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Didactic proposal to promote sustainable competencies in an Early Childhood Education classroom

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Resumen

El presente trabajo recoge una propuesta didáctica que promueve el desarrollo de competencias para la Sostenibilidad en el alumnado de Educación Infantil. En primer lugar, se contextualiza la propuesta en el marco de la Educación para el Desarrollo Sostenible y el desarrollo de competencias en Sostenibilidad. A continuación, se describe la propuesta, que se ha llevado a cabo en un centro escolar de Pamplona, y en la que han participado 24 alumnos y alumnas del tercer curso de Educación Infantil. La recogida de información se ha realizado, principalmente, mediante observación, preguntas orales y hojas de registro. Los resultados muestran la adquisición de hábitos sostenibles por parte del alumnado en lo relativo a la reducción, reutilización y reciclaje de residuos, además de repensar en su utilización y posteriores consecuencias en el medioambiente. Por esto mismo, creemos que estos hábitos tendrán efecto también una vez finalizada la propuesta, y no solo sobre el propio alumnado sino también sobre su entorno. La propuesta se plantea a través de metodologías activas y transformadoras, dejando a un lado la educación tradicional basada en la mera transmisión de conocimientos y convirtiendo a los alumnos y las alumnas en sujetos activos partícipes de su propio aprendizaje.

Palabras clave: Educación para el Desarrollo Sostenible; alfabetización científica; competencias para la Sostenibilidad; 4Rs del medioambiente; pedagogías transformadoras.

Abstract

This paper includes a didactic proposal that promotes the development of competencies for Sustainability in the students of Early Childhood Education. First, the proposal is contextualized within the framework of Education for Sustainable Development and the development of skills for Sustainability. The proposal, which has been carried out in a school in Pamplona, and in which 24 students from the third year of Early Childhood Education have participated, is described below. Information has been collected mainly by observation, oral questions, and record sheets. The results show the acquisition of sustainable habits by students in terms of the reduction, reuse, and recycling of waste, as well as rethinking its use and subsequent consequences on the environment. For this reason, we believe that these habits will also have an effect once the proposal is finalized, and not only on the students themselves but also on their environment. The proposal is presented through active and transformative methodologies, leaving aside traditional education based on the mere transmission of knowledge and turning students into active participants in their own learning.

Keywords: Education for Sustainable Development; scientific literacy; skills for Sustainability; 4Rs of the environment; transformative pedagogies.

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INTRODUCTION

It is undeniable that we are currently immersed in a process of global change, whose more visible symptom is global climate change, but which also includes loss of biodiversity, changes in land use and depletion of natural resources. And some human activities are, at least in part, responsible for these changes, including the emission of greenhouse gases, the excessive generation of waste, pollution of the ground, surface and underground water, seas and coasts, over-exploitation of resources, deforestation... All this is having, and will have, very serious consequences on our planet, to the point that many advocated we are facing a climatic emergence, and some authors have even coined a new term to name this era characterised by the traces of human activities on the ecosystems and a new mass extinction, the *Anthropocene*.

If the current situation is to improve, and if the resources of our future generations are not to be put at risk, we must all commit ourselves individually to Sustainable Development, one of the main axes of this work. In other words, we must all adopt sustainable lifestyles, so that we meet our needs, but, as already mentioned, we also allow future generations to meet theirs.

In turn, for this to be possible, it is essential to promote Education for Sustainable Development (ESD), another of the main axes of this work, and a tool of learning throughout life that is fundamental to get formed, from early ages, competent citizens committed to Sustainable Development and the environment.

In this sense, this paper aims both to describe key concepts such as Sustainable Development and ESD, among others, and to carry out a didactic proposal that demonstrates how the students of the third level of Early Childhood Education are able to acquire, through active methodologies, sustainable skills and habits that enable them to be genuine agents of change.

As for the structure of this work, it presents, first, a theoretical framework composed of three chapters, which address basic concepts on Sustainable Development, and ESD in addition to showing several current projects being carried out in these areas. Secondly, a didactic proposal is presented which, as already mentioned, aims to contribute, through the use of active methodologies, to the formation of a student body committed to the care and conservation of the planet and capable of carrying out sustainable actions that help to improve the dramatic environmental situation that we are living in.

1. THEORETICAL FRAMEWORK

1.1.Frame of reference: Sustainable Development

1.1.1. Sustainable Development

In recent decades, human impact has had devastating consequences on the environment, including, *inter alia*, climate change and the increasingly frequent and devastating natural disasters. However, human development has not only damaged the environment, but it has also caused political and socio-economic conflicts (Klarin, 2018). In this way, as Klarin (2018) stated, humans are "endangering the survival of the Earth and the future generations'' (p.67).

Consequently, as the same author pointed out, attempts are being made to manage all resources in a more reasonable, effective, and environmentally friendly way, without thereby compromising the future of the next generations. This new path towards more accountable behaviours is framed within the term of "Sustainable Development'', whose main progress occurred in the 70s and 80s of the last century.

According to Artaraz (2002) and Ciegis et al., (2009), among other authors, there are currently more than 100 different definitions of the concept of Sustainable Development, which shows the absence of common agreement on the meaning of the term and its controversial nature. However, taken this into account and as Ciegis et al., (2009) stated:

> …it is thought appropriate to use the definition provided in Brundtland commission's report "Our Common Future" (1987), which discloses the idea of Sustainable Development best. It postulates that Sustainable Development is the kind of development, which satisfies the current needs without endangering the future generations to satisfy their own. (p.30)

In this sense, the same authors highlighted that the core idea of Brundtland's definition is providing future and present generations of people from the first, the second and the third world with equitable natural resources, as well as reaching a positive balance between the three pillars of Sustainability, the environmental, the social and the economic dimensions.

Thus, as Ciegis et al., (2009) affirmed, "…Sustainable Development is not about a choice between environmental protection and social progress, but rather more about striving for economic and social development that would be compatible with environmental protection'' (p.30).

The three pillars of Sustainability shape what is known as the "Triple bottom line concept'', which was introduced by Elkington in the 90s (Alhaddi, 2015), and refers to the equilibrium between the three dimensions: social, economic and environmental (Figure 1). That is, according to Klarin (2018), environmental Sustainability implies the need of preserving the quality of the environment, so as to enable the development of the economic activities as well as to ensure the wellbeing of people. Meanwhile, social Sustainability struggles for guaranteeing the fulfilment and respect of the different

cultural identities, human rights, equality, cultural diversity, race, and religion. Finally, economic Sustainability is described as "necessary to maintain the natural, social and human capital required for income and living standards'' (Klarin, 2018, p.68).

As mentioned before, to achieve full Sustainable Development, there must exist an equilibrium between the three pillars of Sustainability. That is, during the accomplishment of their own goals, each of the three dimensions must consider the interests of the others, which is a difficult task. In this sense, Klarin (2018) pointed out the following: "So, while a certain pillar of Sustainable Development becomes sustainable, others can become unsustainable, especially when it comes to ecological Sustainability, on which the overall capacity of development depends'' (p.68).

Finally, it should be mentioned that these three pillars of Sustainability are also often called the three Ps, people, planet, and profit, which refers to social, environmental, and economic Sustainability, respectively (Alhaddi, 2015; Slaper, 2011). An explanatory scheme is given in Figure 1, which shows the complicated relationship between the three pillars of Sustainable Development.

Figure 1.

The Triple bottom line concept of Sustainable Development

1.1.2. Milestones in understanding the term Sustainable Development

It was the increasing awareness of the environmental crisis that generated the emergence of the concept of Sustainable Development (Du Pisani, 2006). However, as the same author stated: "…as a contemporary buzzword 'Sustainable Development' has become rather overworked. We often use it without thinking of its real meaning and implications. Therefore, a historical review of the roots of this concept […] might be useful'' (p.83) (see Figure 2).

Figure 2.

Historical review of the roots of the concept of Sustainable Development

1st Period **Growing awareness that there is a limit to economic growth**	
UN Conference on Human Environment (Stockholm, 1982)	Need for changes in economic development to become sustainable
2nd Period **Evolution of the definition of Sustainable Development**	
Our common future report (Brundtland report, 1987)	Definition of "Sustainable Development", mandate to make rational and controlled use of resources
3rd period **Take joint action to ensure equity and wellbeing while preserving the environment (action for the people and the planet)**	
Earth Summit (Rio de Janeiro, 1992)	Define a global framework for solving issues of environmental degradation through the concept of Sustainable Development
	Rio Declaration on Environment and Development: Urgent need to preserve the environment, co-responsibility in the use of natural resources ***Agenda 21*** A plan to balance economic growth and environmental care. Need for education and international cooperation
UN's MGD (2000)	Millennium Development Goals: 8 objectives to be met by 2015: Global action for the people and the planet Objective #7: Ensure environmental Sustainability
Conference on Sustainable Development (NY, 2015)	*Transforming our world: the 2030 Agenda for Sustainable Development with new 17 Millennium Development Goals* 17 Sustainable Development Goals to be met by 2030 (integrate social, environmental, economic pillars)

Note: based on Klarin (2018).

The formulation of the concept of Sustainable Development resulted from effective participation by different institutions and organizations. However, among all of them, it is the United Nations (UN) the one that stands out because of the active role it has always played in the field of

Sustainable Development. The UN is made up of more than 190 member states and its origin dates to 1945 (Klarin, 2018).

In this sense, it is remarkable that "since the introduction of the concept, many international conferences, congresses, summits and meetings have been held, resulting in various declarations, reports, resolutions, conventions and agreements and dealing with the environmental problems'' (Klarin, 2018, p.73). Specifically, the same author highlights three historical periods in the history of the concept of Sustainable Development.

The first period is characterized by a growing awareness of the limits of economic growth. That is, back then, the concept of development was only understood in economic terms, however, certain economist theorists like Smith or Marx were alerted by the Club of Rome about the devastating impact that economic development could have on the environment. Specifically, this period lasts until 1972, when the First UN Conference on the Human Environment was held in Stockholm (Mebratu, 1998; Drexhage & Murphy, 2010, as cited in Klarin, 2018). Concretely, "this conference marked the introduction of the concept of Sustainable Development, and although it did not fully associate environmental problems with development, it stressed the need for changes in economic development [...]'' (UN, 1972; Mebratu, 1998; Drexhage & Murphy, 2010, as cited in Klarin, 2018, p.73).

In the second period the definition of the concept of Sustainable Development evolves, and unlike the previous period, in this second period it is understood that there is a need for development that does not compromise the needs of future generations. Specifically, this period lasts until 1987, when the report *Our Common Future* was published by the World Commission on Environment and Development (WCED), headed by Gro Harlem Brundtland. For this reason, the report is also known as the Brundtland Report and it was the first document to contain an appropriate definition of Sustainable Development, previously cited, which is indeed one of the most quoted definitions of Sustainable Development in the existing literature (WCED, 1987; Drexhage & Murphy, 2010, as cited in Klarin, 2018). More precisely:

> An imperative of the Brundtland report is: rational and controlled use of resources focused on renewable and long-term usage, protection and conservation of nature, raising ecological awareness, stricter national regulation and international co-operation, stopping population growth, using industry and technology in line with environmental requirements, developing technological innovations in order to reduce impact on environmental. (WCED, 1987, as cited in Klarin, 2018, p.74)

For these reasons, this report is seen as the onset by which the concept of Sustainable Development has been widely accepted, even leading to new policies that have been key to preserving the environment, among other spheres of human activity (Mebratu, 1998).

The third and final period stands out for the joint actions carried out for the benefit of both people and the planet. In other words, in the previous periods the purely theoretical basis of the concept of Sustainable Development were established, and it is not until this third period that true joint action is taken to ensure equity and well-being while preserving the environment. This period lasts from the years following the Brundtland report in 1987, until today, and several important events stand out (Klarin, 2018).

The most relevant one, the UN conference on environment and development called the *Earth Summit* or the *Rio Conference,* in which 178 countries participated, took place in Rio de Janeiro in 1992. Specifically, "its focus was to define a global framework for solving issues of environmental degradation through the concept of Sustainable Development […]'' (UNCED, 1992ab; Mebratu, 1998; Drexhage & Murphy, 2010, as cited in Klarin, 2018, p. 75). What is more, as a consequence of the preparation of the conference, starting in 1989, some documents were created, of which mainly two are key to understanding the concept of Sustainable Development.

The first document, *the Rio Declaration on Environment and Development* establishes 27 principles of Sustainable Development, whose main message is the urgent need to act in favour of the environment. In this sense, each country is responsible for the use it makes of its own resources, but always avoiding damaging the environment of other neighbouring countries. Additionally, "these principles also form the basis for future policy and decision making and balance between socio-economic development and the environment'' (UNCED, 1992b, as cited in Klarin, 2018, p.75).

The second document, *Agenda 21,* gives to the society important insights into balancing socio-economic development and environmental conservation. Concretely, the document assigns great importance to the international cooperation, the role that the governments play in the implementation of policies and programs in favour of the environment and the role of developed countries when it comes to help and protect developing countries and its natural resources, human health, and gender equality (Klarin, 2018). Moreover, Chapter 36 of Agenda 21 highlights the importance and crucial role of education in raising awareness of Sustainable Development and in developing and improving people's ability to deal with environmental problems (UNDSD, 1992).

Apart from these documents, the 1992 Rio conference also established the United Nations Framework Convention on Climate Change (UNFCCC), a cross-country commitment to reduce climate change. Following this, the Kyoto Protocol was adopted in December 1997, a legally binding agreement between more than 160 parties to reduce CO2 emissions and other greenhouse gases (Breidenich et

al., 1998). A summit, Conference of Parties (COP), is held annually, the last being the Madrid/Chile Conference, held between 2 and 13 December 2019 (ENB, 2019, as cited in Bochove, 2020)

In this third period and in recent history, we also distinguish two main advancements in the field of Sustainable Development. First, the Millennium Declaration in 2000, considered as "a milestone in international cooperation, inspiring development efforts that have improved the lives of hundreds of millions of people around the world" (United Nations, 2010, p.3). Specifically, almost all countries agreed on eight aspiring goals that directly address issues such as poverty, hunger, illiteracy, women discrimination, or environmental Sustainability, among others (United Nations, 2005).

Finally, the UN Conference on Sustainable Development, which took place in 2015 in New York, as well as the resolution *Transforming our world: the 2030 Agenda for Sustainable Development with new 17 Millennium Development Goals*, intended to be accomplished by 2030. Among these goals, apart from the ones previously adopted in 2000 on the Millennium Development Goals (MDGs) report, new ones have been adopted: "…assurance of clean water and clean energy […], sustainable cities and communities, responsible production and consumption, preservation of the ecosystem on the ground and in the waters, assurance of the world peace, etc'' (UNDP, 2015b, as cited in Klarin, 2018, p.86).

