EcoCEO™: Understand the Circular Economy by Playing

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Abstract

While Europe is working on the transition toward a more sustainable business model, concepts such as linear and circular economy are rarely dealt with in secondary schools. Here we present an educational game, ecoCEO™, that aims to transfer knowledge about circular economy and sustainable entrepreneurship in a hands-on and fun way. During the game, players act as Chief Executive Officer (CEO) of a company that extracts raw materials and produces microchips. They are asked to make decisions on employees' allocation, resource management, production processes, investment strategies and revenue models. EcoCEO™ has been developed in the framework of the project "SmartPlaCE@Schools - Serious game Platform for education on Circular Economy in high schools" funded by the European Institute for Innovation and Technology (EIT RawMaterials). It is a useful tool for making youngsters aware of the complexity and interrelation of economy with environmental sustainability issues and with the benefits of closing material loops. By playing it, students from high schools get to know concepts such as critical raw materials, recycling, take-back systems, reuse and repair activities. Furthermore, they are induced to practice discussion and trading to reach shared decisions. The gaming approach introduces students to these matters in an interactive, enjoyable and self-explanatory way, motivating them to delve even deeper into the raw materials sector and the circular economy autonomously or by using the educational materials that SmartPlaCE makes available to them and to their teachers.

Keywords: *gamification, circular economy, raw materials, secondary school.*

1. Introduction

The current business models are largely inspired to the linear economy but this approach is proving to have unsustainable costs from social and environmental points of view. Linear economy follows the 'take-make-dispose' approach: it takes resources from the ground to make products which the consumers purchase and, when they no longer want them, they throw them away. This model is based on the assumption that natural resources are endless and easy to source while the waste is cheap to dispose of. The shortage of some raw materials and the occurrence of some pollution-related diseases showed that this model is no longer working for businesses, people, and the environment. Those are the reasons why the European Union is planning a radical shift from linear to circular economy.

The Ellen MacArthur Foundation defines circular economy as a way to maintain the utility and value of products, components and materials as longer as possible. It minimizes the need for new inputs of materials and energy, while reducing environmental pressures linked to resource extraction, gas emissions and waste disposal. This goes beyond just waste, requiring that natural resources are managed efficiently and sustainably throughout their life cycles [1]. Underpinned by a transition to renewable energy sources, the circular model is expected to built economic, natural, and social capital, providing opportunities to create well-being, growth and jobs, while reducing environmental pressure [2]. The transition from the current linear economy to a more circular one needs drastic changes in the way we look at products and in awareness on raw material limits, motivating and spurring for a new entrepreneurial thinking.

To achieve circular economy, bio-based materials are preferred to mineral ones, products are designed for a longer use and reuse cycle, they are well maintained, repaired and refurbished, they have a reasonable second-hand value, they can be expanded or upgraded to keep up with technological evolution. End-of-life products must be considered as resources, they can easily be taken apart and turned into new products while broken or useless parts must efficiently be divided in the component materials for the recycling. In this way, product lives are extended and material cycles are closed, minimizing the need for new materials and energy. At the same time, environmental pressures linked to resource extraction, emissions and waste are reduced.

At the present, the key concepts of circular economy rarely are part of traditional education curricula, so the staff of the project 'SmartPlaCE@*Schools* - Serious game Platform for education on Circular Economy in high school' created the educational game ecoCEO™ in order to fill this gap supporting the teaching of circular economy by using gamification, to make learning more motivating and engaging. Gamification means that the learning goals are included in the subject and in the rules of a game; consequently, the players autonomously practice, match after match, their own education without the feeling to be included in a kind of training [3]. Furthermore, if the students play in teams, they develop proactive dialogue, the ability to reach shared decisions and the skills to trade with an opposite team. In general this informal education can be used to stimulate problem solving capability and to make team building activity, not only for youngsters, but also for adults [4].

2. EcoCEO™, the game

EcoCEO™ is a tabletop game addressed to students of high schools (suggested age group 15-18), it is composed of nine table boards, several types of cards and 'credits' (Figure 1). The game can be stopped after 50 minutes, to adapt it to the standard school timing, or when a team either completes its boards, or at the end of the card deck. The printable English version of the game and the instruction manuals in several languages are downloadable and video tutorials are available online in English with subtitles in several languages [5].

Fig.1. EcoCEO™ overview picture of the game.

In the game, players act as Chief Executive Officers (CEOs) of a microchip factory. The company can be managed by a single or a couple of players, consequently from three to eight people can play together. All the teams start in the same condition but, along the game, they are induced to grow their company starting to produce smartphones or e-bikes, two symbolic hi-tech electronic goods, typical of the current age, very popular today among youngsters but very energy and material demanding. The aim of the game is not to accumulate as much money as possible, but to collect 'victory points' that are markers of the company resilience and circularity. The players are asked to make decisions on employees' allocation, resource management, production processes, investment strategy and revenue models. By combining different investments, they can address their company toward different value chains and improve resilience or profitability.

At the beginning players work in a linear economy model but, when the card signalling 'scarcity of raw materials' appears on the deck, the game switches to the circular economy model. Thus, the teams expand their value chain thanks to a variety of strategies, such as 'waste recycling', 'take back waste and sell for scrap' or 'for reuse', and 'renting services'. The players using all these actions gain more victory points and, if this teams in the first phase of the game invested in 'efficiency' and 'substitution' benefit from the advantages to manage the full value chain and probably will win the match.

