EDUCATING ON CIRCULAR ECONOMY AND DIY MATERIALS: HOW TO INTRODUCE THESE CONCEPTS IN PRIMARY SCHOOL STUDENTS?

Jimena Alarcón, Maritza Palma, Lucía Navarrete, Gabriel Hernández, Andrea Llorens

Universidad del Bio-Bio (CHILE)

Abstract

This article presents an educational experience in primary school students in Chile to create awareness of Circular Economy importance and the use of resources present in the immediate environment. The Circular Economy concept of the product is aimed at reducing 100% of waste. Therefore, it must be focused on keeping products and materials in the economic system as long as possible, then it emphasizes on extending the useful life of products. On the other hand, Do It Yourself (DIY) materials generate new experience, promoting sustainability and self-production, motivating the development of knowledge through the action. They represent local identity and advantages involve basic techniques of manufacture. Resources are available in production territory, reducing collection and waste transport costs, encouraging recycling and relationship with the community of origin. At the same time, it encourages curiosity, engagement, creativity and innovative thinking. The methodology is composed of seven phases 1. Designers collect information about existing waste in the immediate environment; 2. Design and manufacture DIY materials in the laboratory; 3. Presentation of materials designed for students; 4. Development of data collection instrument through semantic differential tables, based on Kansei methodology; 5. Data collection of tactile experience with materials. 6. Data tabulation. 7. Elaboration of conclusions. Results indicate a high emotional assessment of students towards innovative materials possible to manufacture with waste generated in their community. Visual and tactile evaluations are also perceived by students, highlighting positive aspects especially for translucent and flexible materials, as well as morbid and huggable. Students show a 100% interest in manufacturing materials and products applying the concepts presented. Educational results are positive because they integrate perspective addressed at the environmental dimension and social benefit for immediate context. In conclusion, it is important to implement practical experiences, so primary education students carry out a complete cycle of waste collection and material manufacturing, besides of looking for favorable applications to the development of their environment. Integrating this systemic view of the process could increase motivation towards the implementation of waste collection and use systems generated in their community. Encouraging the participation of other actors to build experiences of wider educational and practical benefit is part of this experience project.

Keywords: Circular Economy, design, materials interaction, primary school, waste.

1 INTRODUCTION

The idea of integrating Circular Economy concepts in primary education is to raise awareness from an early age about the need to carry out actions favorable to sustainability. The solutions must be within reach of the immediate possibilities to generate behaviors of change in the short term. This requires the adoption of innovative approaches in educating students to take their place in their communities in the future. The Circular Economy (CE) refers to a model of consumption and production different from the linear economy that has dominated society for decades and is unsustainable. The CE involves creating value for businesses, the economy, and society while minimizing resource use and environmental and social impacts integrating a system thinking in the imagination of individuals [1]. DIY materials generate new experiences, promote sustainability and self-production [2], driving development knowledge through the action [3]. Resources need to be managed more sustainably. Just 6% of materials are recycled [4]. On the other hand, they represent the local identity, since they are made with raw materials, techniques, and resources available in the territory where they are produced, reducing costs, encouraging recycling and linking with the community of origin. This type of materials are based on the experimentation of individual self-production or in communities [5]. Therefore appearance features can be associated to very artisan and imperfect, while production is usually low technology [6]. For the elaboration of DIY materials, all the units that are classified as waste, become an appreciated source of resources [7, 8]. DIY materials offer the opportunity to reach
positive social changes [9], environmental, economic and even political [10, 11]. As part of the process of change, studies must be conducted to know the users' perception of new materials that could integrate their environment. Understandings about the user's emotions demonstrate the relevance they have for the design because they influence the behavior of use [12] and the richness of the experiences [13], [14]. One of the five categories to prove that emotions affect the satisfaction of individuals is through experience sensations [15], so it is relevant to know the meaning of these for a range of users associated with environments of relevance [16], [17]. "When people are asked to describe a certain material, they often refer to their expressive characteristics and these characteristics are based on different aspects of the materials (and products)" [18]. So, one way to integrate the concept of CE in primary education is through the valuation of industrial and organic waste. Show with examples the uses of the new materials and generate synergies favorable to the sustainability applied in daily life. In this sense, it is beneficial to integrate into primary education tools that allow students to integrate concrete changes to take care of the environment from a new perspective [19]. The integration of the DIY approach in education contributes to the formation of students aware of the need to generate product life cycles coherent with circular economy concepts [20, 21].

2 METHODOLOGY

The methodology is composed of seven phases: 1. Designers collect information about existing waste in the immediate environment. The designers visited the primary school and registered the waste generated in a list. Then, students are interviewed to find out which waste is produced more frequently. A list was made of wastes of industrial and organic vegetable origin (Fig.1). Industrial wastes were defined in hierarchical order such as polyethylene (PE) and Polyethylene terephthalate (PET) containers and bags, paper packaging and waste of textile origin. Wastes of organic vegetable origin are of food type such as eggshells and fruit peels (oranges, lemons), among others.