1.2. Education for Sustainable Development

1.2.1. Development of skills for Sustainability

As stated above, the path to Sustainability is a process that consists of bending efforts so that social and economic development is not only possible, but also compatible with environmental care and protection (Ciegis et al., 2009). For this to be possible, as advocated in Agenda21, is needed, among others, the creation of educational initiatives that promote awareness of Sustainable Development, being these initiatives essential for its subsequent implementation (UNDSD, 1992, as cited in Klarin, 2018).

The latter is what is known as *Education for Sustainable Development* (ESD), defined as "education that encourages changes in knowledge, skills, values and attitudes to enable a more sustainable and just society for all" (Leicht et al., 2018, p.7). That is, as Rieckmann (2018) stated, ESD "…aims to develop competencies that enable and empower individuals to reflect on their own actions by considering their current and future social, cultural, economic and environmental impacts from both a local and a global perspective'' (p.39).

In this sense, it is essential that all educational institutions and communities commit themselves to the ESD, so that all students, from early childhood education to tertiary education, develop the competencies needed to take the path towards Sustainability.

Moreover, it is important to differentiate education about Sustainable Development from ESD. On the one hand, education about Sustainable Development is a purely theoretical discipline that aims to simply raise awareness about Sustainability issues and is mainly related to conservative learning.

On the other hand, ESD, unlike the previous one, focuses not only on theory or knowledge, but also on values, skills, attitudes, and behaviour. In addition, ESD goes beyond conservative learning and the mere transmission of knowledge and promotes the reflection and critical thinking of students (Mckeown et al., 2002; Kotul'aková, 2016). Regarding this, Bell (2016) stated as follows:

> Teaching and teachers do have an important role in supporting the requisite Sustainability learning process, but their principal role is no longer simply to transmit knowledge to students. Education is not about filling a pail it is about lighting a fire. (p.52)

Then, it is clear that a new transformative education is needed, in which students acquire not only knowledge but also skills, competencies and values. Specifically, "transformational pedagogy is seen to include the following features: Action-oriented, Inquiry-based learning; Systems-based learning; Integrated, holistic approaches; Creative use of technology'' (Bell, 2016, p. 52).

In this context, it is also worth mentioning the broad consensus that exists today in considering science and technology literacy as a key and priority element in citizenship education. As in ESD, one of the main objectives of scientific literacy is to achieve a responsible and competent society not only to exercise its rights but also to make decisions (Ransey, 1993; Bingle & Gaskell, 1994; Cross & Yager, 1998, as cited in España & Prieto, 2004). That is: "From science education it is necessary to respond to the challenge of preparing citizens to recognize the degree and nature of the impact of human action on the planet and to act in this new global context'' (España & Prieto, 2004, p.346).

1.2.1.1. From Science literacy to sustainable competences.

As mentioned before, today's world is changing, complex and interdependent, and adapting to it is a complicated task that requires, among others, certain key competences, defined as "the ability to meet complex demands, by drawing on and mobilising psychosocial resources (including skills and attitudes) in a particular context" (Rychen & Salganik, 2003, p.4) and that must develop during the course of the whole life.

Therefore, as the same author pointed out, "a competence-based approach can help here to bridge the gap between knowledge and action'' (p.41).

"Basic competences in science and technology", are one of these eight competencies that the European Council (2006) identified as necessary for personal fulfilment and development, active citizenship, social inclusion, and employment. The PISA program (Programme for International Student Assessment) defines *Scientific literacy* as the «ability to use scientific knowledge to identify questions

and draw conclusions based on facts in order to understand and make decisions about the natural world and about the changes that human activity has brought about in it» (OECD, 2006).

However, it is necessary to go further and leave behind the impoverished and distorted visions of science education focused mainly on understanding conceptual facts and adopt "a more creative, open and socially contextualized vision, in keeping with the very tentative nature of scientific activity'' (Fernández, 2002; Gil Pérez, 2005, as cited in Gil Pérez & Vilches Peña, 2006, p.43).

That is, in addition to understanding facts and making decisions:

> …the learning of the sciences can and should also be an adventure that enhances the critical spirit in a deeper sense. Challenges such as facing open problems or participating in the tentative construction of solutions are, in short, the adventure of «doing» science". (Gil Pérez & Vilches Peña, 2006, p.43)

In this sense, science education faces, together with ESD, the challenge of preparing society to take responsibility for the planet and to act consistently in this new global context (España & Prieto, 2004). In order to achieve this, in addition to the scientific competence, competences for Sustainability are also necessary, and although there exist contrasting visions, there is general agreement that eight competencies make a key contribution to promoting Sustainable Development (Rieckmann, 2018):

- *Systems thinking competency:* being able to identify, examine and understand relationships and systems and their organization, as well as to handle uncertainty.
- *Anticipatory competency:* being able to visualize and assess different types of futures considering the existing dangers and transformations and that each act has its own consequence.
- *Normative competency:* self-criticism and being able to reflect on the values and norms behind our actions, as well as to negotiate Sustainability principles, objectives, and values in a context full of conflicts, uncertainty, and contradictions.
- *Strategic competency:* being able to innovate together to promote Sustainability locally and globally.
- *Collaboration competency:* being able to show empathy for others and to solve conflicts in a cooperative and participatory way.
- *Critical thinking competency:* being able to question and reflect on the different norms, values, practices, and opinions that shape the debate on Sustainable Development, as well as to express one's point of view.
- *Self-awareness competency:* being able to evaluate their own actions and feelings and to recognise their own role as local and global citizens.

- *Integrated problem-solving competency:* being able to integrate all previous competencies to solve Sustainability problems by designing possible solutions in an inclusive and equitable manner.

At this point, it is clear that nowadays, achieving successful results is not simply about learning facts, but requires the acquisition of crucial skills such as being collaborative and creative, thinking critically, and taking initiative and action among others (Hazelkorn, 2015). In relation to this, UNESCO (2015a) as cited in Rieckmann (2018) affirmed that:

> In order to contribute to Sustainable Development, individuals need to learn how to understand the complex world in which they live, and how to deal with uncertainties, trade-offs, risks, and the high velocity of societal (global) change. They need to be able to collaborate, speak up and act for positive change within the world. (p.41)

In this regard, ESD not only prepares students to understand Sustainable Development Goals (SDGs), but to be competent citizens and act to achieve a more sustainable society (UNESCO, 2017, as cited in Rieckmann, 2018). That is, over the past 20 years, the ESD has evolved from a mere transmitter of basic knowledge to a competence-based approach, which involves recognizing the most suitable approaches for the real world and promoting the necessary learning.

In addition to this, also opportunities should be considered, that is, the life situation of each individual limits and determines the actions that the individual can carry out in terms of Sustainability.

All in all, it is clear that ESD is a key tool in the promotion of cross-cutting Sustainability competencies that prepare and encourage people to act and face Sustainability challenges. Moreover, as Rieckmann (2018) stated, "it is crucial not only to include Sustainability-related content in the curricula, but also to employ an action-oriented transformative pedagogy'' (59). That is, once all the educational agents are committed to ESD, in order for pupils to develop the appropriate skills, it is also necessary to bring about, first of all, a pedagogical transformation, aimed at a more participatory, collaborative, and action-oriented education, in which pupils themselves are the protagonists who direct their learning (Rieckmann, 2018).

1.2.1.2. Transformative science teaching.

As previously mentioned, it is clear that science education is a key tool in the promotion of scientific literacy, since it prepares people to be accountable, imaginative, and ingenious citizens that are conscientiously engaged and work collaboratively while being fully aware of the ongoing challenges that society faces. What is more, science education guarantees sustainable future societies, since it enables a better understanding of the world around us and the causes and consequences of these major challenges it currently faces (Hazelkorn, 2015). For this to become true, "a more responsive

science education can promote broader participation in knowledge-based innovation that meets the highest ethical standards and helps ensure sustainable societies into the future'' (Science Europe, 2013, as cited in Hazelkorn, 2015, p.7).

Therefore, it is essential to promote scientific literacy from the early educational stages as Infant Education. This is possible, first, through the manipulation of artificial or natural materials, inquiry, and the observation of the functioning of various objects and changes in the environment, among others (Cañal, 2006, as cited in Garzón & Martínez, 2017).

Second, as mentioned before, for this to be possible, science education should move beyond traditional learning about science and promote learning through science, focusing on competences development and the link between science and other subjects and disciplines (Hazelkorn, 2015). That is, there is a need to move away from conservative education, based on the simple transmission of knowledge to pupils, so as to make way for a transformative education, in which teachers stop being mere transmitters of knowledge and become guides and facilitators to help students acquire not only knowledge and values, but also skills and competences (Bell, 2016). In short, "success in the 21st century depends upon acquiring key competences rather than simply learning facts'' (Hazelkorn, 2015, p.20). One of these key competences is, for example, *integrated problem-solving competency.*

However, it is also important to highlight that all these competencies do not ensure that people will act accordingly in each challenging situation. As Rieckmman (2018) affirmed, "…to transform capacities into real sustainable actions, individuals need corresponding values and motivational drivers'' (p.45).

Furthermore, as previously referred, this competence-based approach of ESD is framed within an action-oriented transformative pedagogy, which in turn identifies three pedagogical approaches that are "essential for the development of competencies vital for promoting Sustainable Development'' (Rieckmann, 2018, p.40).

Firstly, *learner-centred pedagogy*, in which, as the name suggests, the learner is the centre of the learning process, which is based on the pupil's prior knowledge and interests. In addition, in this learning process the student has an active and reflective attitude, and the teacher changes its traditional role as a transmitter of knowledge, to become a facilitator and guide for the student during that learning process.

Secondly, *action-oriented learning*, in which the teacher is responsible for providing students with suitable learning environments in which experiences that involve students arise and promote both the need to carry out certain actions and the reflection about them. Besides, as the author argued, "Action-learning increases knowledge acquisition, competency development and values clarification by linking rather abstract concepts to personal experience and the learners' life" (Rieckmann, 2008, p.49).

Finally, *transformative learning*, in which the main role of the teacher is to encourage and defy learners so that they reflect on their own viewpoints and are open to change them or to add new ones. In this way, according to this pedagogy, the students will improve their understanding of the world.

1.2.1.3. Inquiry-Based Science Education (IBSE) and Project-Oriented Learning (POL).

As previously mentioned, according to the learner-centred pedagogy, one of the main pedagogical approaches through which Sustainability in school must be addressed, it is essential that children have an active role in their learning. In the recognition of this idea, as Harlen (2013) pointed out, we find the roots of Inquiry Based Science Education (IBSE). Specifically, IBSE can be defined as follows:

> IBSE means students progressively developing key scientific ideas through learning how to investigate and build their knowledge and understanding of the world around. They use skills employed by scientists such as raising questions, collecting data, reasoning, and reviewing evidence in the light of what is already known, drawing conclusions, and discussing results […]. (IAP, 2010, as cited in Harlen, 2013, p.13)

Regarding the inquiry process (see Figure 3), it begins with an experience or phenomenon that is new to students or with a question they have to answer. At first, based on their previous ideas they have to give possible explanations or hypotheses about that new experience or question. Later, considering the previous existing idea, they make predictions about what they believe can be or happen, and to test whether their prediction is true or not, they must plan and carry out an investigation in which they will collect new data. After conducting the research, they will interpret the data and obtain results that will be compared with the prediction made above, to verify whether this prediction was true or not. Finally, from these results, a final conclusion is drawn about the initial idea, which if good, will turn that initial idea into a ''bigger idea', and if it is not useful enough, other ''alternative ideas' will be considered (Harlen, 2013).

Figure 3.

Inquiry process

Note: modified from Harlen (2013).

In this sense, and as regards the contribution that IBSE makes to ESD, it can be affirmed the following:

> IBSE can contribute to ESD as they share common values: cooperation, creativity, innovation. It can particularly help building the knowledge, skills and attitude that support an objective reflection on environmental, social, and economic phenomena which goes beyond opinion and anecdote. (Kotul'aková, 2016, p.6).

Then, it should also be noted that, by tackling/approaching ESD through the methodology of scientific inquiry, students raise their awareness of current problems and challenges and develop the capacities of critical thinking and creativity, which help them to face these problems, and to "…imagine new scenarios through the active learning processes of conceptualising, planning, acting, and reflecting'' (Kotul'aková, 2016., p.6).

On a similar line, Project Oriented Learning (POL) is defined by Albareda-Tiana et al., (2018) as "…an instructional methodology for active learning, in which students work together in small groups researching and solving real-world problems. Through POL, a shared co-creation process was performed in a learning environment that fostered research''(p.10).

Besides, POL methodology has proven to be an ideal means of teaching and learning in a learner-centred way, which, in turn, makes possible an action-oriented and transformative learning

(SDSN Australia/Pacific, 2017, as cited in Albareda-Tiana et al., 2018). In this sense and as stated above, to promote Sustainability performance among students it is essential not only to include theoretical contents on Sustainable Development but also to employ that action-oriented, learner-centred, and transformative pedagogy (Rieckmann, 2018).

On these presuppositions, it is confirmed that another way of approaching ESD in the classroom is the Project Oriented Learning (POL) research methodology, which it is regarded as ideal for students to develop competencies for Sustainability (Leal Filho et al., 2016, as cited in Albareda-Tiana et al., 2018).

All in all, as the previous authors argued, both IBSE and POL are ideal methodologies by which ESD can be addressed in the classroom so that the students work on the development of Sustainability competencies that enable them to follow the path towards an appropriate Sustainability performance (see Table 1).

Table 1.

Main similarities between IBSE and POL

IBSE & POL
It is framed in a transformative, learner-centred, and action-oriented learning.
It contributes to develop scientific and Sustainability competences.
Question or problem to be solved

1.3. Relevant projects in the field of Education for Sustainable Development

The above sections set out the essential contents to be addressed and the appropriate methodologies to be used when implementing ESD in the classroom. However, this may not be enough to encourage other teachers to conduct projects or educational practices to promote ESD in schools. For this reason, it is appropriate to give some examples of relevant educational projects that are already being carried out in the field of the ESD.

Specifically, of all the existing projects, three have been chosen, thus covering three scales from larger to smaller:

The first, the SUSTAIN project, at the international level, chosen, among other reasons, because it relates ESD to scientific education and the methodology of IBSE, both previously identified as key pieces in ESD (Kotul'aková, 2016).

The second, Agenda 21 Escolar (A21E), at the national level, chosen mainly because it highlights another key element in ESD, the importance of coordination and collaboration of the entire educational community with other institutions to promote and increase participation in ESD (Gutiérrez Bastida, 2007).

The third and final example chosen, at the local level, is the *Red de escuelas sostenibles en Navarra*, as it highlights the importance of exchanging and sharing initiatives, successful educational practices, and experiences in the field of ESD between different educational institutions, such as schools, and teachers, another key piece in ESD (Departamento de Educación. Gobierno de Navarra, n.d.).

