SMALL-SCALE COMPOSTING AND EFFECTIVE MICROORGANISMS: AN EXPERIENCE REPORT WITH PUBLIC SCHOOL STUDENTS

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ABSTRACT

The reflection on sustainable social practices in a context marked by the degradation of the environment involves the articulation of different sectors of society with environmental education practices. Thus, the present study aimed to report a non-formal didactic experience and collaborate to the dissemination and practice of composting, in addition to popularizing the knowledge about biotechnology of effective microorganisms (EM). The methodology included the elaboration of public newsletters, with narration and monitoring of the socialization of knowledge through a workshop given to second grade high school students at a state public school. The action was divided into 3 activities, which included an approach to environmental education applied to composting and use of EM, microscopic observation of microorganisms and composting practice. Two explanatory pamphlets on the topic were prepared and delivered at the end of the workshop. A workshop protocol was also generated and made available for partner school teachers to use in similar activities, multiplying the content of the proposal. The executing team concluded that the teaching-learning activities developed seem to have been important in the appropriation of knowledge, allowing students to learn using the ludic and contributing to the contextualization of Environmental Education contents in several disciplines.

Keywords: Environmental Education; composting; sustainability; effective microorganisms.

RESUMO

A reflexão sobre práticas sociais sustentáveis, em um contexto marcado pela degradação do meio ambiente, envolve a articulação dos diferentes setores da sociedade juntamente com práticas de educação ambiental. Assim, o presente trabalho teve como objetivo relatar uma experiência didática não formal e colaborar com a divulgação e prática da compostagem, além de popularizar o conhecimento sobre a biotecnologia dos microrganismos eficientes (EM). A metodologia incluiu a elaboração de materiais informativos de divulgação e utilidade pública, com narração e acompanhamento da socialização de conhecimentos através de uma oficina ministrada para alunos do segundo ano do ensino médio de uma escola pública estadual. A ação foi dividida em três atividades, que incluíram abordagem da educação ambiental aplicada à compostagem e uso de EM, observação microscópica de microrganismos e prática de compostagem. Foram elaborados e entregues ao final da oficina dois panfletos explicativos sobre o tema. Foi gerado ainda um protocolo da oficina, disponibilizado para professores da escola parceira, para sua utilização em atividades similares, multiplicando o conteúdo da proposta. A equipe executora concluiu que as atividades de ensino-aprendizagem desenvolvidas parecem ter sido importantes na apropriação do saber, permitindo aprender utilizando o lúdico e contribuindo para a contextualização de conteúdos de Educação Ambiental em diversas disciplinas.

Palavras-chave: Educação Ambiental; compostagem; sustentabilidade; microrganismos eficientes.

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INTRODUCTION

Composting has been developed in several environments, such as public or private institutions whether small or large, that treat organic waste generated internally. In this sense, educational establishments have been implementing this technique offering training and awareness to internal employees so that the system starts to operate under self-management (SIQUEIRA; ASSAD, 2015).

As an example, the USP Recicla Program, which started in 1994, stands out in the midst of discussions raised at the time of the Eco-92 Conference. This project is responsible for assisting the management of reusable and recyclable waste, on several campuses at the University of São Paulo, through initiatives that promote responsible consumption and the proper disposal of waste (SUPERINTENDÊNCIA DE GESTÃO AMBIENTAL, 2018).

Another application occurs at the *Instituto Federal de Educação, Ciência e Tecnologia* (Ifes) campus Vitória, which since 2012 has been focusing on studies related to the generation of waste on site. The Institute has shown itself as an opportune generator of organic solid waste (OSW), such as food scraps and especially coffee grounds. A historical survey of selective organic collection, carried out between 2013 and 2016, revealed that coffee grounds are the most representative residue among those generated in different sectors of the institution (COSTA et al., 2016). Given this scenario, researchers from the institution, aiming the adoption of environmentally appropriate practices for the management of OSW, implemented a small-scale composting on the spot as an alternative to treat those residues (BRINGHENTI et al., 2018). Aligned with these actions, it is worth highlighting the importance of dissemination and practice of composting by educational institutions, providing the strengthening of interaction between different sectors of society, in addition to promoting a positive social impact in terms of encouraging sustainable actions.

Considering the practical aspects, composting can be carried out in piles and in compost bins. The model and size may vary according to the available physical space, the demand for compost, the amount of waste generated, and the components that are used to carry out the process (RODRIGUES et al., 2019). Among the materials suitable for composting, are food scraps, leaves, sawdust and manure, and the use of difficult-to-decompose organic matter such as meat, fish and fat should be avoided (EPSTEIN, 2017).

