Wing-yi Cheng, and Harriet C. Choy. 2010. "School Support and Teacher Motivation to Implement Project-Based Learning." *Learning and Instruction* 20 (6): 487–97. https://doi.org/10.1016/j.learninstruc.2009.07.003.

Leonard, Annie. 2010. *The Story of Stuff: How Our Obsession with Stuff Is Trashing the Planet, Our Communities, and Our Health-and a Vision for Change.* New York: Free Press.

Mage, David, Guntis Ozolins, Peter Peterson, Anthony Webster, Rudi Orthofer, Veerle Vandeweerd, and Michael Gwynne. 1996. "Urban Air Pollution in Megacities of the World." *Atmospheric Environment* 30 (5): 681–86. https://doi.org/10.1016/1352-2310(95)00219-7.

Malingreau, Jean-Paul, and Compton J. Tucker. 1988. "Large-Scale Deforestation in the Southeastern Amazon Basin of Brazil." *Ambio* 17 (1): 49–55.

Mallin, Michael A. 2000. "Impacts of Industrial Animal Production on Rivers and Estuaries." *American Scientist* 88 (1): 1–13.

Markham, Thom, John Larmer, and Jason Ravitz. 2003. *Project Based Learning Handbook: A Guide to Standards-Focused Project Based Learning for Middle and High School Teachers.* Novato: Buck Institute for Education.

Martenson, Chris. 2011. *The Crash Course: The Unsustainable Future of Our Economy, Energy, and Environment.* Danvers: John Wiley & Sons.

Meadows, Donella H. 1991. *The Global Citizen*. Washington: DC Island Press.

Meadows, Donella H., Dennis L. Meadows, and Jorgen Randers. 1992. *Beyond the Limits: Global Collapse or a Sustainable Future*. New York: Earthscan Publications Ltd.

Meadows, Donella H., Jorgen Randers, and Dennis L. Meadows. 2012. *Limits to Growth: The 30-Year Update*. White River Junction: Earthscan Publications Ltd.

Meadows, Donella H., John Richardson, and Gerhart Bruckmann. 1982. *Groping in the Dark: The First Decade of Global Modelling*. Hoboken, New Jersey: John Wiley & Sons.

Michael Beman, J., Kevin R. Arrigo, and Pamela A. Matson. 2005. "Agricultural Runoff Fuels Large Phytoplankton Blooms in Vulnerable Areas of the Ocean." *Nature* 434 (7030): 211–14. https://doi.org/10.1038/nature03370.

Morton, D. C., R. S. DeFries, Y. E. Shimabukuro, L. O. Anderson, E. Arai, F. del Bon Espirito-Santo, R. Freitas, and J. Morisette. 2006. "Cropland Expansion Changes Deforestation Dynamics in the Southern Brazilian Amazon." *Proceedings of the National Academy of Sciences* 103 (39): 14637–41. https://doi.org/10.1073/pnas.0606377103.

O'Brien, Will, and Joseph Sarkis. 2014. "The Potential of Community-Based Sustainability Projects for Deep Learning Initiatives." *Journal of Cleaner Production* 62 (January): 48–61. https://doi.org/10.1016/j.jclepro.2013.07.001.

Oldeman, L. R., R. T. A. Hakkeling, and W. G. Sombroek. 1991. *World Map of the Status of Human-Induced Soil Degradation : An Explanatory Note*. The Netherlands: International Soil Reference and Information Centre.

Orr, David W., and Adam Cohen. 2013. "Promoting Partnerships for Integrated, Post-Carbon Development: Strategies at Work in the Oberlin Project at Oberlin College." *Planning for Higher Education* 41 (3): 22–26.

Peet, D.-J., K.F. Mulder, and A. Bijma. 2004. "Integrating SD into Engineering Courses at the Delft University of Technology." *International Journal of Sustainability in Higher Education* 5 (3): 278–88. https://doi.org/10.1108/14676370410546420.