1.3.1. SUSTAIN project

In 2011 it was created La main à la pate, a foundation for scientific cooperation that was founded by the *Académie des Sciences and the Écoles Normales Supérieures* of Paris and Lyon. Its main objective was ''to improve the quality of science and technology teaching in primary and middle school. The common content and skills of these curricula favour a far-reaching impact and allow for the inclusion of equal opportunity initiatives'' (Foundation La main à la pâte, n.d.). In this sense, the main objective of the SUSTAIN project follows a line similar to that of the MDG and Sustainable Development Goals (SDG), which, in addition to scientific aspects, also pursue equity, quality education for all, and gender equality, among others (Loewe, 2012).

In addition, the foundation acts both nationally in France and internationally, advising teachers on their professional development and on the implementation of inquiry-based pedagogies. In this way, children's critical and analytical thinking is promoted, as well as a deeper understanding of the world around them.

In terms of its international actions, the foundation carries out several European projects; among them, it stands out the SUSTAIN project, launched in December 2013. One of its main goals is to demonstrate how the different topics on ESD can be addressed through IBSE. What is more, "SUSTAIN will build upon a well-established network of continuing professional development (CPD) providers who have already begun to link IBSE-based activities with citizenship, ethics, and responsibility issues'' (Foundation La main à la pâte, 2016).

SUSTAIN designed materials on three topics: food, energy, and everyday objects. The first topic, food, was chosen to help children reflect on the implicit values and attitudes in the composition, production, distribution, and consumption of different foods, thus connecting society, economy and the environment and improving their scientific knowledge.

The second topic, energy, was intended to broaden student's knowledge and understanding of topics as important for Sustainability as responsible energy consumption, renewable energy, or the restrictions in the use of fossil fuels…

The third topic, everyday objects, was thought for students to reflect on the life stories of these objects, which they normally take for granted. In this way, responsible consumption and the balance between the environment, society and economy is promoted.

In this sense, the main idea that defines the SUSTAIN project is the aspiration to explore:

> …the way IBSE can contribute to developing ESD: connecting more teachers and pupils with real life challenges and contemporary science; introducing topical issues related to science and technology, economy, culture, as they are debated in society; applying inquiry skills to issues related to Sustainability; connecting schools to the diversity of Sustainable Development stakeholders within the different communities. (Kotul'aková, 2016, p.6)

All in all, it is clear that the fact that there are international programs such as SUSTAIN, favours the training of teachers in ESD and in active methodologies such as inquiry-based education. In this way, also the quality of science teaching and the way ESD is taught in the classroom is improved.

1.3.2. Agenda 21 Escolar (A21E)

Although it is important, it is not enough just to provide training in ESD and active methodologies for teachers in different schools. For ESD to be truly effective, it is also necessary to establish policies that provide opportunities for local schools to assess their current situation and to be able to organise and implement a plan that works towards Sustainability, both at the centre level and in the community itself. For this, in addition, it is necessary the collaboration of schools with other external institutions. That is, innovative plans work when top-down and bottom-up innovations coincide, and one example of this is the A21E project.

As previously mentioned, Agenda 21 is a plan of action developed at the Earth Summit held in Rio de Janeiro in 1992. From among all the chapters of the agenda, number 36 is the one that makes special reference to Education:

> Chapter 36 of Agenda 21 clearly states that 'promoting education, public awareness and training are linked to virtually all areas in Agenda 21.' This signalled an important change in thinking related to environmental education and the start of merging various forms of education (i.e., environment, population, development, etc.) into a single, unifying concept, that of Education for Sustainable Development. (Leicht et al., 2018, p.28)

What is more, chapter 28 of the Agenda 21 includes Local Agenda 21 (LA21), which plays a key role in the local implementation of different Sustainability policies. That is, LA21 requires that all socioeconomic actors in the community participate in the establishment of environmental indicators

that serve to make a diagnosis of the environmental situation and from this, certain measures are agreed to help improve the situation and achieve an increasingly sustainable locality or region. Besides, "Agenda 21 aims to reach and mobilize people, in the knowledge that nothing is going to be achieved without a change of mentality and, in particular, without a change of attitude and conduct" (Echebarria et al., 2004, p.273).

In this sense, as Gutiérrez Bastida (2007) points out, it is in the union of both the ESD and the LA21 that the Agenda 21 Escolar (A21E) is framed. That is, from the consolidation of the different LA21 in different parts of the world, both at the local and regional level, the opportunity arises for schools to act in favour of Sustainability, not only at the internal level, but also in its nearest environment, by participating in municipal decision-making areas. In this way, "it opens a door for the experience of Sustainability and school participation to be transferred to society" (Gutiérrez Bastida, 2007, p.5).

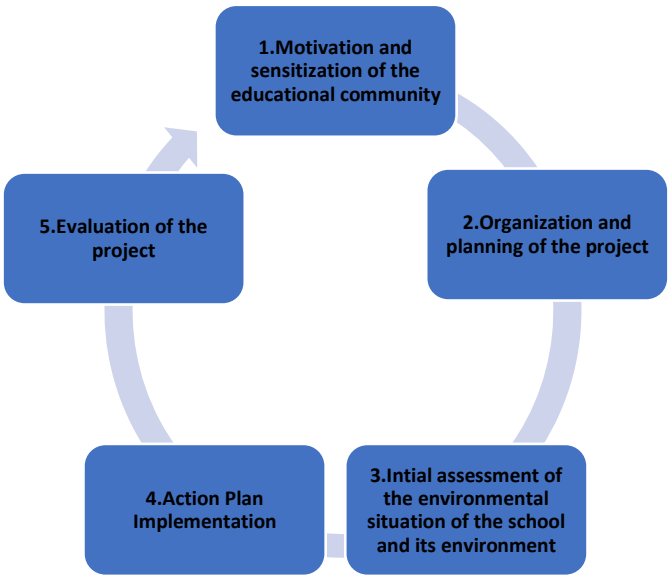
Specifically, A21E is a program that requires the entire educational community to engage and work to improve the environmental quality of both the school and its environment, thus advancing on the path to Sustainability. In Spain, several experiences of A21E have been carried out, concretely in Catalonia, Basque Country, *Galicia, Cantabria,* and *Valencia*, among others.

> As regards the main objectives of the programme, Gutiérrez Bastida (2007) stated as follows:
>
> Its objectives [...] are basically focused on raising awareness, in which the educational community reflects on its values and behaviours and on how to approach Sustainability, rethink the way of teaching, give prominence to students in decision-making about the centre, the environment and its teaching-learning process, promote collaboration between the school and institutions or other bodies, contribute to generating active citizenship, participate or even be a catalyst for citizen participation in the local community… (p.8)

The process of implementing the A21E generally consists of 5 phases which are summarised in Figure 4 below.

Figure 4.

Phases of Agenda 21 Escolar



To conclude, as Gutiérrez Bastida (2007) stated:

This program proposes a scaffolding for the construction of a permanent process (since it covers from childhood to maturity) in which pupils and educational communities become aware of their environment (school and local) and learn knowledge, values, skills, experience and also the determination to act, individually and collectively, in the resolution of present and future environmental problems of both the school and the locality. (p.15)

In conclusion, it is clear that thanks to programmes such as A21E, the establishment of Sustainability policies and the collaboration of different institutions is made possible, to launch ESD projects in schools and different communities.

1.3.3. Red de escuelas sostenibles en Navarra

In order for the aforementioned policies to materialize, they must be taken as their own by the agents of territory, who must bring together the political, social, and educational agenda. That is, we must think globally but act locally. In turn, for these changes to happen, it is essential that there is a network that serves as support, as is the case of the state network presented below:

In the 2012-13 academic year, the Spanish State created a state network of sustainable educational centres called *Escuelas hacia la Sostenibilidad en Red (ESenRED)* (School networks for Sustainability). This initiative is promoted by the public administrations and merges the views of the autonomous department of Education and the autonomous department of the Environment, with the purpose of being included in schools' daily life.

Furthermore, both the United Nations Educational, Scientific, and Cultural Organization (UNESCO) and the United Nations Environment Programme (UNEP) support ESenRED, and at the national level, the initiative has the support of the Centro Nacional de Innovación e Investigación Educativa (CNIIE), with which a collaboration agreement has been established. Specifically:

The network provides a framework for increasing the effectiveness and efficiency of education policies towards innovation, evaluation, quality, and Sustainability. It is also an ideal framework for strengthening the competence of students, their training in social and ethical values, and the assumption of individual and collective responsibilities and commitments (Departamento de Educación. Gobierno de Navarra, n.d.).

At the regional level, during the 2014-15 academic year, the Regional Community of Navarra created a network of sustainable schools to work together and share the educational experiences of each school, including the methodologies used and their specific projects. In this way, in addition to bringing together all the schools involved in this network of sustainable schools, fostering, and encouraging the exchange of initiatives and knowledge.

Currently in the Regional Community of Navarra, there are 10 schools participating in the Network of Sustainable Schools, among which are the following: *IESO Elortzibar, Iturrama BHI, IES Navarro Villoslada, IES Barañáin, CPEIP Gª Galdeano, CPEIP Doña Mayor de Navarra* and *CEE El Molino*, in *Pamplona*. In addition, *CEE Isterria in Ibero, IES Alhama* and *EAySD* in *Corella* (Departamento de Educación. Gobierno de Navarra, n.d.).

In this sense, it is important to highlight the key role that schools play in analysing and understanding environmental problems, thus forming spaces from which they promote, raise awareness, and motivate participation in environmental projects. In addition, it is essential to identify strategies for implementing both environmental improvements in the operation of the centre and projects for Sustainable Development.

Thus, it is clear that "the intervention from the transversality through the elaboration of an own educational project of each centre is the only way to obtain the necessary changes and to control the environmental deterioration'' (Departamento de Educación. Gobierno de Navarra, n.d.).

All in all, it is clear that in order to educate effectively on Sustainability, it is necessary to act at the three levels that each of the projects represents, respectively. In other words, firstly, in order to improve the quality of teaching in science and in ESD, the teacher training proposed by SUSTAIN is necessary, in such a way as to bring about a change from traditional pedagogies to more active and transformative pedagogies.

Second, in addition to teacher training, it is essential to establish sustainable policies that provide opportunities for carrying out projects in favour of Sustainability. In this case, projects such as

LA21E, favour this step to action and collaboration with other institutions outside the school but related to the community.

Third, the last piece that contributes to making the ESD effective is the dissemination of knowledge, made possible by projects such as *Red de escuelas sostenibles en Navarra.* Thanks to this project, the different projects in favour of Sustainability can be shared between different schools and institutions, serving as inspiration, and starting point for developing other similar projects in the field.

Finally, it is important to mention that in addition to these three levels, there is a last level of concreteness, which refers to the curriculum and the reality of each classroom, which undoubtedly has to be considered. No matter how much the institutions develop projects like those mentioned above, what really makes the difference is what happens inside the classroom, and this is where our proposal begins.

2. SCIENCE-IN-ACTION PROPOSAL

The following didactic proposal aims to answer the concerns expressed in the theoretical framework, building on the strategies unveiled therein. In this vein, the proposal enacts active methodologies to contribute to the development of competencies for Sustainability. In this sense, the proposal reflects that educating for Sustainable Development involves not only providing students with conceptual tools, but also empowering them and inciting them to action.

2.1. Objectives

General objectives:

- To develop a proposal to address Education for Sustainable Development in an Early Childhood Education Classroom.
- To create sustainable habits in students.

Specific objectives:

- To raise awareness of the importance of the care and conservation of the planet.
- To make students aware of the 4Rs rule for Sustainability: reduce, reuse, recycle, and rethink.
- To encourage the development of scientific competence and competencies for Sustainability (critical sense, reflection, research...).

2.2. Methods

2.2.1. Context and participants

This proposal takes place in a school located in Pamplona. In this educational centre, families' socioeconomic status is medium-high, and they are very committed to the education of their children, which has favoured and enabled the collaboration of these families at key moments of the proposal.

As for the classroom, it corresponds to the third year of Early Childhood Education and is formed by 24 students between 5 and 6 years old, which has also favoured the realization of this proposal, since at this age most children in this classroom are already able to read and write, and they also understand more complex concepts. What is more, of these 24 children, 3 of them receive support from the pedagogue, a fact that has been considered when designing the proposal, so that through the necessary resources and adaptations it is accessible to all students.

The classroom was not environmentally conscious. There were not only alternatives to use and throw, such as aluminium foil, showing total ignorance of other less polluting alternatives such as snack bags or bocn' rolls. The most worrying thing was that not even the most basic approach, recycling, was done correctly.

For these reasons, it was necessary to work on the issue of the 4Rs of the environment in this classroom but changing the usual order in which they are presented. That is, instead of doing so by its usual order of importance (reduce, rethink, reuse, recycle), they are presented starting from and emphasizing the most basic R, recycling, and continuing with others that besides having more impact on the environment, also require a greater commitment to the environment, such as reducing and rethinking.

2.2.2. Questions and instruments

Evidence has been gathered both during and after the proposal, for assessing, respectively, the level of achievement while the proposal is being carried out and longer-term impact.

2.2.2.1 Internal indicators: during the proposal.

Several indicators served to ascertain whether the activities had had the desired impact. The information collected included previous knowledge on each of the 4Rs that could be compared with the final productions, and evidence of achievement of the specific objectives targeted by each activity.

As for the instruments, direct observation, and oral questions - aided by photographs and observation sheets - were the main source of data, together with poster boards created with the students (see Table 2).

Table 2.

Internal indicators and instruments of the proposal

Phase/Activity	Indicator/ Targeted knowledge	Instruments
Discussion about the 4Rs of the environment	Previous knowledge	Oral questions and poster boards
Recycle - Introductory	Whether the children dispose of the garbage correctly or not	Direct observation and photographs
Recycle - Follow up		Direct observation and observation sheet
Recycle - Closing	Whether the posters from the recycling corner are helpful or not	Direct observation and photographs
Reuse	Ideas on how they can reuse some materials	Direct observation and observation sheet
Reduce	Amount of aluminium foil reduced	Two collections of aluminium foil and comparison of the amount collected before and after having created reusable snack bags
Rethink	Final and bigger ideas	Oral questions and poster boards

2.2.2.2 External indicators: after the proposal.

To verify whether the proposal has had a positive impact on learning and on the creation of sustainable habits in children, these indicators need to be measured after some time after the proposal has been finalised.

At the qualitative level, the indicators that have prevailed are, on the one hand, their sustainable attitudes, and the tendency to choose to reduce rather than reuse or recycle, and, on the other hand, the acceptance, and the positive and proactive attitude towards recycling.

