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## EDUCATION TO SUPPORT THE DEVELOPMENT OF A CIRCULAR ECONOMY APPROACH

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**Abstract:** Global environmental problems, wasteful over-consumption with the increasing volume of waste, growing and increasingly dangerous effects of pollutants released to the environment, depletion of raw material resources, all call attention that it's no longer enough to just talk about sustainability, but we need to act. It requires first of all a change in the approach to the economy and a turnaround to replace the linear management systems still widely used today with a waste-free system. The product of today is the raw material of the future. The implementation of circular economy requires long-term thinking covering the entire life cycle of products from the initial moment of design. It requires well-informed decision-makers who have all the competencies that help to validate the mechanism of natural ecosystems' operations in today's economic systems. Development of skills and abilities expects a change of attitude in education. Through education, such knowledge and values must be conveyed, skills and abilities essential for the realization of a sustainable society and economy must be developed, primarily the responsibility and ethical behaviour towards the environment. This is supported by Environmental Pedagogy as an integrated, independent science and educational strategy for project teaching. The study presents an educational strategy that is also effective in developing the competencies needed to implement a circular economic approach.

**Keywords:** circular economy, competences, project education, sustainable development

### INTRODUCTION

In the concept definition of sustainable development, the Brundtland Commission stated in its report 'Our Common Future' (1987), that the economy can only grow by preserving the environment. However, the unresolved environmental problems of the past years call attention to the fact that the **need for economic growth has overridden the conservation of natural resources, making it increasingly** urgent to reinterpret the environmental dimension and thus the viability of a sustainable economy and society. Recognition of this fact prompts professionals around the world to take action and find ways to use raw materials and energy resources that are both environmentally and economically sustainable. It requires a new approach, especially in the economy. Instead of the linear economic model that typically works today, it is necessary to create a new material management and business model based on an exhaustive, finite number of resources. Main ambassador and supporter of this new economic model is the Ellen MacArthur Foundation, which, by introducing the concept of circular farming, aimed to create an economic model in which the value of products, materials and resources used in the economy was preserved and maintained for as long as possible, minimization is the main goal. [1] The circular economy no longer wants to lose (dispose as waste), but to preserve as much as possible the work and energy invested in materials and products during the production and economic processes (Figure 1).

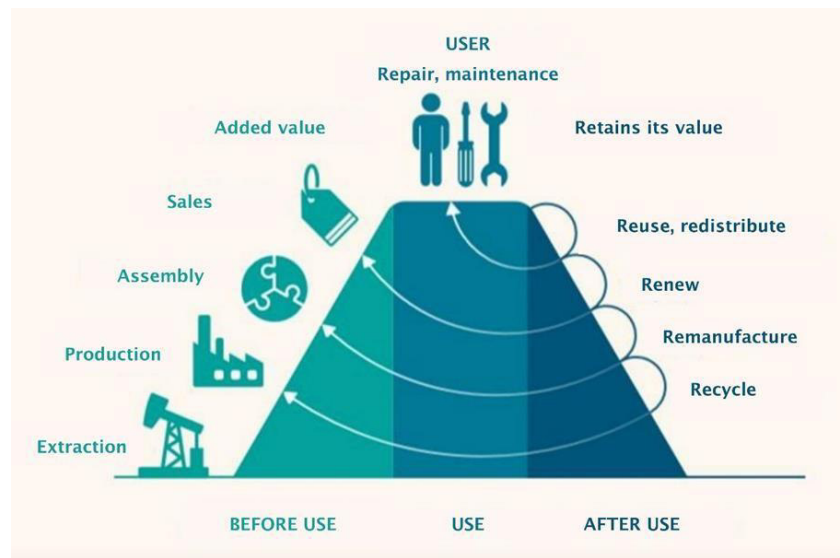


Figure (1) Flow of material in a sustainable world [2]

Definition Chapter in the Regulation 'Establishing a framework for the promotion of sustainable investment' of the European Parliament and Council defines the concept of circular economy as follows [3]: "... to preserve and maintain the value of the products, materials and resources for as long as possible and to minimize the generation of waste, including the application of waste hierarchy set out in Article 4 of Directive 2008/98 / EC of the European Parliament and of the Council".