![Figure 1. Methodological approach for the design of DIY materials applied to the context of primary education.](image)

In phase 2. Design and manufacture of DIY materials in the laboratory, designers manufacture materials with waste and select those that can be manufactured by students at school or in their homes with the help of an adult. The designers elaborate technical documents including the waste selection process, DIY manufacturing of the material and possible applications for the manufacture of objects. 3. Presentation of materials designed for students, in this phase three new materials are subjected to affective study (Fig.2 and 3). The prototypes are sheets of 0.3 mm to 5 mm thickness made with a) Carton of egg boxes and eggshell; b) Polypropylene plastic bags; c) Polyester textile fibers (Table 1); 4.Development of data collection instrument through semantic differential tables, based on Kansei methodology, the designers ask the students about the emotions they feel when they see and touch the new materials. The answers are written down in questionnaires with semantic differential tables. 5. Data collection of tactile and visual experience with materials allows to establish lists of emotions associated with each material; 6. Data tabulation, to know the preferences of students about the emotions proposed for each material. A focus group is held to know the opinions of the students about this experience and to complement them with the information gathered in the questionnaires; in stage 7. Elaboration of conclusions, emotional evaluations are established.
regarding the presented materials and evaluates the possibility of advancing to a next stage of experimentation of the methodology with students and adults such as parents and teachers.

<table>
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<tr>
<th>Table 1. Materials properties</th>
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<td>(1 the lowest valuation and 5 the highest valuation)</td>
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<tr>
<td>Material a</td>
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<tr>
<td>Translucency</td>
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<td>Flexibility</td>
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3 RESULTS

3.1 Capabilities and attitude, support, emotional assessment

3.1.1 Students capabilities and attitude
The first issue to be evaluated after the experience is the willingness of the students to continue with the following phases of implementation of CE concepts. A next stage considers the team planning (students and designers) of an CE-based system that allows to plan a waste collection system, design, and manufacture of new DIY materials and the application of new materials in products useful to their environment. The students showed interest in continuing to develop a material manufacturing experience. They evidenced an understanding of the different basic characteristics of the materials and the diverse emotions that these can motivate in people. For this specific case the children who participated in the activity, were able to identify emotions such as tranquility, happiness, curiosity, always in ranges superior to their antagonistic unrest, unhappiness, indifference.

3.1.2 Support of the school to carry out activities on CE
The teachers who collaborated in the experience, show a willingness to continue with activities with new approaches in relation to sustainability. Likewise, the school authorities show a positive attitude, because they are willing to provide hours and equipment to carry out new participatory activities. It is essential to make these lessons compatible with the existing curriculum, in order to provide current approaches to the contents that must be taught.

3.1.3 Emotional assessment
The students showed surprise at the new materials and the DIY concept. The emotions expressed in relation to the materials have been tabulated, but detailing the results correspond to another document focused on that topic. The most recurrent emotions related to the perception of the new materials were tranquility, happiness, curiosity, always in superior to their antagonistic unrest, unhappiness, indifference. Students have shown greater affinity with materials that have remarkable visual and tactile qualities. The soft and huggable materials, colorful and energetic. In addition, materials that change with the light quality of the environment, showing translucency, have been among the
favorites. This aspect presents a relevant finding because work with children should be focused on the design and manufacture of new materials with attractive visual and tactile values, with powerful qualities to draw their attention. This will be more motivating for them and will provide the possibility of making products according to their emotional preferences. This approach has allowed making a list of pleasant emotions for the students. A study of the designers should develop proposals for future materials to be developed for this environment, based on those emotions and the existing waste. Along with the emotion caused by each of the materials, it is positive to highlight the one associated with the possibility of generating new contributions to the environment through creativity. A renewed and sustainable perspective is opened thanks to the knowledge of the CE and DIY concept.

4 CONCLUSIONS

The approach of the DIY and CE concept in primary education presents broad expectations for the understanding of waste as possible value elements to be reinvested. The systemic view that is possible to install at an early age in individuals offers the real possibility of installing short-term changes through the implementation of concrete ideas. In the medium and long term, it could mean important changes in the schools and their surroundings due to the generation of a conscious culture in the students. It is relevant to integrate concrete examples and possible to apply in school environments so that children understand from small how they can contribute to sustainability. It is equally important that the examples are creative, surpassing the classic reuse stage according to the shape and materiality of the waste objects. For example, a plastic bottle is used as a pencil holder; a glass container is used as a vase. It is relevant to deliver a new, more creative projection to children. Make them think more broadly about the possibilities that the concept of CE means. For this, the concept of DIY materials is very relevant. A second phase, now that we have seen the good attitude of children and the school regarding this type of teaching, will be to prepare children and teachers to make their own materials and discover appropriate uses in their environment. This system will reduce the amount of waste, with considerable contributions to the garbage collection system (Fig. 4). The first step is to observe the micro-environment, that is, the most immediate resources to the study context where the experience will be carried out, make a list of potential materials and select those that have the possibility to be worked with the DIY concept. The new materials must be manufactured first in the laboratory and subjected to physical-mechanical tests and user studies. The manufacturing with the students having the technical sheet of the material. Application proposals and prototypes are later stages of development, as is the integration of active solutions in society. The recommendation is to organize the process in two stages, the first one up to the manufacture of materials with the students; and, the second, definition of applications and their integration into society. This will facilitate understanding of the concepts and their possibilities for the benefit of the community.

Figure 4. DIY materials process applied to the context of primary education. Source: Project file.
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REFERENCES