At the quantitative level, the indicators that demonstrate this positive impact of the proposal are, firstly, the level of success in recycling (i.e., the number of times they throw the garbage in the right container), secondly, the number of times that students make use of toys made with reused

materials in the following weeks after they were created, and thirdly, the reduction in the amount of aluminium foil produced.

To measure all this, the main instruments that will be used are observation without them being aware and log sheets and tables with the indicators previously mentioned.

As for the span of the observation, it should be noted that the above-mentioned indicators are measured, after completion of the proposal, for approximately one month.

2.3. Description of the proposal

2.3.1. Curricular objectives

While targeting the acquisition of skills for Sustainability by students, this proposal also contributes to the development of the following objectives established by the curriculum of the second cycle of Early Childhood Education in Navarra, approved in Foral Decree 23/2007 of 19 March (Departamento de Educación. Gobierno de Navarra, 2007):

- CO1: Carry out, in an increasingly autonomous way, routine activities and simple tasks to solve problems of daily life, increasing the feeling of self-confidence and the capacity for initiative, and developing strategies to meet their basic needs.
- CO2: Actively observe and explore their environment, generating interpretations about some significant situations and events and showing interest in them.
- CO3: To start in the mathematical skills, manipulating functionally elements and collections, identifying their attributes and qualities, and establishing relationships of groupings, classification, order, and quantification.
- CO4: To know and value the basic components of the natural environment and some of its relationships, changes, and transformations, developing attitudes of care, respect, and responsibility in its conservation, taking as reference the landscapes of the Autonomous Community of Navarra.

2.3.2. Activities

The proposal included 13 activities (see Annexe 1), to be carried out for 6 weeks. After an introduction activity that serves as contextualization of the topic, the following activities are carried out in increasing order of complexity: Recycle, Reuse, Reduce and Rethink. Each activity aims to achieve distinct objectives, in terms of competences, and also distinct key conceptual ideas (see Table 3).

Table 3.

Summary of activities

W	SESSION	ACTIVITY	OBJECTIVES	KEY CONCEPTS
1	INTRODUCTION			
	Session 1 - 22/02/21 (*)	1- Too much trash on our planet	To become aware of the amount of waste produced and the consequences for the planet To think of possible solutions	Excessive waste produced by humans damage the environment
	RECYCLE			
	Session 2 - 22/02/21	2- Let's recycle	To understand the concept of recycling To know the types of residues ad associate with the right container	Recycling is the process of collecting and processing materials to turn them into new products There are 6 types of containers, each associated with a residue: paper, glass...
	Session 3 - 24/02/21	3- Recycling competition		
	Session 4 - 25/02/21	4- Our Recycling corner	To create a dedicated corner for recycle To acquire sustainable habits	
	Session 5 - 25/02/21			
2	REUSE			
	Session 6 - 1/03/21	5- How can we reuse this?	To know the life cycle of everyday objects To envisage new uses for used materials and objects	Reuse means giving an object or material a second life Reuse has priority over recycling
	Session 7 - 2/03/21	6- Let's reuse	To become aware of the possibility of giving objects a second life To acquire sustainable habits	
	Session 8 - 3/03/21	7- Let's play with	To become aware of the possibility of giving objects a second life	Reusing is useful and sustainable

		reusable toys	To acquire sustainable habits	
	REDUCE			
	Session 9 - 4/03/21 (*)	8- Let's reduce: how much aluminium foil?	To measure and register the amount of aluminium foil produced in a week To understand what "reduce" is and its importance for the planet	Reduce means using fewer products Reducing has priority over reusing
		9- What will decompose first in soil?	To predict what elements will decompose first in soil To collect data about what elements decompose first and last in soil To understand why aluminium foil is harmful to the planet To observe and understand that the nature of a material determines its decomposition and the effect it has on the environment	Unlike natural elements, artificial materials take a long term to decompose and thus pollute, as in the case of aluminium foil
3	ALUMINIUM FOIL COLLECTION			
4	Session 10 - 15/03/21 (*)	9- What will decompose first in soil?	(see 9)	(see 9)
		10- How much aluminium foil?	To measure and register of the amount of aluminium foil produced in a week To search for a sustainable solution that reduces the amount of aluminium produced	Aluminium foil pollutes the environment, so it is important to avoid its consumption
	Session 11 - 16/03/21	11- Let's create our		Aluminium foil is harmful to the planet

	Session 12 - 17/03/21	snack bags	To create reusable and sustainable snack bags to avoid the use of aluminium foil To acquire sustainable habits	and there are more sustainable reusable options that reduce its consumption
5	ALUMINIUM FOIL COLLECTION			
6	RETHINK			
	Session 13 - 30/03/21	12- Aluminium foil comparison	To check if the use of reusable snack bags has managed to reduce the amount of aluminium foil produced or not To acquire sustainable habits	We are agents of change, every little action counts. Rethink about the impact of our actions on the environment
		13- Let's Rethink	To review the most important concepts that have been addressed throughout the proposal To rethink critically about the impact of their own actions on the environment	

Note: *Each session takes 45 min except from the first (20') and the ninth and tenth ones (1h05').

3. RESULTADOS

En lo que respecta a los resultados de la propuesta, destacan los siguientes:

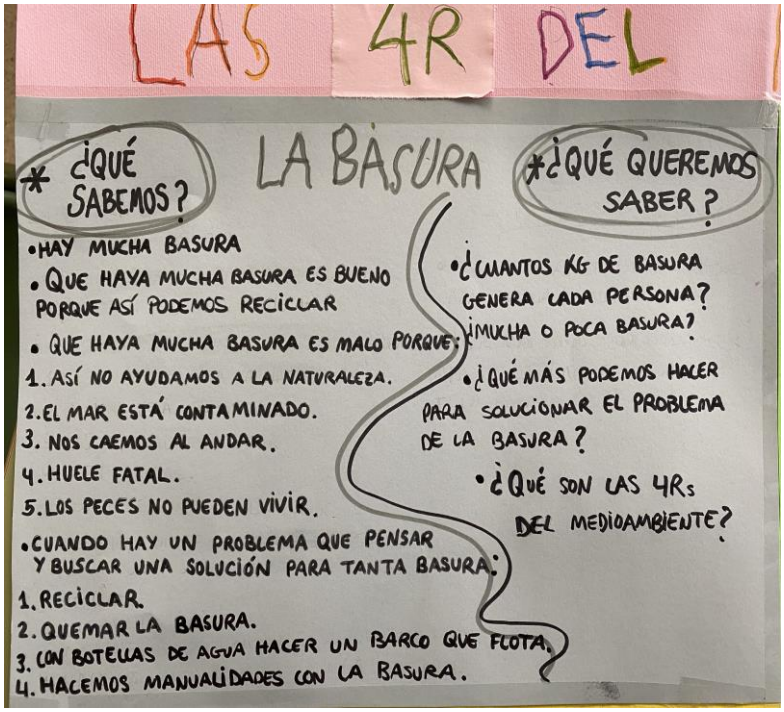
3.1. Las 4Rs del medioambiente

3.1.1. Introducción

En primer lugar, mientras la mayoría del alumnado era consciente de que la gran cantidad de basura que generamos es un problema para el medioambiente ya que contamina el planeta, es también cierto que ningún alumno o alumna conocía las 4Rs del medioambiente, eje principal de la propuesta (ver Figura 5).

Figura 5.

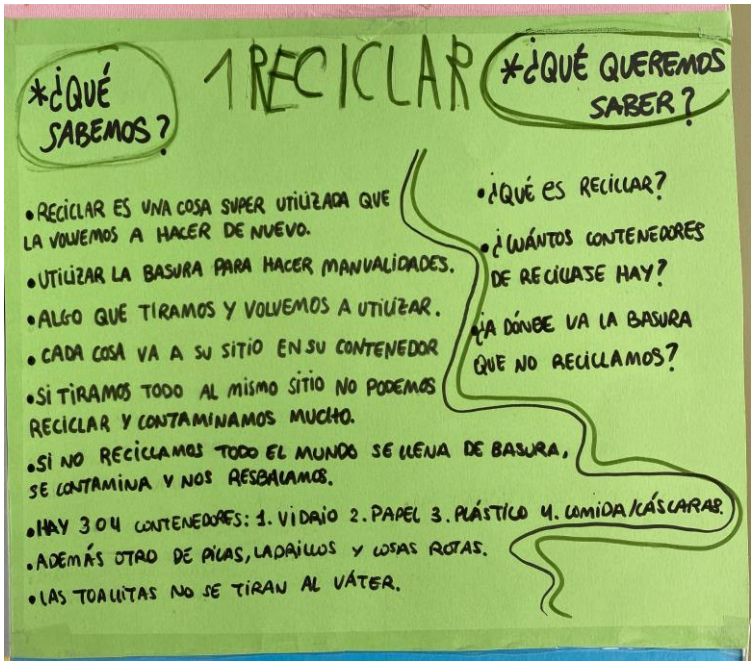
Póster de ideas previas sobre la actividad introductoria



En segundo lugar, queda claro que, en un principio, la mayor parte del alumnado no tenía hábitos de reciclaje, incluso algunos alumnos y alumnas lo confundían con reutilizar y no tenían claro su significado, mientras que sí tenían claro su importancia para no contaminar el planeta (ver Figura 6).

Figura 6.

Póster de ideas previas sobre el reciclaje



3.1.2. Reciclar

Aunque la mayoría de los alumnos y alumnas conocía el contenedor de papel, el del plástico, el de vidrio, y, en algunos casos, “el de las cáscaras’’ (orgánico), a la hora de reciclar, la mayoría de los alumnos y las alumnas dudaba y no tenía claro dónde debía depositar cada residuo. Concretamente, encontraban menos dificultad a la hora de reciclar el papel, y la ropa y el calzado (tras conocer su existencia), y más dificultad al reciclar las latas, los briks, y al tener que diferenciar los residuos que van al contenedor de resto (verde oscuro) y al orgánico (marrón) (ver Figura 7).

Figura 7.

Actividad inicial sobre el reciclaje

Para seguir afianzando estos conceptos sobre el reciclaje, se realizó una competición (ver Figura 8), en la que les siguió resultando fácil decidir dónde depositar los papeles, los cartones, la ropa, y el calzado, y mejoraron a la hora de clasificar el vidrio y el plástico, pero siguieron teniendo dificultades a la hora de diferenciar los residuos de los contenedores de resto y orgánico.

Figura 8.

Competición del reciclaje

Como ya se menciona, a pesar de haber trabajado el reciclaje en las diferentes actividades (act. 2-4), se observó que el alumnado aún seguía teniendo algunas dificultades a la hora de clasificar ciertos residuos, por lo que crearon, como parte del rincón de reciclaje del aula, unos posters de ayuda y consulta (ver Figura 9). Estos posters, fueron sin duda de gran ayuda al alumnado a la hora de desarrollar unos buenos hábitos de reciclaje.

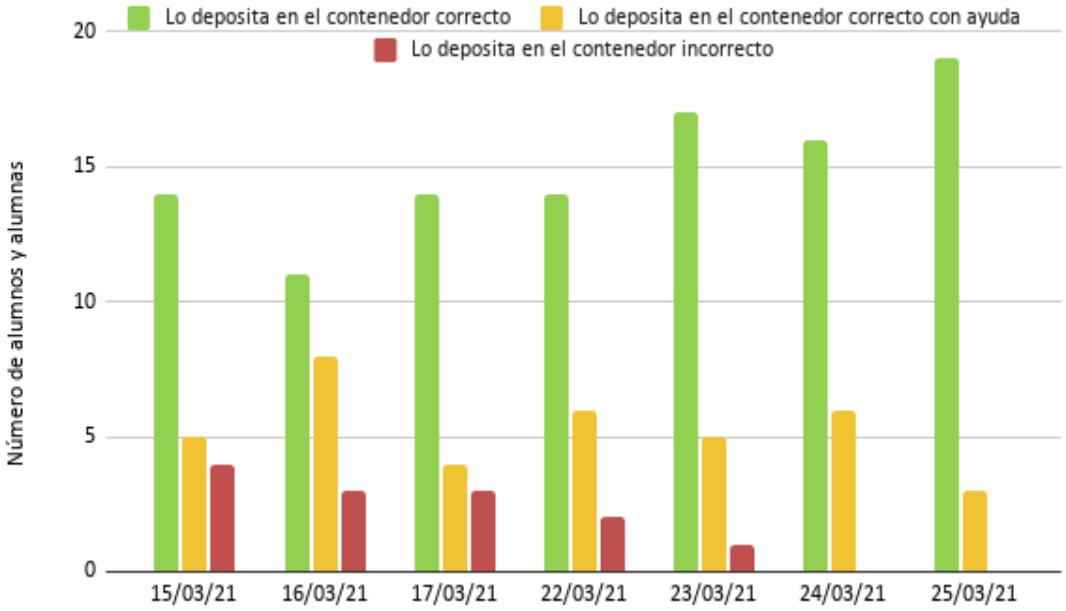
Figura 9.

Posters de ayuda y consulta del rincón del reciclaje

Es decir, tras observar sus hábitos de reciclaje durante una semana, una vez finalizada la propuesta y sin que ellos fueran conscientes, quedó patente que había ocurrido una mejora. Más de la mitad de los alumnos y alumnas fueron capaces de depositar correctamente los residuos en los tres contenedores instalados (papel, plástico, orgánico), mientras que un 20% lo hizo con ayuda, y sólo un 15% cometió errores (ver Figura 10). Cuando tenían dudas los alumnos y alumnas se valieron de los carteles instalados en el rincón de reciclaje, o se ayudaron entre ellos, de modo que al cabo de una semana el número de alumnos que depositaba los residuos adecuadamente había escalado hasta el 85%, y en los dos últimos días de recogida de datos nadie se equivocó.

Figura 10.