Achieving this goal requires competencies like responsibility for the environment, creative and problem-solving thinking, interoperability, ability to innovate and, last but not least, environmental management approach. These competencies and their associated abilities, skills and attitudes are needed to achieve the main goal of keeping the value of the products and raw materials used for the longest time, minimizing waste generation and resource use, and creating new value by reusing end-of-life products. Necessary knowledge and development of competencies are the tasks of an educational process, where the main goal is not to view development as a purely economic process or ecological threat, but as a series of rational and moral decisions. Sustainable development requires active, knowledgeable individuals and attentive, well-informed decision-makers, who can take the right steps to handle the complex, interrelated economic, social and environmental issues that arise in human society. The effectiveness of education for sustainable development can therefore be measured by the extent to which it changes people's attitudes and behaviour, both individually and in relation to their collective role and civic responsibilities. [4]

## CIRCULAR ECONOMY

Nature itself provides a good example of a circular economy. No waste is generated in natural processes, as all by-products and end products are starting points of something. The ecosystem uses the energy of the Sun to keep the materials flowing through it at different speeds in a continuous cycle. This natural process can provide the basis for a sustainable economy, and this basic idea is reflected in the circular economy theory introduced by the European Union in 2015. [5] Circular economic theory aims to achieve a system in which there is no waste and the products of today are the raw materials of the future. Its primary goal is to validate the mechanisms of natural ecosystems in the economic systems of our time. [6]

In the linear economic model used today, products are produced from natural resources and primary raw materials, which become waste after use. Leaving the system, the available - non-renewable - natural resources are constantly decreasing. (Figure 2)



Figure (2) Linear economic model [7]

In the circular economy, on the other hand, the products are returned to the production in the same or processed form. This may be a known process, as selective waste collection or recycling has already appeared in economic processes. However, experience shows that they are not solutions for waste management on their own: due to wear-and-tear of the materials and the limited reuse opportunities. Circular economy complements and creates a closed material process by counting what the product will become once the user discards it during product design. (Fig.3) shows the implementation of a closed recycling cycle in the textile industry in which resources are not consumed but used.

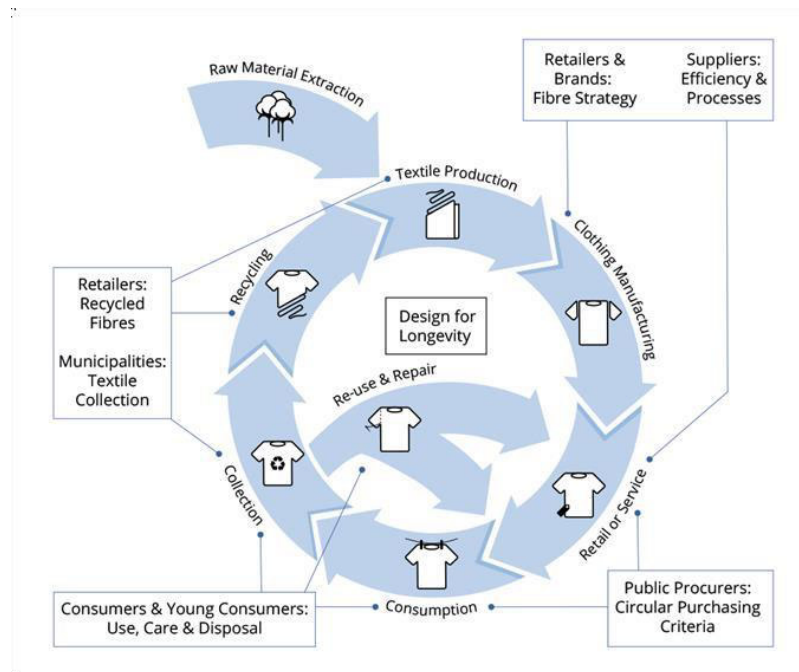


Figure (3) The circular textile and clothing model [8]

Circular economy is one of the possible and practical solutions for sustainable development, as it creates an economic system that minimizes waste, emissions, and energy losses. [9] The main goal is to keep the value of the products and raw materials used for as long as possible, to minimize the level of waste generation and resource use, and to keep resources still in the end-of-life products in the economy, creating added value through re-use. Jobs for society can be created, and consumers will have access to more durable, innovative products that, in addition to saving money, will improve the quality of life.

