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RESEARCH ARTICLE

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## CIRCULAR ECONOMY AND ITS STRATEGIC ROLE IN EDUCATION\_A QUALITATIVE AND QUANTITATIVE APPROACH FROM THE PERSPECTIVE OF A PUBLIC SCHOOL

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### ABSTRACT

This paper aims to present a study carried out in a municipal school on the city of Manaus, in the state of Amazonas (Brazil). The proposal was to assess students' perception of the concepts related to education and sustainability and how the circular economy can be boosted in society through consistent educational policies. The methodology consisted of the application of a questionnaire to students of a public school, in order to assess their perception about the environmental theme and the promotion of circular actions. As a conclusion from the study, the existence of a solid educational policy, when offered from the bottom up, is capable of naturally boosting the concepts advocated by the circular economy, creating a natural virtuous circle so that these concepts are strongly rooted in all layers of the individual's educational background.

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### INTRODUCTION

It is clear that the evolution in industrial processes, from what we know as the first industrial revolution to the present moment, which we call Industry 4.0 (fourth industrial revolution), that the most relevant approach has its focus on processes and their evolution, since the massive employment of labor (replacing mechanized processes) up to the use of artificial intelligence (replacing labor) as a way of showing the progress achieved. However, aspects related to sustainability and environmental preservations were not relevant pillars for the affirmation and consolidation of the models advocated by the well-known industrial revolutions. Considering the current stage, although Industry 4.0 supports the pillars of the circular economy (reuse, recycle and reduce - 3R's), as [Rajput, 2019], even so, the discussion and actions developed are not enough when the question of sustainability is deepened and resource limitation.

However, in a moment of deep global reflection, with scenarios that lead to the restriction of resources, labor and material, it was naturally necessary to discuss the entire production model hitherto employed, which involves the design of new forms of consumption habit and compulsory reduction in the use of natural resources in production processes. The need for reinvention takes us to a new way of living and relearning, and reinforces the basic questions focused on awareness and our formation and education process. It is in this context that this work is developed, which explores the perception of consumption habits of students in a public school and its relationship to the environment, posture and daily habits, showing the importance of awareness still in the education of citizens, which will be achieved through of educational policies that favor environmental education as a bridge for a society based on excessive consumption to

transform itself into a society based on sustainable consumption. This work is the result of an Extension Project developed by the Federal University of Amazonas with a Municipal Public School, in order to observe the school's strategies regarding the Environmental Education theme. The main objective of this work was to show the importance of the actions recommended by circular economics from the educational process.

## LITERATURE REVIEW

**Circular Economy and Sustainability:** The circular economy has been widely discussed as a way to revitalize economic and productive processes from the perspective of reducing impacts on the environment and boosting sustainability. In this sense, the classic definition of CE refers to the contributions of researchers working in this area, and they define it as the replacement of a linear model by a circular model, where residues are inputs for a new process or product that are related in a closed-loop [MacArthur, 2013; Weetman, 2017]. The transition from the linear model to the circular model is supported by a transition to renewable-energy sources, so that the circular model builds economic, natural and social capital and is based on the following principles: eliminate waste and pollution from the beginning, maintain products and materials in use and regenerate natural systems [Ellen MacArthur Foundation, 2017]. However, there are studies that indicate that the systematic of using waste to feed another process does not always result in products with the same level of performance as those made with original raw material [Zink, 2017]. In addition to the ideas of CE need greater scientific support [Korhonen, 2018] and be appropriately measured using appropriate indicators to assess the effectiveness of circular actions [Moraga, 2019; Busu, 2019]. Indeed, the actions recommended by the CE lead us, inevitably, to assess how these actions have a strong relationship with the concepts of Sustainability, since the term is associated with human actions and activities that aim to meet the current needs of human beings, without compromise the future of the next generations [Von Wehrden, 2016; Sustainable Development Goals, 2020]. Moreover, it is discussed how the linear and ecological economic models are opposed [Von Hauff, 2016] and how its premises influence the discussion by adopting circular flows or the immediacy of linear flows.

**Sustainable Environmental Education:** The environmental issue is one of the pillars of Sustainability and, as such, the educational process must not be omitted when it comes through a process of social awareness. Following this approach [Roorda, 2016] emphasizes that education must play an essential role in sustainable development. For the author, Education for Sustainable Development occurs when the university acts as a learning organization, with the premise of creating a set of disciplines throughout the training period that are focused on environmental issues, that is, with reflex's educational curriculum. In addition, they focus on how this issue relates to the role at the university with regard to the type of training given and its contribution to the professional field. However, the issue of education should not start from the top, but at the bottom, with long-term actions that should start early in the individual's educational career [Kirchherr, 2019]. In fact, the concepts related to education for sustainable development (ESD) have been discussed as a way to raise the critical thinking of citizens, so that they can evaluate and take actions focused on these issues [Morad, 2015]. As attested

[Andrews., 2015], learning about sustainability, from an educational process, can influence the individual's future actions, outlining his behavior against these issues. Initiatives aimed at developing actions linking education with circular and sustainable processes have become more frequent, and reveal that new methodologies can contribute to this teaching-learning process focused on circular and sustainability issues in an integrated manner [Rodríguez-Chueca, 2020].