Ramsey, Phil. 1997. *Billibonk and the Thorn Patch*. Waltham: Pegasus Communications.

———. 1998. *Billibonk and the Big Itch*. Waltham: Pegasus Communications.

Rogers, Peter. 2008. "Facing the Freshwater Crisis." *Scientific American2* 299 (2): 46–53.

Ruiz-Pérez, Manuel, Fátima Franco-Múgica, José A. González, Erik Gómez-Baggethun, and Miguel A. Alberruche-Rico. 2011. "An Institutional Analysis of the Sustainability of Fisheries: Insights from FishBanks Simulation Game." *Ocean & Coastal Management* 54 (8): 585–92. https://doi.org/10.1016/j.ocecoaman.2011.05.009.

Senge, Peter M., Bryan Smith, Nina Kruschwitz, Joe Laur, and Sara Schley. 2008. *The Necessary Revolution: How Individuals and Organizations Are Working Together to Create a Sustainable World*. New York: Crown Busines.

Sterman, John D. 2000. *Business Dynamics: Systems Thinking and Modeling for a Complex World.* Cambridge: McGraw-Hill.

———. 2014. "Interactive Web-based Simulations for Strategy and Sustainability: The MIT Sloan LearningEdge Management Flight Simulators, Part I." *System Dynamics Review* 30 (1–2): 89–121.

Tam, E. K. L. 2007. "Developing a Sustainability Course for Graduate Engineering Students and Professionals." *The International Journal of Engineering Education* 23 (6): 1133–40.

Viederman, Stephen. 1993. "A Sustainable Society: What Is It? How Do We Get There?" *The George Wright Forum* 10 (4): 34–47.

Wiek, Arnim, and Braden Kay. 2015. "Learning While Transforming: Solution-Oriented Learning for Urban Sustainability in Phoenix, Arizona." *Current Opinion in Environmental Sustainability* 16 (October): 29–36. https://doi.org/10.1016/j.cosust.2015.07.001.

Wiek, Arnim, Angela Xiong, Katja Brundiers, and Sander van der Leeuw. 2014. "Integrating Problem- and Project-Based Learning into Sustainability Programs." *International Journal of Sustainability in Higher Education* 15 (4): 431–49. https://doi.org/10.1108/IJSHE-02-2013-0013.

Wind, Yoram (Jerry) R., and Colin Cook. 2006. *The Power of Impossible Thinking: Transform the Business of Your Life and the Life of Your Business.* Upper Saddle River: Pearson Education.

Wyman, Robert J. 2013. "The Effects of Population on the Depletion of Fresh Water." *Population and Development Review* 39 (4): 687–704.

Yin, Robert K. 2015. *Qualitative Research from Start to Finish.* New York: Guilford Publications.

Os Impactos Sistêmicos de um Programa Educacional Socioambiental de Larga Escala

RESUMO

Neste artigo, apresentamos nossas conclusões sobre os impactos sistêmicos do programa Educação Ambiental para as Comunidades (ECOA), um programa educacional patrocinado pelo Instituto Alcoa. O programa, desenvolvido de 2014 a 2016 no Brasil, envolveu uma corporação (Instituto Alcoa), uma empresa de consultoria educacional (Evoluir), sete Secretarias Municipais de Educação e 30 escolas e suas comunidades vizinhas. O programa promoveu a conscientização ambiental, seguindo uma abordagem de aprendizagem baseada em projetos (ABP): primeiro, os alunos tomaram conhecimento de problemas socioambientais de suas regiões e, em seguida, desenvolveram projetos para resolver esses problemas, com o apoio das comunidades locais e a orientação de professores e educadores da Evoluir. Nosso objetivo da pesquisa foi entender os impactos do programa. Seguimos uma abordagem qualitativa de pesquisa, coletando dados por meio de análise de documentos e entrevistas, revelando os