Circular economy rethinks the path of products from product design through production to consumption, providing an answer to what the product will become once the user discards it. With minimal or zero waste and resource utilization, it recycles the products it produces at the end of its life cycle, ensuring the longest possible product life, benefiting both the economy and nature. [10] There are the three key pillars to operate the model [11]:

1. "Preserve": Appreciate and preserve the value of materials and products, favouring renewable energy

- and raw materials, and preserve natural capital by using waste as a resource.
2. "Innovate": Make optimal use of resources by keeping materials and products in the circular process. Through smart product design and innovation, develop business models (e.g. collaborative economy, an economic and social system that provides collective access to goods, services, data and knowledge; renovation, redistribution, further utilization to provide a kind of added value; return logistics, digitalization) which encourage operators responsible for production or marketing to give the product concerned as long a useful life as possible.
  3. "Close the loop": Improve the efficiency of the system by recycling, repairing, and re-using materials and products that turned into waste, to create new value after the end of their life cycle. System efficiency can be increased by identifying negative externalities and by minimizing them through life-cycle planning.

Closed-loop and thus design of the entire life cycle assume longer-term thinking; build on individuals with a wide range of knowledge and attentive, well-informed decision-makers, who can take the right steps to address the complex, interrelated economic, social, and environmental issues human society is facing. Lack of these is probably the reasons, why we have not achieved the desired result since the concept of sustainability emerged. Solving the problem is not a task of a single discipline, or individual international or national organizations, but a joint, complex assignment of different disciplines, a process that requires national and international consensus and action. The effectiveness of education for sustainable development can therefore be measured by the extent to which it changes people's attitudes and behavior, both individually and in relation to their collective role and civic responsibilities.

## **EDUCATION TO SUPPORT THE DEVELOPMENT OF A CIRCULAR ECONOMIC APPROACH**

In its new action plan for a circular economy for a cleaner and more competitive Europe, the European Economic and Social Committee sets out the expectations for education as follows: "*Through education, capacity building and greater responsibility, more emphasis needs to be placed on spreading a 'circular culture' to encourage people to adapt and change their daily habits.*" [12]

An effective method of this can be the self-regulation based project education, where the foundation of the learning process comes from experience and the sharing of good examples.

The priority objectives of circular economy projects are the following [13]:

- to master and understand the basic concepts of the circular economy.
- to understand the limited availability of resources.
- to develop the capacity to use the business model of the circular economy.
- to identify the needs of companies in relation to the circular economy.
- to develop the systems approach and problem-solving capability.
- to get to know the management tools related to the circular economy.
- to identify technological, economic opportunities and barriers and find the best solution.
- to ensure the possibility of developing competencies by applying appropriate teaching methods.

It is expected that at the start of the project, participants have a basic knowledge of the circular economy and are familiar with the principles. It can be measured with the concept map in the first session. If participants don't have the theoretical knowledge required starting a project, it can be provided as part of an introductory session or via an online course. In the further phases of the project, newer and newer knowledge can be gathered based on experiences during practical activities

Primary condition for launching a project is the involvement of an external partner - small, medium and large company, association, municipality, community, or even an individual - who provides a real-life problem, as there can be no project without a problem. The most important aspect of the project work is to satisfy a real need, which motivates the participating students to do the work and thus gain experience and learning. Not always will the solution be revolutionary, but it is not an expectation, it can be a survey, study, analysis, testing, development, innovation, or even a dissertation, doctoral research, or service. The partner monitors the entire project process, available for consultation, and -it is important- evaluates the finished product. Partner is expected to share its expertise with project participants, to provide information on an ongoing basis, to provide ideas, to observe, to supplement, but not to give ready-made answers and to make

a decision on behalf of the group. You can express a critical opinion, but rather encourage, understand, and evaluate students' ideas.

The project schedule "Fig.4" is compiled by the project manager to help planning and conducting the project. The first step in the schedule is to provide resources: involve students in the project, provide locations, and provide necessary equipment, labs, and other resources. The project leader is contacted by the external partner; they jointly formulate the project task and agree on the evaluation criteria. The project task must be specific, clear; it can refer to e.g. resource efficiency testing or recycling, or product life cycle extension, product renewable, risk analysis, etc. A good task sets simple, clear goals, makes room for innovation, and requires development of different skills. In connection with the task, the project manager may ask other experts and teaching colleagues from other fields to cooperate. The next step is to raise students' interest in solving a problem. If the project takes place within a lecture or practical course of a certain subject, the participation of students is given, but if it is run as a separate course, information is needed to attract students to take the course and the project task. It is very helpful to present short summaries of previous projects, as well as project evaluations and possible awards. Rewarding, recognizing, or possibly employing a student at a company can be much more motivating than just the credit value of the course.