## METHODOLOGY

This chapter presents the exploratory study carried out to identify the environmental management practices adopted by the school involved in the work. The study involved a questionnaire, developed based on bibliographic analysis and based on the knowledge of the area, seeking to be comprehensive in the themes, including issues related to all management and environmental education processes, as well as those related to Circular Economy and Sustainability. The questionnaire was sent to the students of the college, covering all grades and the results were analyzed using a descriptive and inductive approach and took place from November 2019 to January 2020. In the descriptive approach, information related to the posture of the school and students regarding environmental management, posture in relation to the circular economy, sustainability, recycling practices, consumption habits, among other environmental aspects were evaluated. In the inductive approach, hypothesis tests were conducted to assess the dependency relationship between environmental education and circular practices, as well as environmental education and sustainability. The questionnaire aimed to identify the practices related to environmental management adopted by the school and students in the context of sustainable actions, recycling, consumption habits and circular systems. The questionnaire consists of open and closed questions, and it is structured in three sections, namely: *Section I - Habits and Posture; Section II - Environmental Education, and Section III - Environmental Management and Sustainability.* The criteria for choosing the school took into account its location (a school in the center of the city was sought, as it is the community where the master's student resides) and, secondly, a school that serves high-school students. The Frei Silvio Vagheggi municipal school agreed to participate in this study and is structured to serve 605 students, distributed in the morning and afternoon shifts with 344 and 261 students respectively. For this work, a cut was made of the 1st afternoon of high school. Three (03) classes of 1st year in the afternoon are offered, serving 91 students, where 67 participated in the survey, making a response rate of 73% of the total students. The average age of the students who participated in the research is 15.45 years and lives in different neighborhoods in the city of Manaus. In addition, as it is an investigation that also relates the habits of students within the family, the number of people living in the same residence was raised, and we obtained an average of five (05) people, with extremes in the order of sixteen (16) people and two (02) people.

## RESULT AND DISCUSSION

**Exploratory Analysis:** This section aimed to investigate aspects related to environmental education, selective collection, the importance of environmental management and the students' attitude towards these current themes. In this sense, with respect to the question that investigates whether the student knows how to differentiate between garbage and solid

waste, we have that 41% say they know the difference between them. Regarding the statement about environmental education, about 76% said they had full knowledge about it. It was also questioned whether there is understanding and understanding about what selective collection is, where about 66% said they had complete understanding. Environmental issues were addressed in this questionnaire. In this sense, we sought to investigate whether recent themes on climate change and themes related to environmental preservation were addressed, where 52% said that such themes were discussed.

Corroborating this question, about 94% of the respondents considered the discussion of these topics important. Aspects related to the practice of selective collection are important in the context of environmental education, circular economy and sustainability. In that sense, these themes were addressed in this questionnaire. Thus, we sought to investigate such actions in the context of the necessary preparation for carrying out these activities. About 52% of respondents reported not knowing how to separate and classify waste for proper selective collection. Corroborating this question, about 83% of respondents said they did not perform such activities within the family. The details of these questions are shown in Figure 1.