Registro del nivel de acierto y error al reciclar



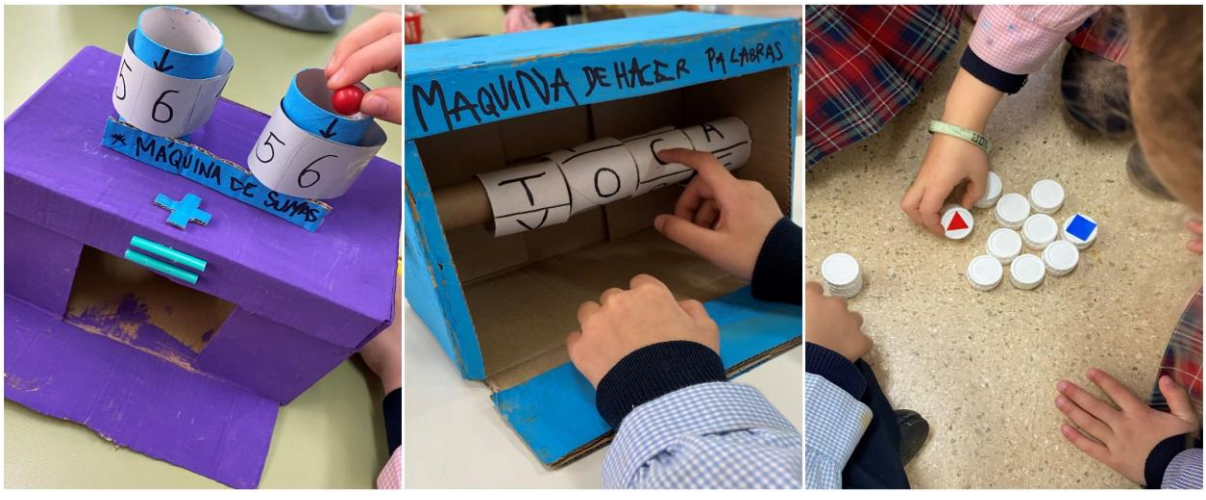
3.1.3. Reutilizar

En tercer lugar, los resultados de la R de reutilizar demuestran que sucede justo lo contrario a lo que sucede con la R de reciclar. Es decir, desde un principio el alumnado conocía el significado de reutilizar e incluso estaba habituado a reutilizar mucho más que a reciclar, reducir o repensar, por lo que se les ocurrían bastantes ideas sobre cómo reutilizar los materiales que se les presentaron.

Concretamente, se crearon cinco juguetes "educativos" que tuvieran una utilidad práctica en el aula, como una máquina de sumas para trabajar las habilidades matemáticas, una máquina de hacer palabras para trabajar la lectoescritura, o un juego para trabajar la memoria, entre otros (ver Figura 11).

Figura 11.

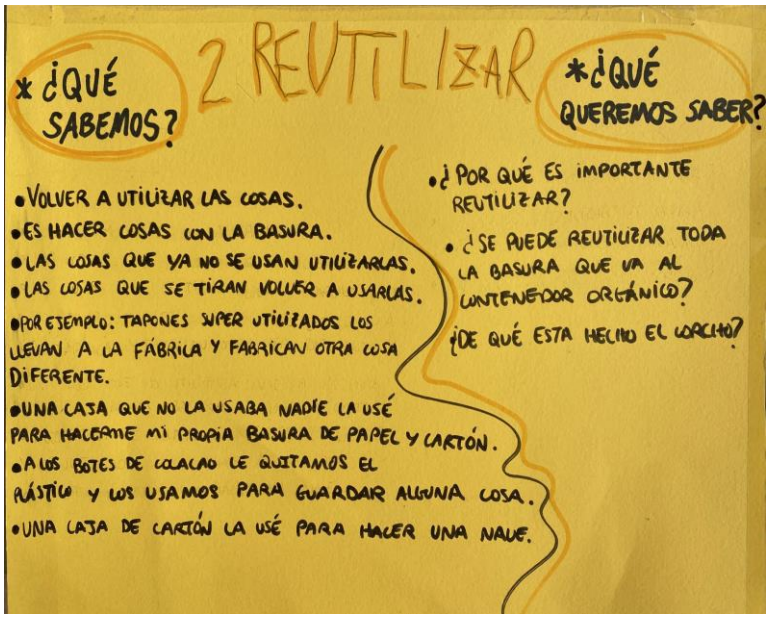
Ejemplos de juguetes creados con materiales reutilizados



A pesar de conocer muy bien el significado de reutilizar, el alumnado desconocía su importancia para el planeta. Es decir, los alumnos y las alumnas no asociaban la acción de reutilizar con una reducción directa de los residuos generados (ver Figura 12).

Figura 12.

Poster de ideas previas sobre Reutilizar



Tras finalizar la propuesta, habiendo creado varios juegos con materiales reutilizados, y habiéndoles explicado lo importante que es reutilizar para el planeta, los resultados obtenidos a partir de las preguntas orales y la observación son muy positivos, ya que la mayoría del alumnado acaba siendo consciente de que reutilizar es una manera de evitar la generación de más basura para el planeta, incluso un alumno o alumna concreta señaló que había reutilizado una caja de cartón en casa para crear una basura de papel en su cuarto.

En cuanto a los juguetes hechos con materiales reutilizados, se observa que, aunque al principio los niños y las niñas jugaban con ellos en sus ratos de juego libre, al poco tiempo dejaron de utilizarlos. Esto se debe, tanto a la naturaleza de los propios juguetes, como a la manera en la que están planteados sus ratos de juego libre. Es decir, estos ratos son considerados por los alumnos y las alumnas como una recompensa a un trabajo previo, más duro y menos divertido, de matemáticas o lectoescritura, entre otros. Por esto mismo, el carácter educativo, y no lúdico, de la mayoría de los juguetes creados, no incentivaba su uso durante estos ratos, sino que, solo eran utilizados de vez en cuando como apoyo o refuerzo en ciertas actividades.

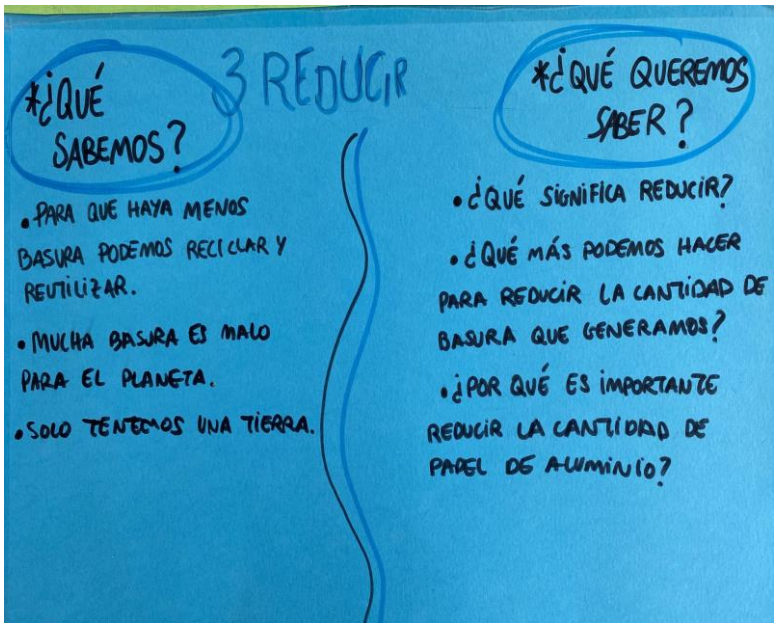
3.1.4. Reducir

En cuarto lugar, queda claro que, a pesar de ser la R de reducir la que más impacto positivo tiene en el planeta, el alumnado nunca la había puesto en práctica conscientemente, ya que

desconocía por completo su significado, y, por tanto, también la importancia que esta tiene para el cuidado del medioambiente. Sin embargo, tras explicarles tanto su significado como su importancia para el planeta, y preguntarles qué residuo podríamos reducir en clase en la hora de los almuerzos, los propios alumnos y alumnas fueron conscientes de que el papel de aluminio era uno de los residuos que tenían que reducir, aunque no supieron justificar por qué era importante hacerlo (ver Figura 13).

Figura 13.

Poster ideas previas reducir.



3.1.4.1. Actividad de indagación: ¿qué se descompondrá antes en la tierra?

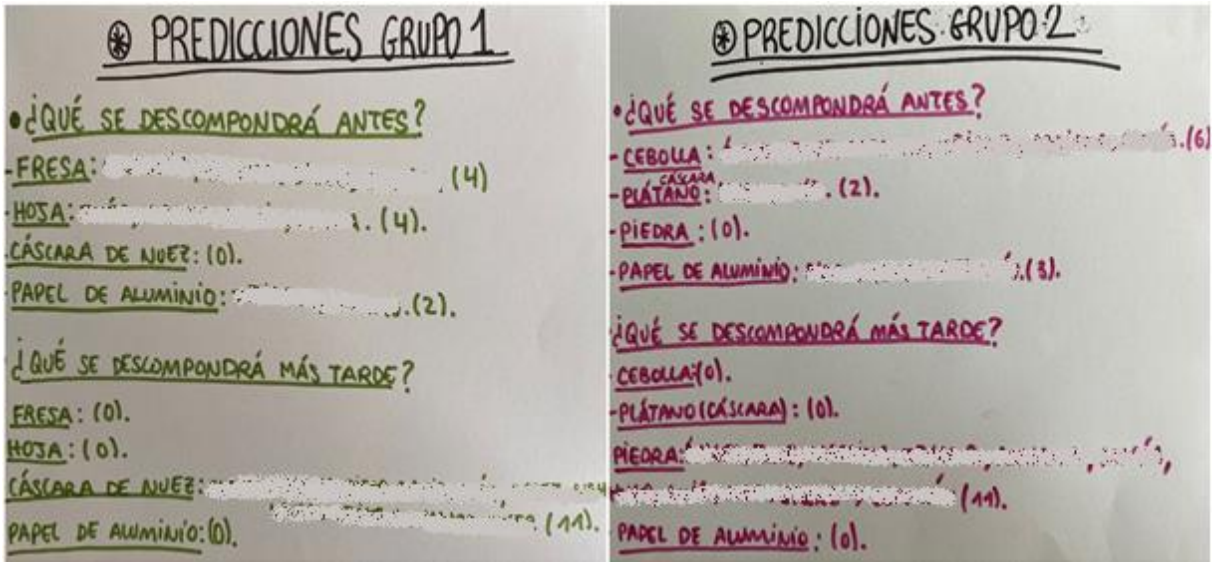
Para que los alumnos y las alumnas conocieran la razón por la cual es importante reducir la cantidad de papel de aluminio producida, o, en otras palabras, para que entendieran por qué el papel de aluminio es perjudicial para el planeta, se realizó una actividad de indagación en la que comprobaron que ciertos materiales (artificiales), como el papel de aluminio, no se degradan.

Concretamente, en cuanto a los resultados obtenidos de las predicciones que los alumnos y las alumnas realizaron acerca de qué material se iba a descomponer primero en la tierra, destacan los siguientes:

La mayor parte del alumnado coincidió en que los elementos que creían que más iban a tardar en descomponerse serían la piedra y la nuez, ya que eran las más duras. Sin embargo, sorprendió que, aunque en este caso no supieron justificar su elección, varios alumnos y alumnas señalaran el papel de aluminio como el elemento que se iba a descomponer primero, y nadie lo marcó como último (ver Figura 14). Es decir, queda claro cómo los alumnos y las alumnas, a la hora de decidir, se guiaron por "dureza" o capacidad de mantener su forma, no por naturaleza orgánica o inorgánica del material.

Figura 14.

Predicciones



Tras haber guardado en tierra los diferentes materiales que cada grupo decidió, se observó que, finalmente, la fresa fue la primera en descomponerse, seguida de la cebolla, el plátano y la hoja. A su vez, el papel de aluminio y la piedra no mostraron cambio alguno, seguidos de la cáscara de nuez, que solo estaba ligeramente más marrón (ver Figura 15).

Figura 15.

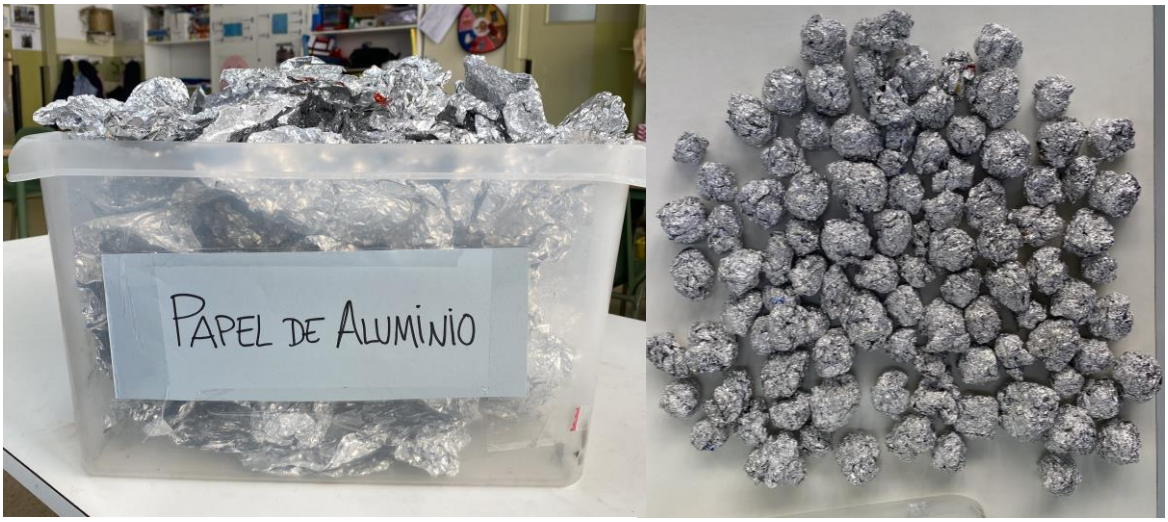
Materiales grupo 1 y 2 tras 12 días guardados en tierra

Tras finalizar la actividad de indagación y sus correspondientes explicaciones, las respuestas a las preguntas orales realizadas al alumnado demuestran que este terminó siendo muy consciente de que el papel de aluminio era uno de los elementos que más tardaría en descomponerse al ser artificial, y que por tanto era muy perjudicial para el medioambiente.

Además, gracias a la recogida de papel de aluminio que se estaba realizando al mismo tiempo que la actividad de indagación, los alumnos y las alumnas pudieron observar no solo lo perjudicial que el papel de aluminio era para el planeta, sino que en clase se producía una cantidad ingente de este, y que por tanto era necesario reducirla (ver Figura 16).

Figura 16.

Cantidad de papel de aluminio recogida durante 5 días



3.1.4.2. Creación de las bolsas de snack reutilizables.

Una vez que el alumnado era consciente de que se tenía que reducir la cantidad de papel de aluminio generada en el aula, se decidió crear bolsas de snacks reutilizables (Annexe 2). Para crearlas, se les pidió a los alumnos y las alumnas que trajeran sus propias camisetas viejas blancas, para así, no sólo reutilizarlas en lugar de comprarlas, tal y como habíamos defendido previamente, sino también para involucrar más al alumnado y las familias en el proceso de creación de las bolsas. Cabe destacar la buena respuesta de las familias ante la petición de colaboración y el disfrute del alumnado durante la decoración de sus camisetas (ver Figura 17) y posterior creación de una bolsa como ejemplo.

Figura 17.