During the game several different events can randomly occur, for example: 'tax on CO_2 emission', 'employees strike', 'new materials reserves', 'EU support programmes', etc.. These events benefit the players who organized their companies more resiliently and sustainably. When the mega-event 'Severe material scarcity on the market!' appears on the deck, the availability of primary resources is halved and the teams understand the importance of recycling and close loops. All these events show

that investing revenue toward improving production processes, lengthening value chains, and close product loops make companies more resilient. Victory points measure this determining the winner.
The SmartPlaCE Consortium tested EcoCEO™ in their four countries (Belgium, Estonia, Germany, and Italy) with several classes of students and organized a game session at the IV European RM@Schools Conference in Bologna in 2019, involving teams from different parts of Europe.
Figure 2 shows the results of a short satisfaction questionnaire submitted to 102 students, mainly Italian, after the first match. The collected data showed that the students enjoyed ecoCEO™ and an half of the students felt inclined to learn more on the subject after playing the game. If the game sessions are accompanied by other educational tools such as seminars or a final discussion with experts, the ask for further information was higher.

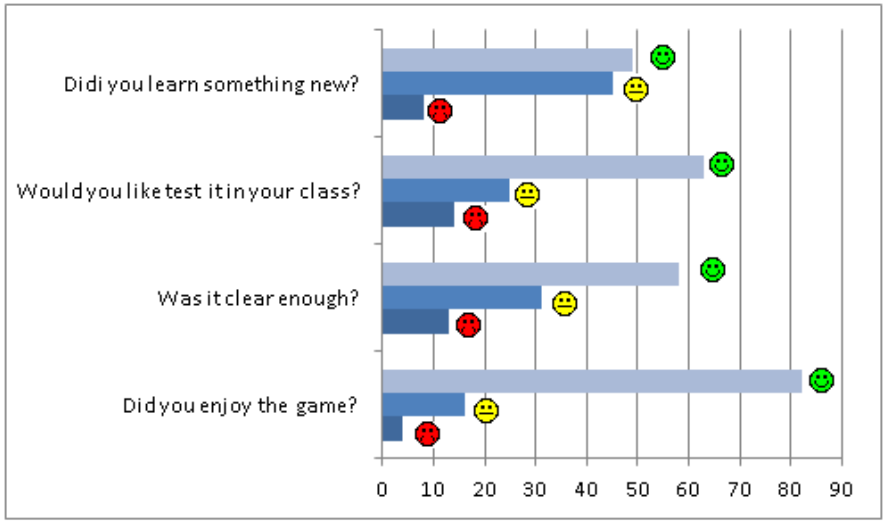

Fig.2. Results on the satisfaction questionnaire by students

3. Educational materials and learning goals

EcoCEO™ transmits basic knowledge on circular business models but it also should stimulate players to look for further information on this subject and related ones. To satisfy this need, the SmartPlaCE Consortium is setting up a 'teacher board', to consult on the further tools and educational material that will be available for teachers. Thus, an online platform [5] is going to collect the material to help schools to integrate ecoCEO™ and circular economy topics into their educational curricula. This educational materials provide complementing background information on the subjects addressed in the game, and suggestions for a wide range of linked learning activities, such as suggestions for homework, quizzes, roleplay games, hand-on activities, and experiments to perform in the school laboratory. They contain relevant information on topics such as material mining and processing, material challenges, product value chains, new circular strategies and business models, and sustainable materials consumption, providing both valuable background information for players and learning materials to be used individually.
Moreover, as typical school activities are divided into separate disciplines, there is a particular need for linkages between subjects and interdisciplinary courses to reflect today's constantly evolving and complex society. The game and learning materials will cover a multitude of fields like economics, geology, technology, environmental science, negotiation, accounting, and corporate governance. Because of this multi- and interdisciplinary focus, they will form a means to decrease the discrepancies between narrowly focused school subjects and the real world, with its natural interaction between the fields mentioned. Moreover, the game may foster discussion about sustainable entrepreneurship, consumption patterns, resource scarcity, work dignity and waste management, and provides a clear link to the European Union Green Deal [6], its Circular Economy Action Plan [7] and United Nation Sustainable Development Goals [8]. According to it, a selection of more tangible and thematic learning materials has been developed in order to translate the theoretic concepts into concrete case studies and examples appealing to the students' field of interest and everyday life. In regards to one of the electronic goods of the game, the smartphone, some activities are suggested to present the huge number of critical raw materials present in it and to discuss social and geopolitical conflicts behind its supply. Taking into account that every year, in Europe, 120 million people change their smartphone, students are invited to discuss the importance of the substitution of critical materials

with sustainable ones, the design-to-repair to lengthen the use life of the device, the take-back and recycling activities. As an experimental activity related to that, it will be possible to download the protocol to perform the leaching of electronic boards and the recovery of copper in the laboratory of the school.

4. Conclusions

The transition toward a circular economy is becoming a goal for the European Union but it is not yet fully expressed in official high school curricula. The test on ecoCEO™ demonstrated that it is a useful tool to make students aware of the complexity and interrelation of economy with social and sustainability issues. The game presents concepts such as raw materials and circular economy in a funny and engaging way, fostering the aware consumption, opening to them new occupational perspectives and stimulating environmental-friendly entrepreneurship. Finally, teachers may use the game to stimulate pupils to reflect on the two business models, to look for information on their own, and to engage them in the other activities available on the web platform.

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