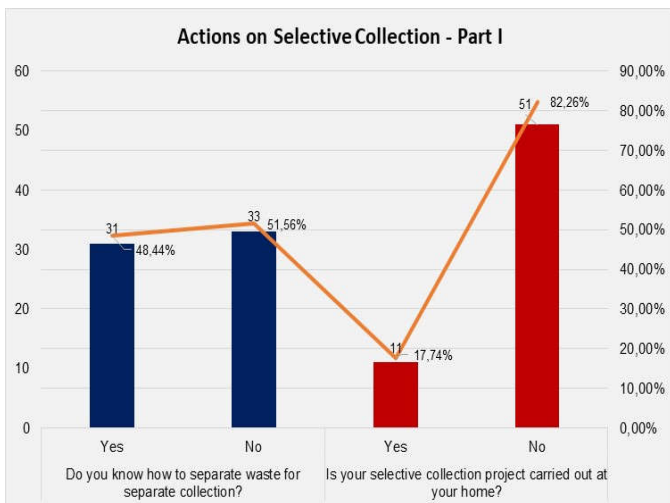


Figure 1. Actions on selective collection – Part I

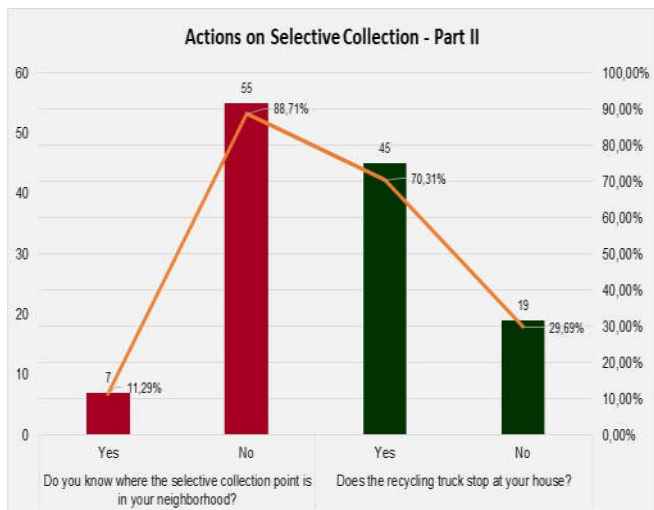


Figure 2. Actions on selective collection – Part II

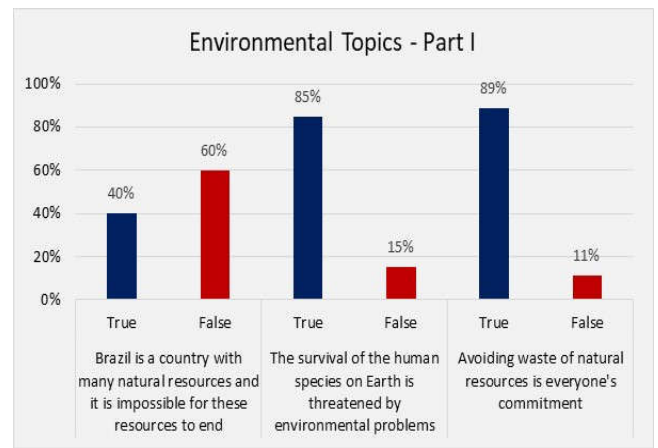


Figure 3. Environmental topics – Part I.

Still in the context of selective collection, knowing that many actions are also due to the existence of public policies, the extent of the adoption of community measures was explored. Thus, we sought to investigate the existence of selective collection points in the neighbourhood where the students live, as well as in the area where the school is located. About 88% of respondents reported not knowing about the existence or location of a selective collection point in their neighbourhood or near surroundings. In contrast to this question, the same group, about 70% of respondents positively affirmed that the garbage collector passes in their neighbourhood, where it was not investigated if it was a common or specialized collection. The details of these questions are shown in Figure 2. Although public policies are relevant factors in the approach to environmental actions, it is important to explore the individual's position in this context. In this sense, individual attitudes were addressed in this questionnaire. With this, we sought to explore the individual's contribution to environmental issues and their performance in the environment. About 87% of respondents reported being concerned with environmental issues and their impacts. Corroborating this question, about 84% of respondents stated that they would participate in initiatives aimed at environmental practices, if invited. However, about 60% stated that they do not feel responsible for the destination of the waste or garbage it generates, believing this to be a function of the public power. In this sense, with respect to the question that investigates the potential of the use and exploitation of natural resources, we have that 60% stated that our resources are not finite. With respect to the issue that relates the exploitation of natural resources and the continuity of species, we have that 85% stated that the burden on the environment can cause future problems due to the impact on the ecosystem and the scarcity of non-renewable resources. Awareness about the preservation of natural resources, as well as their rational use, led us to explore the students' perception regarding the waste of such resources, inputs and products. With regard to the issue that explores everyone's commitment to the rational use of non-renewable resources, 89% said that the commitment not to exhaust the environment must be everyone's commitment. The details of these questions are shown in Figure 3. The role of everyone in society, in view of environmental practices, led us to explore the students' perception of their own performance. Regarding the question that asks about public participation in these actions, 68% stated that the responsibility for the entire waste management cycle, from collection to disposal is the responsibility of the public authorities. Still addressing the issue about the role of

everyone in society, we sought to assess the perception of students with respect for the impact that they themselves have on the environment. With regard to the question that asks how consumption habits impact upon the environment, 86% stated that their actions contributed to the degradation of nature. The details on these questions are shown in Figure 4.

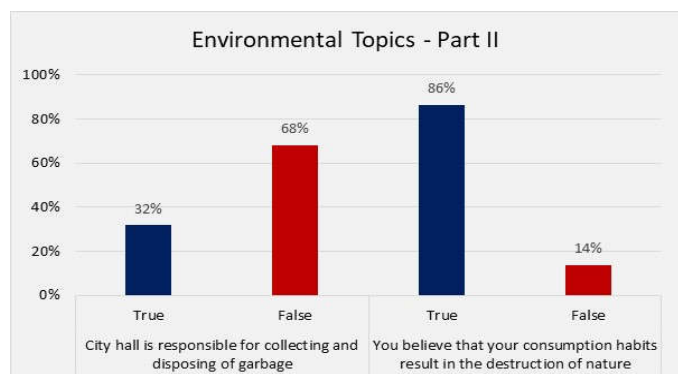


Figure 4. Environmental topics – Part II.