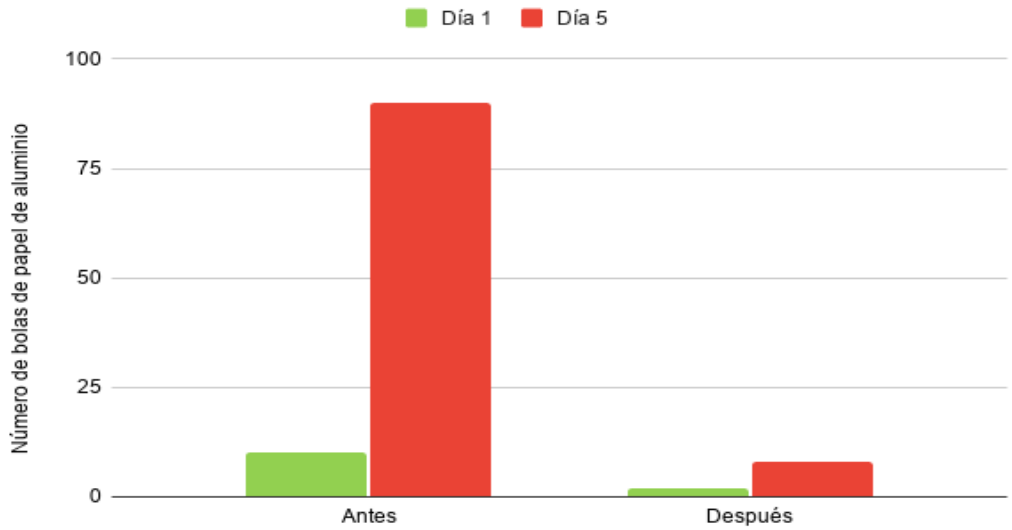
Alumnado decorando sus bolsas de snack reutilizables

En cuanto a los resultados obtenidos tras la creación de las bolsas de snack reutilizables, cuyo principal objetivo era reducir el papel de aluminio en los almuerzos, destacamos los siguientes:

En la primera recogida de papel de aluminio, antes de la creación de las bolsas de snack reutilizables, se obtuvieron 90 bolas de papel de aluminio, una cantidad bastante considerable. Mientras que, en la segunda recogida de papel de aluminio, que se realizó tras comenzar a utilizar las bolsas de snack reutilizables, y siendo ya conscientes de lo perjudicial que era el papel de aluminio para el planeta, únicamente se obtuvieron 8 bolas de papel de aluminio (ver Figura 18). Esto es, sin duda, una diferencia muy positiva que evidencia el cumplimiento del objetivo que se pretendía conseguir con la realización de las bolsas de snacks reutilizables, reducir la cantidad de papel de aluminio de los almuerzos.

Figura 18.

Comparación recogidas de papel de aluminio antes y después de crear bolsas de snacks reutilizables



3.1.5. Repensar

Los resultados obtenidos de la última R, repensar, demuestran que, desde un principio, la mayoría de alumnado fue consciente de su significado meramente literal, volver a pensar, pero no de su importancia y relación con el planeta y el medioambiente, entendible debido a la edad de los alumnos y las alumnas.

Sin embargo, tras las explicaciones pertinentes, las preguntas orales que se les realizaron a los alumnos y las alumnas acerca de cada una de las 4Rs del medioambiente arrojan evidencias muy positivas. A partir de sus respuestas, se observa cómo gran parte del alumnado había interiorizado las ideas más importantes de cada una de las 4Rs, incluida esta última, la de repensar.

Concretamente, un alumno o alumna señaló lo siguiente: “No sólo tienes que pensar en ti si quieres un juguete, también tienes que pensar en el planeta y que igual si lo compramos se puede morir el planeta, y este es el único planeta que tenemos, no hay ninguno más’’. Este comentario,

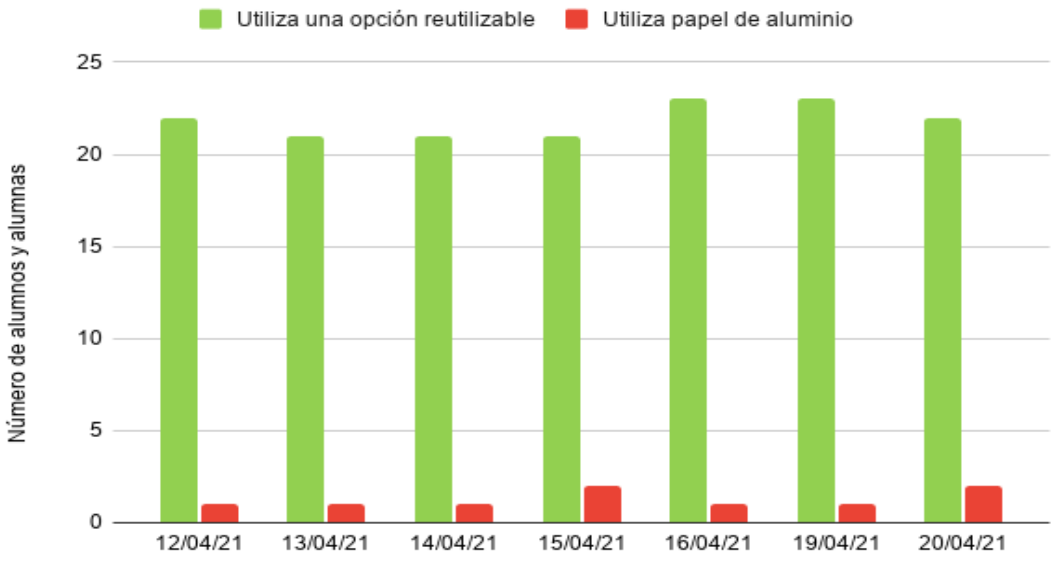
además de demostrar la interiorización de contenidos como la importancia de reutilizar antes que comprar para así reducir, demuestra también la adquisición de competencias para la sostenibilidad por parte de este alumno o alumna. Por un lado, la competencia anticipatoria, que le permite imaginar diferentes tipos de futuro teniendo en cuenta las consecuencias de nuestras acciones presentes, y por otro la competencia normativa, por la que es capaz de reflexionar y pensar de manera crítica acerca de sus propias acciones y las consecuencias que estas conllevan para el planeta.

3.1.6. Adquisición de hábitos sostenibles.

Dos semanas después de haber finalizado la propuesta, tras observar de nuevo al alumnado, pero sin que este fuera consciente de ello, se obtuvieron también resultados muy positivos, ya que la gran mayoría de los alumnos y las alumnas continuaban utilizando sus bolsas de snack reutilizables u otras alternativas sostenibles que evitaran el uso del papel de aluminio, mientras que sólo 1 o 2 alumnos o alumnas traían, esporádicamente, papel de aluminio (ver Figura 19).

Figura 19.

Uso de opciones reutilizables vs. papel de aluminio



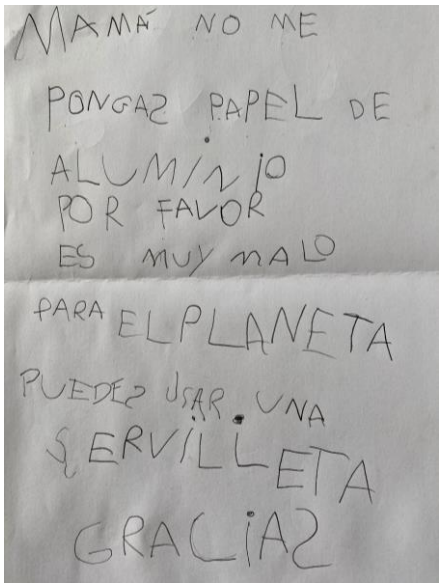
Además de esto, una vez finalizada la propuesta también se registraron anécdotas y comentarios que los alumnos y las alumnas hacían, de manera espontánea, acerca de temas relacionados con la propuesta y los hábitos sostenibles. Concretamente destacan dos:

Alumno o alumna 1: “Mira Natalia, mi padre me había puesto papel de aluminio en el bocata dentro de la bolsita, pero yo le he dicho que lo quitara y lo metiera sin papel de aluminio dentro de la bolsita’’.

Alumno o alumna 2: “Natalia, mi madre me ha puesto papel de aluminio, yo sé que está mal, pero se me olvida, vamos a escribirle una nota y se la doy y así no se me olvida’’ (ver Figura 20).

Figura 20.

Nota de alumna para su madre



Estas evidencias, demuestran la adquisición de competencias para la sostenibilidad por parte del alumnado, siendo capaces tanto de pensar de manera crítica sobre sus acciones, las de los demás y las consecuencias que estas tienen para el medioambiente, como de pensar y llevar a cabo soluciones o alternativas que eviten que esas acciones sucedan. Es decir, más allá de interiorizar la teoría, también queda claro que, los alumnos y las alumnas han adquirido hábitos sostenibles que les han convertido en auténticos y auténticas agentes del cambio.

En conclusión, tanto las evidencias recogidas durante la propuesta, como las recogidas tras finalizar la propuesta, no sólo demuestran los hábitos sostenibles y competencias que el alumnado ha adquirido, sino también el impacto tan positivo que estos hábitos han supuesto para el medioambiente al haber conseguido reducir la gran cantidad de papel de aluminio que era generada en el aula.

4. DISCUSSION

From the beginning, it is clear that the discourse that advocates the care and conservation of the environment is already widespread in society, most students have this in mind. However, the mere knowledge of this discourse does not imply changes in the way students act, who does not consider the consequences of their actions, nor the fact that these are related to the previously mentioned discourse. In other words, they do not take responsibility for the current climate emergency that we are experiencing, since it is easier to perceive and discuss the problems globally rather than engaging with the locals, and thus forgetting that change begins to be built from the base, acting locally (Ferdig, 2007; Tilbury et al., 2003).

Although it is true that, once the proposal has been carried out, the students are more aware of the importance of care and conservation of the environment. In addition to more verbalizing the discourse (you have to recycle, you have to take care of the planet...), students carry out actions consistent with it, such as reusing a cardboard box for use as a recycle bin, or ensuring that in class it is recycled properly, among others. For this reason, it can be said, firstly, that the proposal has been effective in creating and strengthening the consciousness of students, and, secondly, more importantly, the proposal has provided students with tools for action in relation to the 4Rs of the environment.

Firstly, with regard to recycling, and as already mentioned in the results, the students ended up being aware of the six containers that exist and the waste that must be deposited in each of them. So much so that, it has shown a remarkable and sustained evolution over time when it comes to correctly classifying waste, going from having two bins in class to classifying the waste well into four different bins.

Secondly, in terms of reducing, it is worth noting again the success of the initiative of reusable snack bags carried out. Thanks to this initiative, the amount of aluminium foil generated was reduced to a minimum, at least during the first few weeks, demonstrating the acquisition of sustainable habits by students and generating a very positive impact on the environment, at least for now.

Thirdly, as for rethinking, evidence has also been previously shown to demonstrate how students have developed Sustainability competencies that have allowed them to reflect and think critically about their own actions, those of others and the consequences they have, both in the short and long term, for the environment. In this way, coinciding with the ideas of Rieckmann (2018), it can be said that one of the main objectives of ESD is fulfilled.

In addition to the above, there is also evidence that some students have internalized the importance of the order in which these 4Rs are usually presented (rethink, reduce, reuse, recycle). That is, the verbal productions of students show that they are clear that the most important thing is to reduce the amount of garbage produced or avoid generating it (make a toy with reused materials instead of buying a new one, for example).

In this sense, there is no doubt that, although it must be contextualized and it would be necessary to measure it when more time has passed, it has been possible to move from theory to action, thus coinciding with the idea that several authors, previously cited, have about what ESD is for them (Mckeown et al. 2002; Kotul'aková, 2016; Leicht, Combes & Byun, 2018).

The fact that all this has been possible is probably due to several factors, both contextual and methodological.

On the one hand, the context in which the proposal has been carried out has been fun and novel for the students, both for the topic and the activities carried out, and for the fact that it was a

new trainee teacher who directed these activities. In addition, the fact that it was fun and innovative has made students motivated and therefore increase their attention in activities and encourage their learning. In other words, by gamifying the activities the students have become more involved in the proposal and in addition to having fun they have improved their learning on the topic, and they have been initiated in the process of acquisition of sustainable competencies (Kiryakova et al., 2013).

On the other hand, the methodological approach of the proposal has also made possible the transition from theory to action and the consequent creation of sustainable habits in students, since it has made them active participants in their own learning. That is, it is clear that, as Hazelkorn (2015) defends, active methodologies are key to educating in competencies, both scientific and for Sustainability, being this, in addition, the only way to achieve enriching results.

Specifically in this proposal, no activity has been designed solely for the mere development of "manual" skills, as it may seem in the creation of posters, games made with reused materials or reusable snack bags. These action-oriented activities also contribute to the development of competencies for Sustainability, such as strategic competence, which, as Rieckmann (2018) holds, allows students to collaborate and innovate together to promote sustainable alternatives such as reusable snack bags, for example .

Another of the competencies for Sustainability that Rieckmann (2018) establishes and that students have managed to develop after the proposal is systemic thinking. Thanks to the inquiry activity, the students realized, to a certain extent, how much the aluminium foil persists in the ground, and that therefore, it pollutes. In this way, students are aware that their actions have consequences on the environment, and therefore on others, thus encouraging the adoption of a more holistic view of reality and awakening in them the desire to change it.

This research activity has also played a very important role in helping students to compare their previous ideas with the finals, in order to form more "big" and precise ideas (Harlen, 2013). In addition, in carrying out this activity, students have developed anticipatory competence, as they have had to predict, and imagine possible scenarios and situations, as well as different solutions for the care of the planet, as the creation of reusable snack bags (Rieckmann, 2018).

With this, it is clear that, coinciding with the ideas of Kotul'aková (2016), inquiry-based education combines perfectly with ESD, since both share values such as innovation, creativity, action-oriented learning, or critical thinking, among others. However, it is important to point out that they are not equivalent, so for this combination to be possible an appropriate theme and ethical orientation must be chosen. In this sense, there are several projects that have already focused on developing teaching materials that combine both approaches, including the STELR Project http://www.stelr.org.au, the National Geographic Society https://www.nationalgeographic.org/, the

Science NetLinks (AAS) http://sciencenetlinks.com/, or the SUSTAIN Project https://www.fondation-lamap.org/en/sustain previously mentioned, among others.

These share values, moreover, are also promoted, in large part, by including the fourth R, rethinking. Although not all authors explicitly include this fourth R, in this proposal is considered an essential part, since, as already mentioned, in order for students to become agents of change, it must happen, first, a change in their understanding of environmental discourse. Not only is it enough for students to bear the discourse in mind, but it is necessary to reflect on it and the relationship it has with their actions.

For all this, it is believed that this proposal can serve as inspiration to propose effective didactic proposals in the field of ESD, highlighting, mainly, the following strengths.