An important task is to keep in touch with the project groups, to discuss the reports of partial results, experiences gained so far, to which the external partner can also be invited. At the beginning of the project, it is necessary to define the evaluation criteria, share them with the participants and agree on the conditions for closing the project. Equally important to agree on the form of the expected results, e.g. the partner expects a solution or product or analysis, etc.

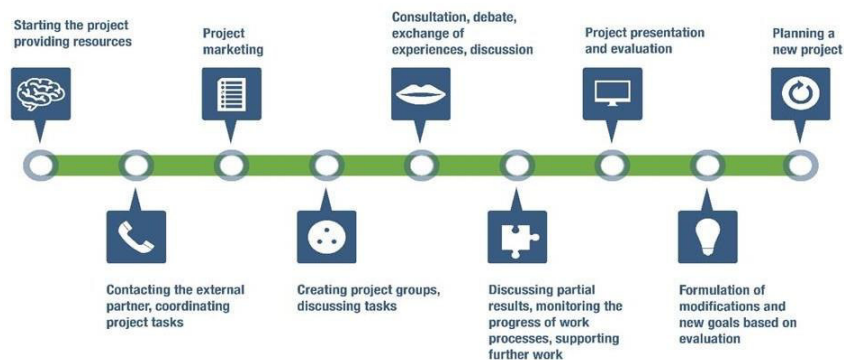


Figure (4) Project schedule [13]

Project groups are created to solve specific tasks, students can either freely choose a task and group, or the project manager assigned participants for each group. The groups always elect a team leader, who constantly monitors the group's activity, and activity effectiveness, ensures that the project is progressing as planned and, if necessary, motivates the group for further work, liaises with the project leader and the external partner. An equal division of labour should be targeted within the group, the sub-tasks should be chosen freely by the members of the group based on their intrinsic motivation and interest, striving for a clear division of roles. The work of the team leader and the group can be supported by higher grade senior students as tutors, who have already gained experience in project work.

Closing the project and presenting the results achieved is an important moment in the project work and differs from traditional pedagogical evaluations. Complexity of the project determines the complexity of evaluation, which must take into account the work of the whole group, the products, their quality and the learning process leading up to it, from the formulation of the problem to the solution. It is necessary to consider the learning processes that have taken place in terms of the growth of professional subject and metacognitive knowledge systems. The work should be evaluated from social relations and from the individuals' perspective, how much cooperation, helpfulness in the group has been developed during the

work, and how the students were able to integrate into the group, if they had conflicts and how they resolved them, how much they could count on others, how and how much they learned during the project. These points can be assessed mainly by the project leader teacher, based on continuous observation and student self-assessment. Comments on this should be discussed with the students in the group sessions to help them develop and succeed in their further work. However, the main aspect of the evaluation is when the group evaluates their own and the other group's work, thus practicing opinion-making and decision-making. Each project team presents to the professional jury of invited guests (teaching colleagues, external partner and guests invited by them), the work done and the products. The evaluation can be assisted by a pre-developed specific evaluation and scoring system. The evaluation of the partner plays an important role in the further work and learning process. In particular, this should show how forward-looking the idea is, whether it takes into account the circular economy, whether it fits into national and international strategies, whether it can be financed, whether it is profitable, whether it is competitive, whether it is in line with principles of sustainable development, etc.

Achieving the goal of project teaching is facilitated by several pedagogical methods; they are primarily based on individual work and group cooperation, such as discussion, concept map, presentation, explanation, illustration, research, study, observation, experiment, analysis, field research, case study, impact assessment, group work. Due to these, in addition to the knowledge and skills of the students, their abilities and skills are also developing. This way, education in a project aimed at solving a real problem becomes suitable for developing and disseminating a broader approach to the circular economy.

## CONCLUSION

Higher education has major responsibility in achieving the goals of sustainable development, since it is where the professionals, economic, technical, and political decision-makers and leaders playing a key role in shaping the society of the future graduate. Their view of the world, its systematic operation, connections, and causal relations is the basis for their future decisions taking into account principles of sustainability. There is a need for pedagogical methods that help to develop practical implementation of sustainability and the circular economic approach by developing necessary competencies.

One of the most effective ways to do this is to break away from traditional teaching methods by a learning process motivated by experiential learning, practical activity, and solving a real problem, the method of which is the project teaching. The project can be adjusted to the level of skills of the students studying at specific level of education. Its scope, timing and product can always be changed flexibly according to the goal set, it can be run as an independent course or even within the framework of a specific subject. Its effectiveness in terms of both the acquired knowledge and competencies is proved by several results, so it is an indispensable educational method for achieving sustainable development.

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