In general, composting is simple, accessible, and basically consists of joining organic waste and substrates. It is also necessary the place do not receive strong sunlight incidence and moisture in the right amount. In addition, it is important to turn over the material, so that it can be oxygenated. Furthermore, it is common to use worms to accelerated degradation of organic matter, a technique known as vermicomposting (EPSTEIN, 2017).

Composting occurs naturally, being carried out by microorganisms and microfauna present in waste and in the environment. However, in order to optimize this process, commercial inoculants can be added to the compost. As an example, we highlight the Effective Microorganisms (EM) suspensions, that are handcrafted by the user, which integrate several beneficial microorganisms, non-pathogenic and non-genetically modified, with different functions, which coexist within the same liquid medium (HIGA, 1991; ZACARIA et al, 2010).

Several studies indicate that the use of EM technology in composting allows to accelerate the material decomposition process, controlling the generation of odors and leachate (PATLE et al., 2014; VICENTINI et al., 2009). It can also contribute to improving the microbiological and nutritional quality of the final product generated, increasing the solubilization of nutrients and beneficial substances, producing a pathogen-free and good quality compound (ETHIER et al., 2016; JUSOH et al., 2013) and being a sustainable, economical, natural, safe and easy to use technology (BONFIM et al., 2011).

The implementation of actions that value organic waste in its generation place faces challenges related to the educational persuasion of the public that frequents these environments. This is because the awareness of the participants must occur in different and efficient ways, since the conviction and the effective participation of people are determining factors for the success of decentralized organic waste management systems (OLIVEIRA; NOGUEIRA, 2014).

Embarking on the path of sustainable development requires a major transformation in the way people think and act. To create a more engaged world with issues related to sustainability, as described in the United Nations (UN) Sustainable Development Goals (SDG), individuals must become agents of change, needing knowledge, skills, values and attitudes that allow them to contribute to sustainable development, education being crucial for this (UNESCO, 2017).

Through environmental education, not only environmental issues can be addressed, but also social, political, cultural and of any segment that is involved in the obligatory relations of individuals with each other and with the environment (OLIVEIRA; NOGUEIRA, 2014).

The approach to education for sustainable development enables students to make conscious decisions and take responsible actions to ensure environmental integrity, economic viability and a fair society for present and future generations (UNESCO, 2017). Thus, actions to encourage the dissemination and implementation of composting in an institutional environment are collaborating with SDG 4, which aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all, and SDG 12, which seeks to ensure sustainable production and consumption patterns.

Brazilian Federal Law n. 9.795/1999 defines Environmental Education as a set of processes through which the collectivity and individuals build social values, skills, knowledge, attitudes and competences towards environmental conservation. (BRAZIL, 1999). Therefore, this tool aims to actively involve society to solve environmental problems, motivating individuals to change their behavior. All the practical experience in sustainable actions collaborates in forming attitudes and education for a more sustainable life (PELICIONI, 2005).

The use of skills of qualified professionals to promote a change in the population's paradigms can result in the motivation of the community to reach environmental knowledge. As a result, new ethical and moral values are acquired, followed by a new mentality and attitude so necessary to deal with environmental problems, in order to find solutions to them (OLIVEIRA; NOGUEIRA, 2014).

The development of environmental projects, with conscious, critical, reflective and ethical acts, involving the environmental theme and the community, contributes to the formation of citizenship and to the construction of social and environmental commitment. Therefore, it is important that these practices are inserted since the first years of schooling, contributing to the internalization of sustainable habits that will be practiced throughout the life of individuals (OLIVEIRA; NOGUEIRA, 2014).

Practical activities developed in and with the environment contribute for children to develop sustainable habits in their daily lives and not just in a conceptual way. It is also worth highlighting the importance of schools and institutions to know the socio-environmental problems in their surroundings and encourage those involved in the search for measures to solve them (OLIVEIRA; NOGUEIRA, 2014). Thus, it is considered that, although it is a challenge to harmonize all these perspectives, in a pedagogical model that meets the specificities of individuals, it is important that due attention is given to this problem, articulating educators, society and existing public policies.

The teaching of sustainable activities can be inserted in daily life with the problematization of practical situations, such as the generation of waste and its destination, which discussion can be didactically approached through a methodology that is close

to teaching by investigation. After proposing the problem of what to do with the waste, its solution can be investigated and discussed with students in a manner similar to an investigative demonstration (AZEVEDO, 2004), in which EM can be observed by microscopy and how small-scale composting can be implemented. Explanations will involve the application of subjects covered in theoretical classes like contents of Microbiology and sustainability.