First of all, it is clear that early Childhood Education pupils are potential agents of change who have played an active role in the proposal, not only in the discourse, but they have also been mentally involved. Second, students have begun to acquire competencies for Sustainability, which is a lifelong task, and thirdly, they have also acquired sustainable habits that have had a positive impact not only on them but also on the environment. Finally, all of the above has been carried out through active methodologies such as inquiry-based learning, among others.

Of course, the proposal also has its limitations, since, in the first place, it has been carried out at the same time as other projects and activities of the centre, being unable to devote all the time and attention to this single issue. For this very reason, among others, it has been necessary to decide which aspects were given the highest priority, and to set others aside, despite being important.

Concretely, coinciding with the ideas that authors such as Klarin (2018) or Alhaddi (2015) maintain, Sustainable Development implies the integration of the environmental, social, and economic sphere. However, due to the age of the student body and the given context, it has been decided to prioritize and focus the proposal on the environmental dimension, the most basic, but also very urgent (MDG #7). If it had been an older student body, it would have been interesting to integrate the three pillars of Sustainability, for example, to analyse the full life cycle of products.

Another important limitation is due to the fact that child practices are influenced by, or in other words, depend on, the adult world. That is, on the one hand, the cleaning service of the centre, who was in charge of emptying the bins of each class, did not have the habit of recycling, but of disposing all the waste into the same container. On the other hand, some of the students' families did not give importance to, or prioritized, recycling or waste reduction, so they continued to wrap their children's lunches in aluminium foil. For this reason, although it is clear that many times generating a positive impact on the environment does not depend on students or teachers, this should not stop us, we must continue trying to move forward more and more (Ferdig, 2007).

Regarding the sustainable habits mentioned, it should also be noted that to see if they have actually been acquired or not by the students, it is necessary to measure them more in the long term, something that due to time constraints has not been possible. That is, although all efforts have been made in the right direction, it would be pretentious to say that the habits and competences of students have been influenced to the extent that it really impacts their future actions and decision-making. The latter, coincides with what several authors, previously cited, point out as one of the main objectives of ESD (Ransey, 1993; Bingle & Gaskell, 1994; Cross & Yager, 1998; as cited in España & Prieto, 2004).

In short, it is clear that, despite having certain limitations, the present proposal addressed from the framework of ESD, has achieved that Early Childhood Education pupils not only learn and internalize concepts about the 4 Rs of the environment, but, for the moment, the students have also been equipped with the necessary tools and skills to act in accordance with the discourse of care and conservation of the environment. And we must not forget that, as Bell (2016) said:

> Teaching and teachers do have an important role in supporting the requisite Sustainability learning process, but their principal role is no longer simply to transmit knowledge to students. Education is not about filling a pail it is about lighting a fire. (p.52)

CONCLUSIONS AND OPEN QUESTIONS

Firstly, it is clear that the issue that this proposal advocates, Sustainability and care and conservation of the environment, is urgent and needs to be addressed in the classrooms as soon as possible. However, it has been observed that in terms of Sustainability, something as basic as recycling correctly has not yet been achieved. For this reason, it is necessary to start from the very basics, but always aspiring to reach the top, as reflected in this proposal, which starts from the most basic R, recycling, to the most complex ones, such as reducing and rethinking.

Secondly, in addition to starting from the most basic, it is also possible and necessary to begin to raise awareness and provide students with tools from an early age. It is possible for pre-school pupils to participate in educational proposals in favour of Sustainable Development, they are capable of internalising concepts, developing awareness, and then turning all of these outwards in the form of actions that generate a positive impact on the environment. Pre-school pupils are undoubtedly potential agents of change.

Thirdly, it is also clear that for pupils to become agents of change, it is not enough just to pass on knowledge and raise awareness of environmental care and conservation. In addition to this, it is also essential to provide them with action-oriented learning, to carry out didactic proposals through active methodologies that teach them and help them to reflect, construct and contrast their ideas, to carry out sustainable actions...

Fourthly, with regard to the development of competences for Sustainability in pupils, it can be said that although it has not been a great advance, some progress has been made. In other words, we must bear in mind that it is not possible to be fully competent from one day to the next; the acquisition of competences is a lifelong task. For this reason, although the pupils have not fully acquired all the competences for Sustainability, they have started and made progress in the process of acquiring these competences.

Fifthly, it should be noted that the proposal has been effective not only in initiating pupils in the competences for Sustainability, but also that they have acquired, at least for the time being, sustainable habits. These sustainable habits have meant that the proposal has not been limited to the school context but has also had a favourable impact on the environment, with actions such as recycling or reducing aluminium foil, among others.

Sixthly, we must also be aware that although these practices have an impact on the environment, it is a small impact. These practices are limited, as children, due to their young age, depend on the context, they depend on the adult world, in which there are inertias that are difficult to break. But this should not stop us, the important thing is to start, and as already mentioned, even if it is complex, we must start from the basics, but always with the intention of reaching the top.

Finally, as a result of this proposal, it would be worth considering the option of developing future proposals that are, firstly, more ambitious, so that they not only take into account the environmental sphere, but also the social and economic spheres, and, secondly, that are more long-term in nature, in order to ensure that the achievements obtained are real and lasting over time.

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ANNEXES

Annexe 1: Tables of the activities developed in depth

Activity 1: Too much trash on our planet		
Class organization	**Materials**	**Timing**
Big group - Assembly	Garbage can Scale Computer Digital display	½ session (20 min)
Objectives		
To become aware of the amount of waste produced and the consequences for the planet To think of possible solutions		
Curricular objectives		
CO2,CO3		
Sustainable competencies		
Anticipatory competency Normative competency Self-awareness competency		
Key concepts		
Excessive waste produced by humans damage the environment		
Activity development		
First of all, as an introduction, I take the garbage from the class, and I ask the students different questions to stimulate their previous knowledge, such as, for example: What is this? What is inside? Do you have one like it at home? Etc. Then, I ask them the following question: did you know that specifically in Spain each person generates a total of approximately 500 kilos of waste per year? Imagine if we multiply it for all the people who live in society. It is a lot, isn't it? Because the numbers are so high that they are not meaningful at that age, I take a scale and I weigh the garbage we have in class, and for example, if it weighed about 2 kg, equivalent weight to that of a hen, I would search the internet for a picture of almost 250 hens and I would show it to them, so they could imagine as much garbage as hens were in the picture. In this way, it would be easier and more meaningful for them to imagine the 500kg of garbage. Finally, to reflect before presenting the 4Rs of the environment I ask them the following questions and we discuss them together: Is it good that people generate so much garbage or is it a problem? Why? Is it a problem that we must try to solve all together or not? How can we solve it?		

What can we do with so much garbage? What can we do to reduce the amount of garbage we generate?

After their answers, and once they are recorded in a mural, I present the 4Rs of the environment to them: Recycle, reuse, reduce, and rethink.

<table>
<tr><th colspan="3">Activity 2: Let's recycle</th></tr>
<tr><th>Class organization</th><th>Materials</th><th>Timing</th></tr>
<tr><td>Big group - assembly</td><td>Waste (aluminium foil, empty yogurt cans, newspaper, clean food remains…)
6 plasticized images of containers
Computer
Digital display
Video</td><td>1 session (45 min)</td></tr>
<tr><th colspan="3">Objectives</th></tr>
<tr><td colspan="3">To understand the concept of recycling
To know the types of residues ad associate with the right container</td></tr>
<tr><th colspan="3">Curricular objectives</th></tr>
<tr><td colspan="3">CO1, CO2</td></tr>
<tr><th colspan="3">Sustainable competences</th></tr>
<tr><td colspan="3">Anticipatory competency
Normative competency
Self-awareness competency</td></tr>
<tr><th colspan="3">Key concepts</th></tr>
<tr><td colspan="3">Recycling is the process of collecting and processing materials to turn them into new products
There are 6 types of containers, each associated with a residue: paper, glass...</td></tr>
<tr><th colspan="3">Activity development</th></tr>
<tr><td colspan="3">Once the topic and the 4 Rs of the environment are introduced to the children, I start with the R of recycling.
First, I ask them some questions to activate their previous knowledge and I wrote their answers on a mural: What does recycle consist of? Do you recycle at home? And at the school? Is it important to recycle? Why?
Then, I take some pieces of garbage (aluminium foil, empty yogurt cans, pieces of newspaper, "clean" food remains (clean eggshells, nutshells...) and I ask them, in turn, to put them next to the image of the container that they think is appropriate. Once all the waste is classified, I put a video of the Mancomunidad de Pamplona in which an ant tells a short story in which it clearly explains the basic rules of recycling and why it is important to do so.
After a first visualization and a subsequent joint reflection, we put the video again to finish strengthening the knowledge it transmits.</td></tr>
</table>

Finally, after viewing the video, we resume the classification of waste, but this time, as they have already learned to recycle, they have to correct the classification they made before watching the video in case they have deposited some residue next to the wrong container.

<table>
<tr><th colspan="3">Activity 3: Recycling competition</th></tr>
<tr><th>Class organization</th><th>Materials</th><th>Timing</th></tr>
<tr><td>Small groups - 4 groups of 6 students each</td><td>Roulette
Waste images
Pushbuttons
6 plasticized images of containers</td><td>1 session (45 min)</td></tr>
<tr><th colspan="3">Objectives</th></tr>
<tr><td colspan="3">To understand the concept of recycling
To know the types of residues ad associate with the right container</td></tr>
<tr><th colspan="3">Curricular Objectives</th></tr>
<tr><td colspan="3">CO1, CO3</td></tr>
<tr><th colspan="3">Sustainable Competences</th></tr>
<tr><td colspan="3">Critical thinking competency
Self-awareness competency</td></tr>
<tr><th colspan="3">Key concepts</th></tr>
<tr><td colspan="3">Recycling is the process of collecting and processing materials to turn them into new products
There are 6 types of containers, each associated with a residue: paper, glass...</td></tr>
<tr><th colspan="3">Activity development</th></tr>
<tr><td colspan="3">After introducing them the term of recycling and its main norms, I prepare a recycling competition game, which consists of the following:
First, as a way of introducing the activity to the children, I show them an example of the 6 different waste items that can be picked out on the roulette (paper, plastic, glass, organic, rest, and clothes), and their containers with the corresponding names (one by one). After, I ask the children to raise their hands when they have read all the containers' names and they know which is each one (in this way, you give time for everyone to think and strive to read, so that those who are faster do not give the rest of the children the solution). In addition, I show them the pushbuttons and their colours, so they understand that they are associated with the containers' colours.
Once the activity is introduced, the game begins. A member of a team pulls the roulette, takes the image of the waste, and says aloud what it is. Then, the members of each group think together with their group where they think they should deposit that residue, and then, only one member of the group get up and go to press the button of the corresponding container (i.e., if it is</td></tr>
</table>

the image of a newspaper, they will have to push the blue button, corresponding to the container of paper and cardboard).

The team that does it correctly gets a point, and so on. The team that gets the most points is the winner.

<table>
<tr><th colspan="3">Activity 4: Our recycling corner</th></tr>
<tr><th>Class organization</th><th>Materials</th><th>Timing</th></tr>
<tr><td>Small groups - 4 groups of 6 students each</td><td>4 cardboards (green, brown, blue, and yellow)
Waste images
Coloured markers
Pencils
Scissors
Glues
4 bins
4 bin bags
Lunch waste</td><td>2 sessions (45 min each)</td></tr>
<tr><th colspan="3">Objectives</th></tr>
<tr><td colspan="3">To create a dedicated corner for recycle
To acquire sustainable habits</td></tr>
<tr><th colspan="3">Curricular objectives</th></tr>
<tr><td colspan="3">CO1, CO3</td></tr>
<tr><th colspan="3">Sustainable competences</th></tr>
<tr><td colspan="3">Critical thinking competency
Self-awareness competency</td></tr>
<tr><th colspan="3">Key concepts</th></tr>
<tr><td colspan="3">Recycling is the process of collecting and processing materials to turn them into new products
There are 6 types of containers, each associated with a residue: paper, glass...</td></tr>
<tr><th colspan="3">Activity development</th></tr>
<tr><td colspan="3">For this last activity on the topic of recycling, we create our recycling corner in the classroom.
First of all, four working groups are formed and each one is responsible for creating the poster of one of the containers: plastic, paper and cardboard, rest and organic (we do not add the container of glass and clothing because in an Early Childhood Education class such waste is not generated). Moreover, each group is also responsible for putting a bag of its own colour in the trash can.
On the poster they have to write the name of the container and also paste examples of the waste we can throw into each container, so that, when it comes to recycling, if they have doubts,</td></tr>
</table>

the poster can help them. What is more, I create pictograms to help children with SEN, and the groups that finish first, will help to create the label on which ''our recycling corner' is written.

In addition to creating our recycling corner, that day I will ask them to leave the leftovers of the lunches on a table instead of throwing them in the trash, so that once we have the corner of recycling created, by turns, they would already recycle their own leftovers from the lunches.

Activity 5: How can we reuse this?		
Class organization	**Materials**	**Timing**
Big group - assembly	Waste and different materials NT Preschool Science Games	1 session (45 min)
Objectives		
To know the life cycle of everyday objects To envisage new uses for used materials and objects		
Curricular objectives		
CO2, CO4		
Sustainable competences		
Systems thinking competency Self-awareness competency		
Key concepts		
Reuse means giving an object or material a second life Reuse has priority over recycling		
Activity development		
First, to introduce students to the new topic, reuse, I ask them a series of questions to help them activate their previous knowledge and I also write their answers on a mural: What does reuse consist of? Do you reuse at home? And at the school? Why is it important to reuse? Then, once the topic is introduced, I place the materials in the middle of the big group of children sitting in a circle. Next, the children have to select an item from the middle of the circle and answer questions like, 'What object is it? What is it made of? What is it used for?' (it is important to ensure that each child has a turn to share an idea). Once all the students have participated, I choose one particular object and explain to the children that it could be reused to make something new. Specifically, I will give them some examples: A cardboard cereal box could be used to make a paper bin or a book organizer. Finally, I invite the children to take the object they took in the first round of questions, but this time, once I have already given them the above example, I ask them the following question: 'How can you reuse that object?' That is, I encourage the students to suggest a new use for the object they selected and to discuss all their ideas together (I will also write them down in a mural).		