**Comparative Analysis:** In this first part of the comparative study, it was intended to assess whether the habits and posture of school students have an influence on the perception of environmental education, since the approach to this theme can be a factor that influences the behavior of students at school or at home. Thus, the data were stratified for each of the questions analyzed, and hypotheses were formulated for the performance of comparative tests. The Chi-square independence test was applied to assess the students' response to the questions asked, and the results are presented in Table 1.

- H<sub>1</sub>.** The differentiation of garbage and solid waste is independent of its orientation towards environmental education;
- H<sub>2</sub>.** The discussion on environmental issues is independent of its orientation towards environmental education;
- H<sub>3</sub>.** The importance of discussing environmental issues is independent of its orientation towards environmental education;
- H<sub>4</sub>.** The perception of selective collection is independent of its orientation towards environmental education;
- H<sub>5</sub>.** The degree of concern with environmental issues is independent of its orientation towards environmental education;
- H<sub>6</sub>.** The degree of responsibility for the waste generated is independent of its orientation towards environmental education;
- H<sub>7</sub>.** The preservation of the individual as part of the environmental balance is independent of his orientation towards environmental education;
- H<sub>8</sub>.** The preservation of natural resources is independent of its orientation towards environmental education.

Table 1. Comparative analysis of the habits and posture of students with respect to Environmental Education

Hypothesis	$\chi^2_{(1)}$	p-value	Null hypothesis
H <sub>1</sub>	4,684	0,030	Reject
H <sub>2</sub>	0,554	0,500	Do not reject
H <sub>3</sub>	0,210	0,647	Do not reject
H <sub>4</sub>	0,616	0,433	Do not reject
H <sub>5</sub>	0,013	0,909	Do not reject
H <sub>6</sub>	0,056	0,813	Do not reject
H <sub>7</sub>	1,846	0,174	Do not reject
H <sub>8</sub>	0,058	0,810	Do not reject

**As results for each hypothesis:**

- Definition of garbage and solid waste is dependent on an adequate understanding of environmental education;
- The discussion on environmental issues is related to an adequate understanding of environmental education;
- The importance of discussing environmental issues is related to an adequate understanding of environmental education;
- The importance of selective collection is related to an adequate understanding of environmental education;
- The importance of selective collection is related to an adequate understanding of environmental education;
- The responsibility for the waste generated is related to an adequate understanding of environmental education;
- The responsibility for the waste generated is related to an adequate understanding of environmental education;
- The responsibility for the waste generated is related to an adequate understanding of environmental education.

**Conclusion**

This work sought to identify the importance of educational training as a way of understanding the processes advocated by the circular economy without, however, wanting to explore the mastery of this subject by the students of the school that participated in the project, but rather to understand their perception of two important pillars that make up and are affected by the concept of a circular system: the environment and sustainability. Concepts about solid waste and garbage are not very clear, and the survey revealed that 59.1% of students do not know how to differentiate them. In addition, the curriculum composition in schools is almost evaluated and as environmental themes are present in academic discussions at earlier levels, it was noticed that about 50% of students do not associate the discussion of environmental themes with actions aimed at environmental education, although they understand that discussions on the subject are important, and that they are concerned with the environment and the preservation of natural resources.

However, about 11% of students consider that natural resources are infinite, and another 86.4% maintains that their consumption habits did not cause an environmental impact. With respect to habits and a sense of responsibility, students understand the selective collection is important and necessary, but it is the function of the government to carry it out and understand they are not responsible for the management of the waste they generate, attributing to the public authorities the responsibility for this process. In this question, it was possible to observe that only 48% of the respondents have some understanding about selective collection and leave opportunities to be able to understand the circular mechanisms and how the community organization can create actions aimed at generating income within the community, from the recycling of material generated in the residence, school and surroundings. In this sense, the consolidation and understanding of circular concepts involve strengthening our environmental awareness, changing habits and customs, as revealed by the research. However, in the vast majority of cases, what is understood about such concepts is not due to the training received in years of coexistence at school, but to empirical practices. The existence of a solid educational policy, when offered from the bottom up, is capable of

naturally boosting the concepts advocated by the circular economy, creating a natural virtuous circle so that these concepts are strongly rooted in all layers of the individual's educational background. To be effective, it should not be limited to higher-education cycles, which is where this topic has been discussed today, which will produce short and long-term results in society, not depending on moments of exception (pandemics, for example) to bring along a change in habits in society.

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