In this context, this study aimed to report a non-formal didactic experience and collaborate with the dissemination and practice of composting, a widely used technique, indicated and environmentally appropriate for the disposal of organic waste, in addition to popularizing the knowledge of biotechnology of EM, which has several applications in everyday life.

METHODOLOGY

Material elaboration

Initially, an information and publicity material on the implementation of small-scale composting was developed, addressing topics such as the generation of organic waste, what this biotechnology is, its benefits, how to assemble the domestic compost, what factors influence the process, guidance on its use and the use of leachate and the generated organic compost. In addition, another material was created highlighting aspects about the use of EM, including content on their study history, concept, applications, advantages, methodology for homemade preparation of EM and care guidelines for them.

The materials, which were intended to contribute to the dissemination and popularization of small-scale composting and use of EM were pamphlets, which followed a didactic way to expose the informations. They were prepared using simple and direct language in order to allow the understanding of its content by the largest number of people.

The production of the pamphlets was developed in Microsoft Word, once is accecible. Initially, bibliographic research on the topics was carried out. Then, the most interesting approaches were listed, making the language suitable to a 14- to 25-year-old public, since the materials were made available to high school students, and can also be extended to undergraduate students. The cover was developed in a way that was attractive and inviting, instigating the opening of the material. The content was prepared in a clear and accessible language, including images and texts in its body.

Workshop

In order to obtain a wider coverage of the target audience, a workshop was held on the institute campus with second grade high school students at a state public school.

For the implementation of the workshop, a script was elaborated and a teaching sequence was followed with an initial approach to knowledge related to solid waste and tailings focusing on organic waste, once composting was the highlight of the presentation. In this stage, the concept of composting, its benefits, and the factors that influence the process were developed in addition to tips on composting time and the use of vermicomposting.

Subsequently, the class was divided into 2 groups with one directed to the Microbiology laboratory to perform the microscopic observation activity of slides fixed and stained with EM and microorganisms present during the composting and vermicomposting processes. The observations were made in an optical microscope model DM (Lyca Systems) equipped with an image capture system. The other approach was directed to the practice of demonstrating and implementing small-scale composting. In all cases, dialogue and students' participation and appreciation of prior knowledge on the topic were valued and applied in order to give realism and application to the topic discussed in practical life.

Evaluation by the executing team

At the end of the activities, the executing team met to evaluate the conduct during the workshop, the procedures, the public participation by questions and interaction, and

the didactic material used (protocol and pamplets). The possibility of improvements in protocols to better assist the actions was raised.

RESULTS AND DISCUSSION

Encouraging small-scale composting is an effective way to achieve sustainability with a vision of acting locally and thinking globally. In this context, informational and instructional materials of public utility were produced with the intention of encompassing this social aspect and contributing to the dissemination of this technique, in addition to popularizing knowledge about the biotechnology of EM, which has several applications in everyday life.

Two pamphlets were prepared. The first refers to the dissemination of the small-scale composting technique being developed with the aim of promoting the valorization of OSW generated in institutional and domestic environments. The second addressed aspects about the use of EM. Their respective covers are shown in Figure 1.

Figure 1 – Covers of information materials of public utility prepared. A) Pamphlet on domestic composting. B) Pamphlet on use of EM

Source: Own authorship (2020).

The pamphlets were delivered to second grade high school students at a state public school, during a workshop on solid waste and composting, which was attended by 31 students and 2 teachers from the partner institution. The executive team was composed of 2 graduate students and 1 professor from the Ifes Campus Vitória.

The workshop lasted 1h20min, and each activity, from the 3 proposed, lasted approximately 20min. The time proved to be adequate, since students interacted and participated well during all the presentations without loss of attention. The photographic records of the actions are shown in Figures 2, 3 and 4.

It was also noticed the importance of using modern microscopy equipment and laboratories for teaching scientific dissemination work like this, which instigated students in learning, as these were tools they had never had the opportunity to know.

Figure 5 shows a microscopic image captured during the activity at the Microbiology Laboratory. Handling microscope and observing microorganisms in composting process was important for the understanding the science method included in the workshop, turning visible one step of the process.