<table>
<tr><th colspan="3">Activity 6: Let's reuse</th></tr>
<tr><th>Class organization</th><th>Materials</th><th>Timing</th></tr>
<tr><td>Small groups - 4 groups of 6 students each</td><td>Cork stoppers
Eva rubber
Milk bricks plugs
Cardboard plates
Cardboard boxes
Cardboard rolls
Tempera paint
Paintbrushes
Rollers
Glue
Scissors
Punches
Markers
Stickers
Plastic straws</td><td>1 session (45 min)</td></tr>
<tr><th colspan="3">Objectives</th></tr>
<tr><td colspan="3">To become aware of the possibility of giving objects a second life
To acquire sustainable habits</td></tr>
<tr><th colspan="3">Curricular objectives</th></tr>
<tr><td colspan="3">CO1</td></tr>
<tr><th colspan="3">Sustainable competences</th></tr>
<tr><td colspan="3">Systems thinking competency
Self-awareness competency
Strategic competency</td></tr>
<tr><th colspan="3">Key concepts</th></tr>
<tr><td colspan="3">Reuse means giving an object or material a second life
Reuse has priority over recycling</td></tr>
<tr><th colspan="3">Activity development</th></tr>
<tr><td colspan="3">This activity consists of each group of the 4 that are formed reusing some of the materials that we have already talked about in the previous activity, to create something useful for the class.</td></tr>
</table>

One of the groups creates seals with cork stoppers, EVA, and glue. They first have to cut the shapes they want from EVA and then glue them to one end of the cork stoppers. In this way, they would have several stamps to print and make drawings and paintings.

Another group creates a disc throwing game, with cardboard plates, a cardboard roll and paint. To do this, they first have to punch the centre of the plates to form the discs and they also have to use one of the leftover pieces from the centre of the plates as a base to glue the cardboard tube through which the discs they throw must enter. Then, they have to paint everything to give it a more cheerful and personalized touch.

The next group creates a memory game with milk bricks plugs and different shapes and colours of stickers. This same group also paints an addition machine that I have previously prepared with a cardboard box, two cardboard rolls and plastic straws.

And finally, the remaining group paints and customizes a word-making machine that I have also prepared previously with a cardboard box and a cardboard tube.

<table>
<tr><th colspan="3">Activity 7: Let's play with reusable toys</th></tr>
<tr><th>Class organization</th><th>Materials</th><th>Timing</th></tr>
<tr><td>Small groups - 4 groups of 6 students each.</td><td>Seals
Disc throwing game
Memory game
Addition machine
Word-making machine</td><td>1 session (45 min)</td></tr>
<tr><th colspan="3">Objectives</th></tr>
<tr><td colspan="3">To become aware of the possibility of giving objects a second life
To acquire sustainable habits</td></tr>
<tr><th colspan="3">Curricular objectives</th></tr>
<tr><td colspan="3">CO1</td></tr>
<tr><th colspan="3">Sustainable competences</th></tr>
<tr><td colspan="3">Systems thinking competency
Self-awareness competency
Strategic competency</td></tr>
<tr><th colspan="3">Key concepts</th></tr>
<tr><td colspan="3">Reusing is useful and sustainable</td></tr>
<tr><th colspan="3">Activity development</th></tr>
<tr><td colspan="3">After having made the five reusable toys, the next day, I will show the students the materials each group has created, they will share each other's opinions and reflections. Also, the students will be able to play with the materials and I will leave them in a specific corner of the class for the students to play whenever they want.</td></tr>
</table>

Activity 8: Let's reduce: how much aluminium foil?		
Class organization	**Materials**	**Timing**
Big group - assembly	Container Aluminium foil Cardboard Pencil	½ Session (20 min)
Objectives		
To understand what "reduce" is and its importance for the planet To measure and register the amount of aluminium foil produced in a week		
Curricular objectives		
CO2,C03		
Sustainable competences		
Anticipatory competency Critical thinking competency Self-awareness competency		
Key concepts		
Reduce means using fewer products Reducing has priority over reusing		
Activity development		
First of all, to introduce the R of reducing students, I will ask them questions that help stimulate their previous knowledge such as the following: what is reducing? Do you try to reduce waste at home? and at school? Why is it essential to reduce waste? I will write all their ideas on the mural of previous ideas. Next, I will ask them to think about some waste or material that they generate in class and that they have to reduce their production because it is bad for the environment. I'll guide them with clues like, for example, "you use it to wrap up some of their lunches''. Having come up with the solution (aluminium foil) and talking about this and the damage it does to the environment, I will ask them, firstly, if they know how much aluminium foil they generate in class in a week, and secondly, why they think aluminium foil is so bad. Finally, as most of them probably do not have a clear and more or less accurate answer to the previous two questions, I will suggest them to pick up aluminium foil for a week so as to see how much they generate, and also, to understand why aluminium foil is so bad, I'm going to present them with an inquiry activity called "what will decompose first in soil?".		

<table>
<tr><th colspan="3">Activity 9: What will decompose first in soil?</th></tr>
<tr><th>Class organization</th><th>Materials</th><th>Timing</th></tr>
<tr><td>Big groups - 2 groups of 12 students each</td><td>Ziploc bags
Soil
Scale
Water
Half an onion
The peel of a banana
A strawberry
A leaf
A stone
A nutshell
Aluminium foil
Cardboard
Pencils</td><td>2 sessions (45 min each)</td></tr>
<tr><th colspan="3">Objectives</th></tr>
<tr><td colspan="3">To predict what elements will decompose first in soil
To collect data about what elements decompose first and last in soil
To understand why aluminium foil is harmful to the planet
To observe and understand that the nature of a material determines its decomposition and the effect it has on the environment</td></tr>
<tr><th colspan="3">Curricular objectives</th></tr>
<tr><td colspan="3">CO2, CO3</td></tr>
<tr><th colspan="3">Sustainable competences</th></tr>
<tr><td colspan="3">Anticipatory competency
Critical thinking competency</td></tr>
<tr><th colspan="3">Key concepts</th></tr>
<tr><td colspan="3">Unlike natural elements, artificial materials take a long term to decompose and thus pollute, as in the case of aluminium foil</td></tr>
<tr><th colspan="3">Activity development</th></tr>
<tr><td colspan="3">New experience / Motivation
Firstly, as a way of presenting and introducing the topic to the children, I show them some pictures of some compost bins and I ask them some attention-focusing questions, such as: Do you</td></tr>
</table>

know what that is? Have you ever seen one? Where? What do you see inside it? How does it look? How do you think it smells?

From that first contact with the compost, a lot of questions will emerge, and they will serve to set out the problematic scenario.

The last part of this motivation activity consists of exploring freely the materials I will have brought to class (Ziploc bags, soil, organic matter, aluminium foil, stones…) so as to promote curiosity among the children.

Possible explanation and prediction

In the second part of the activity, after the free exploration, I let the students choose, among all the materials, the ones they want to try and investigate.

The activity as such, is based on some action questions about the materials they have explored, such as: what would happen if I put that material in the soil? Which of them will decompose first, the aluminium foil or the onion? That is, based on the previous knowledge that they have rekindled in the motivation activity around the compost, we start with more specific and direct questions.

They know from the previous situation, that some materials, when mixing them with soil, disappear or change their appearance (because of what they had seen in the compost). However, some of the questions that can emerge are: what materials decompose, and which ones don't? and how fast do they do it? In that way, the inquiry sequence continued with the students starting to make predictions, that were recorded in a cardboard, and their own possible explanations about the given materials and the following question: What will decompose first in soil?

Research

So as to begin with the research activity, I divide the students into two different groups (12 students per group), and I give four different materials to each of the two groups. The only material that the two groups will have in common is the aluminium foil. The rest of the materials, in spite of being different, I will consciously give them the ones that experience similar changes when decomposing. That is, I will give a group the banana (that gets brown when decomposing), the onion (that gets mushy), the rock (that stills the same despite being natural), and the aluminium foil (that remains the same because of being artificial). And I will give the other group the leaf (it turns brown), the strawberry (it gets mushy), the nutshell (it still the same despite being natural), and the aluminium foil (it remains the same since it is artificial).

Once each group has its own materials and the Ziploc bag, I let them introduce the different materials on it, and then, we pour some water on the bags so as to help the decomposition of the materials.

Then, we let the materials one week in class so as to enable decomposition, and children will be able each day to observe the changes that the materials have experimented with. In order to record these changes, we will create a decomposition diary, in which every day, one student has to write down the changes that have occurred in the materials, or if on the contrary, they remain the same as at the beginning.

Results

After having let the materials decompose for one week, in another session, we take them, and we observe the results. That is, what has happened, and which ones have decomposed first. In that way, the students will be able to compare the results with their own previous predictions and explanations.

In that part of the activity, the type of questions that are made to the children so as to promote critical thinking are comparison and reasoning questions, such as: How are these the same or different? Has it changed a lot or is it still the same? Why do you think that one has decomposed first? What is your reason for it? Can you invent a rule for what has happened in both terrariums to the materials?

Conclusions

Finally, after having compared their predictions with the results, and inventing their own rules and reasons to explain what has happened, together with my help, they will reach some conclusions. What is more, these final conclusions will lead to some bigger ideas (existing and previous ones that had evolved to a more accurate one).

For instance, as they had observed that the aluminium foil still the same, while the onion and the strawberry (among others), have decomposed, they arrived at the following bigger idea: the majority of the natural materials decompose while artificial ones still the same. That is, in this way, they realized that aluminium foil is very harmful to the planet because, among other things, it is artificial, and not only contaminates at the time of producing it, as a student very well pointed out, but also takes a long time to decompose in the earth, thus polluting the environment.

Activity 10: How much aluminium foil?		
Class organization	**Materials**	**Timing**
Big group- Assembly	Aluminium foil container	½ session (20 min)
Objectives		
To measure and register of the amount of aluminium foil produced in a week To search for a sustainable solution that reduces the amount of aluminium produced		
Curricular objectives		
CO2, CO3		
Sustainable competences		
Anticipatory Competency Self-awareness competency Strategic competency		
Key concepts		
Aluminium foil pollutes the environment, so it is important to avoid its consumption		
Activity development		
Once students have understood why aluminium foil is harmful to the planet and have collected, for a week, aluminium foil, it is time to count how many pieces of aluminium foil have been collected. For this, we first make balls of aluminium foil with each of the pieces, and then, the students sit in a circle and I show them the container full of aluminium foil to reflect on the amount collected. Realizing that there is a lot of aluminium foil, and already knowing how bad it is for the environment, children will be asked to think and share different ways to replace aluminium foil with other more sustainable alternatives to avoid its use.		

<table>
<tr><th colspan="3">Activity 11: Let's create our snack bags</th></tr>
<tr><th>Class organization</th><th>Materials</th><th>Timing</th></tr>
<tr><td>Small groups - 4 groups of 6 students each</td><td>Cardboard
Scissors
Pencils
T-shirts or old fabrics
Textile markers
Food plastic
Textile glue
Tweezers
Adhesive velcro</td><td>2 Sessions (45 min each)</td></tr>
<tr><th colspan="3">Objectives</th></tr>
<tr><td colspan="3">To create reusable and sustainable snack bags to avoid the use of aluminium foil
To acquire sustainable habits</td></tr>
<tr><th colspan="3">Curricular objectives</th></tr>
<tr><td colspan="3">CO1</td></tr>
<tr><th colspan="3">Sustainable competences</th></tr>
<tr><td colspan="3">Integrated problem-solving competency</td></tr>
<tr><th colspan="3">Key concepts</th></tr>
<tr><td colspan="3">Aluminium foil is harmful to the planet and there are more sustainable reusable options that reduce its consumption</td></tr>
<tr><th colspan="3">Activity development</th></tr>
<tr><td colspan="3">To do this, I write an email to the families asking for their collaboration so that the children would bring to class old T-shirts or fabrics they have left over, and I buy the food plastic, the textile markers, and the textile glue.
Once we have all the materials, the first step is to create the templates of the piece of fabric and plastic that we need, and once this is ready, we start to cut the T-shirts (we cut some of them in class so they can see the process and can be involved, but the rest of the T-shirts and pieces of plastic I cut them myself, because due to the limitation of the time there is, it is not possible to cut them all in class.
Once all the T-shirts are cut, the next step is to paint and customize their pieces of fabric with the textile markers.
Finally, I will make a whole snack bag with the children, so that although each one can does not make his bag for lack of time, in that way they are equally participants, and they can realize how</td></tr>
</table>

one snack bag is made. In different groups they glue the fabric to the plastic, they make hems, they put tweezers to fix the glue, they put the velcro... And all together they create a snack bag (I will do the rest of them at home, Annexe 2).

Once I have all the snack bags ready (see Annexe 2), I give them to each of the children. In addition, we will collect aluminium foil again for a week, to see if they really reduce the use of aluminium foil thanks to the use of the reusable snack bags or not.

Activity 12: Aluminium foil comparison		
Class organization	**Materials**	**Timing**
Big group - Assembly	Aluminium foil container Photographs of the previous aluminium foil collection	½ session (15 min)
Objectives		
To check if the use of reusable snack bags has managed to reduce the amount of aluminium foil produced or not To acquire sustainable habits		
Curricular objectives		
CO2, CO3		
Sustainable competences		
Self-awareness competency		
Key concepts		
We are agents of change, every little action counts Rethink about the impact of our actions on the environment		
Activity development		
After the second collection of aluminium foil, carried out at the same time that the students used their reusable snack bags, it is time to count again the aluminium foil balls collected throughout the week. For this, I show the students, who are sitting on a circle, the container with the amount of aluminium foil collected, and photos of the container from the previous aluminium foil collection, so that they compare the quantities of aluminium foil of both collections. In this way, children are aware that thanks to the creation and use of reusable snack bags, the amount of aluminium foil has been greatly reduced and so they are helping the planet.		

Activity 13: Let's rethink		
Class organization	**Materials**	**Timing**
Big group - assembly	A cardboard Pencils Markers	½ session (30 min)
Objectives		
To review the most important concepts that have been addressed throughout the proposal To rethink critically about the impact of their own actions on the environment		
Curricular objectives		
CO2		
Sustainable competences		
Systems thinking competency Anticipatory competency Normative competency Critical-thinking competency Self-awareness competency		
Key concepts		
We are agents of change, every little action counts Rethink about the impact of our actions on the environment		
Activity development		
First, I present the latest R of the environment, Rethink. To learn about it I ask several questions: What is rethinking? Why is it important to think before you act? and after? Why is it important to think before you throw something away into the trash? Why is it important to think before buying something? What are the consequences of our actions for the planet? After answering all the previous questions and understanding the most important ideas, we go on to ''rethink'' about the whole proposal of the 4Rs of the environment, and this concludes it. For this, students sit in a circle and we will remember among all the most important ideas and concepts they have learned throughout the proposal. That is, I will ask the students the following questions about the first R: What do you remember about recycling? What is it? Why is it important? How many recycling bins are there? Then, I will ask the students the following questions about the second R: What do you remember about reusing? What is it? Why is it important? Finally, I will also ask the students several questions about the third R: What do you remember about reducing? What is it? Why is it important? What can we do to reduce the amount		

of garbage we generate? And to reduce aluminium foil? Why is it important to reduce the amount of aluminium foil? Why is aluminium foil harmful to the environment? I will write all their answers and reflections on a mural.

Annexe 2: Reusable snack bags examples