temas recorrentes e analisando as conexões entre eles por meio de uma análise sistêmica. Nossas principais conclusões foram: 1) O uso da abordagem ABP, envolvendo escolas e comunidades em processos conjuntos de planejamento e execução, promoveu a conscientização ambiental e fortaleceu os laços entre as escolas e as comunidades locais.2) A abordagem ABP desafiou os alunos a resolver problemas da vida real, melhorando seu pensamento crítico, suas habilidades de comunicação e resolução de problemas, levando à melhoria de sua autoconfiança e do interesse em aprender. 3) A abordagem ABP empoderou os professores, motivando-os a estudar e a estabelecer conexões com os parceiros da comunidade, alterando assim a maneira como os cursos eram realizados e as relações entre a escola e as comunidades locais.

Appendix 1. Schools name and location.

Schools location (State/ City)	School name
Pará/ Jurity	E. M. Professora Zelinda de Souza Guimarães
	E. M. Professora Maria da Silva Pereira
	E. M. Vereador Raimundo de Sousa Coelho
	E. M. Professora Maria Lucia Pinheiro
	E. M. Professora Maria da Saúde Pinheiro Cunha
Maranhão/ São Luis	U.E.B. Hortência Pinto
	U.E.B. Evandro Bessa
	U.E.B. Arthur Azevedo
	U.E.B. Gomes de Sousa
	U.E.B. Zebina Eugênia Costa
Pernambuco/ Igarassu and Itapissuma	E.M. Adolfo Brol
	E.M. Albin Stahli
	E.M. Senador José Ermírio
	E.M. Maria Oliveira da Silva
	E.M. Otacília da Souza Silva
Minas Gerais/ Poço de Caldas	E.M. Prof. Arino Ferreira Pinto
	E. M. Dr. Pedro Affonso Junqueira
	E. M. Maria Ovídia Junqueira
	E. M. Vitalina Rossi
	SESI José Alencar Gomes da Silva
São Paulo/ Santo André	EMEIEF Vinícius de Moraes
	EMEIEF João de Barros Pinto
	EMEIEF Vereador Manoel de Oliveira
	EMEIEF Tarsila do Amaral
	EMEIEF Prof. Darcy Ribeiro
Santa Catarina/Tubarão	EMEB Juscelino Kubitschek
	EMEB João Hilário de Mello
	EMEB Manoel Rufino Francisco
	EMEB Manoel José Antunes
	EMEB João Paulo I
	U.E.B. Hortência Pinto

Source: Authors.

Appendix 2. Stakeholders and number of people involved.

Stakeholders	Number of people involved
Evoluir consulting firm	5
Alcoa Institute/ Alcoa	8
Evoluir's field team (Evoluir's educators)	12
City's secretary of education representatives	7
School teachers	400
Students	2,500 students

Source: Authors.

Appendix 3. Project's Modules.

	Months	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Module 01 Project Preparation	Training the educators		X	X									
	Engaging schools			X	X								
	Mapping the community				X	X							
	Getting volunteers				X	X							
Module 02	Joint Planning of Projects					X	X	X	X				

Project Planning															
Module 03 Project Execution	Development of the projects									X	X	X		
	Collecting data about the project									X	X	X		
Module 04 Project closure	Reflecting on the project achievements												X	X

Source: Authors.

Appendix 4. The main types of products and services created by the projects.

Project results	2014	2015	2016	Total
Revitalization of school or public spaces	20	22	23	**65**
Tree planting and gardening	17	12	12	**41**
Promoting environmental awareness	16	10	8	**34**
Encouraging healthy habits	9	9	14	**32**
Creating bonds with communities	7	10	8	**25**
Recycling	7	5	7	**19**
Waste Management	6	2	1	**9**
Human rights	2	5	2	**9**
Water management	1	3	1	**5**
Traffic	1	1	2	**4**
Safety	2	2	0	**4**
Total	**88**	**81**	**78**	**247**

Source: Authors.