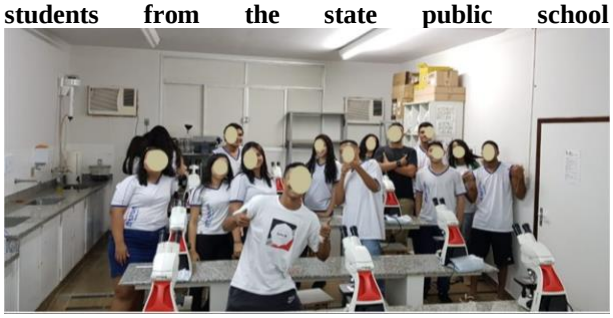
Figure 2 – Initial moment of the workshop on solid waste and composting, held with students from the state public school

Source: Own authorship (2020).

Figure 3 – Practice of implementing small-scale composting with high school students from the state public school

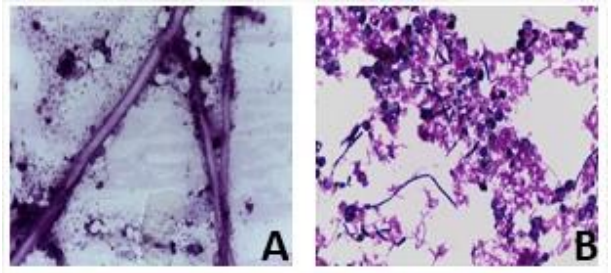
Source: Own authorship (2020).

Figure 4 – Observation practice of composting, vermicomposting and EM slides with high school students from the state public school



Source: Own authorship (2020).

Figure 5 – Microscopic image of slides buried in the composting process (A) and commercial product containing EM (B) with 1,000x magnification



Source: Own authorship (2020).

The prepared script was made available for the partner school teachers to use in their activities in the future. In addition, for greater dissemination of the content, the pamphlets may be displayed on murals of educational institutions, where there is a large movement of people. This initiative was aimed to raise awareness, guidance and insctruction to the public that attends school environments, fostering in these citizens the interest in recycling OSW generated in their daily activities, as well as disseminating the various utilities related to MS.

Bibliometric studies such as the one carried out by Bringhenti et al. (2017); Filogônio et al. (2018); Ribeiro et al. (2019) are a first incentive, because when building banks of experiences, they provide bibliographic support for the production of information material. According to Medeiros et al. (2015) these data results in a survey of other researchers' perspectives on the topic, in the identification of investigative gaps and in the use of this material as a source of study and new publications.

This social perspective in scientific work contributes to the transformation of the way we think and act, in order to create a more engaged world with issues related to sustainability, in addition to being aligned with the SDG, which brings education as a crucial tool for individuals to become agents of change, acquiring knowledge, skills, values and attitudes that allow them to contribute to sustainable development.

The adoption of composting brings with it the possibility of its expanded use as a local tool for the development of actions that seek the establishment of sustainability with respect to the management of OSW on a global scale. Thus, the workshop contributed with the the notion that people can act locally and think globally in terms of sustainable development. The use of composting as a promising sustainable instrument can leverage a more agile and innovative change process, close to everyday life, and with a greater potential for good results.

In the evaluation of the executing team, the different activities were developed within the perspective of proposing a solution to a problem: the sustainable destination of OS; discussing its resolution, valuing the students' prior knowledge in a dialogued activity, bringing concepts, techniques and demonstrative practical actions. The approach

came close to an experimental investigative demonstration, as defined by Azevedo (2004). The activities of this research, illustrated the phenomenon of composting, simulated the assembly of a composter and the residues to be used, as well as demonstrated by microscopic observation, the action of microorganisms involved in biodegradation. Ultimately, the workshop collaborated with the integration of theoretical and practical knowledge, using composting as an instrument. In addition, the union of knowledge obtained with theory and practice favors the awareness of the environmental responsibility of those involved no matter they are teachers, students or speakers.

Recognition of the valorization of organic waste and its treatment, as environmental goods endowed with economic value and opportunities for social empowerment, are fundamental for society consideration on the necessity of implementing composting and reintroducing the generated compost into a circular production and consumption system.

CONCLUSIONS

The scientific and instructional material production of explanatory pedagogical pamphlets with accessible language profile proved to be a direct way to stimulate the target audience interest upon implementation of small-scale composting and knowledge of EM.

The results found in this study expand and strengthen knowledge valorization of small-scale composting in domestic and institutional environments. It is expected that this research will contribute to the awareness of participants from other institutions and promote the scientific dissemination of this practice as a simple, agile and easy to replicate technique, since the valorization of solid waste can contribute to a culture that reintegrates man to the environment.

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