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ABSTRACT

Circular economy (CE) is an alternative to a fossil resource-based linear economy. Transformation towards a CE additionally requires reformation at all levels of education. Due to the close connection of the topic with working life, the authors of this study wanted to study the role of CE education at the Finnish universities of applied sciences (UAS).

The status of CE education at the Finnish UAS's was studied using a questionnaire among the UAS staff members in 2018, and by summarizing the CE education work done in the national project titled "Circular economy competence to universities of applied sciences" in 2018–2020.

According to the results of the survey, CE was moderately known amongst the staff members of the Finnish UASs in 2018. Majority of the courses in CE were available in the fields of Civil Engineering, Natural Resources and Business Administration since most of the respondents were working in these fields. Most of the courses and programs were provided at the Bachelor level, and the average number of credits (ECTS) ranged between 3 and 15. However, until the end of 2020, CE education developed significantly, meaning that there were an increasing number of CE teaching methods, learning environments and materials available at the Finnish UAS.

The study provides a picture of the current state of the teaching of CE at the Finnish UASs and helps to understand the general process that has taken place at higher education institutions concerning CE education. CE has become a recognized concept, but the integration of CE is still an ongoing process at the Finnish UASs.

Keywords: Circular economy; higher education; University of Applied Sciences

1 INTRODUCTION

Finland has set the goal of reaching carbon neutrality by 2035. Also, all the Finnish universities of applied sciences (UASs) and universities are committed to this goal as part of the governmental targets. As Finland moves towards the goal of carbon neutrality, it is recognized that especially know-how and education need to be invested in (Rissanen, 2020, p. 9 - 10). The Finnish UASs are jointly committed to promoting sustainability development, and their activities are based on the UN's Sustainable Development goals 2030 (Arene, 2020). Finnish companies and society will not become more climate-friendly without considering knowledge transfer and education as part of the green transition of Finland (Marin's government, 2021).

A circular economy (CE) is recognized as an alternative to the traditional fossil resource-based, "take-make-use-dispose" linear economy. CE is based on the wise use of resources, and it is closing the loop of resources taken in use. It has potential to reduce negative environmental impacts and to mitigate climate change because materials and resources are used effectively and resource-wisely. The shift from the traditional unsustainable economic system towards a CE is an interdisciplinary process, which should be cross-sectoral (Ellen MacArthur Foundation, 2021a).

Consequently, CE forces educational systems to change. However, many of the current studies are concerned with CE business models (e.g., Planing, 2015; Lewandowski, 2016), and there are only a limited number of publications dealing with CE education (e.g. Andrews, 2015), or how it should be taught at schools or in higher education.

CE demands actions at schools and in the educational system so that it can be included in curricula. There have been differences between countries as to how integrated CE is in school curricula (Forslund, 2018). Publications concerning CE in higher education were scarce before 2018, with few exceptions, such as Kılış & Kılış (2017), Forslund (2018), Hall & Velez-Colby (2018), and Whalen et al. (2018).

Since 2018, there has been an increasing number of different studies on CE education worldwide. These studies have been conducted, e.g., in Europe (e.g. Rokicki et al., 2020; Bugallo-Rodriguez & Vega-Marcote, 2020) and South America (e.g. Maruyama et al., 2019), concerning either different business sectors and universities or higher education in general.

The forerunners in the field are the Ellen MacArthur Foundation and Sitra – the Finnish Innovation Fund, both of which are actively promoting CE education. Currently, there are 57 different higher education institutions mentioned as CE profiled Universities at the Ellen McArthur Foundation's website, and their number has rapidly increased since 2020. However, it has been noted that publications and reports on CE education at national levels are absent (Ellen McArthur Foundation, 2021b).

The present article studied the status of CE education at 19 Finnish universities of applied sciences (UAS). There are a total of 25 universities of applied sciences in Finland, so most of them were covered by this study. Universities of applied sciences, or sometimes called Vocational universities, are officially used terms in several European countries such as

Sweden, Germany, Austria, and the Netherlands, and their responsibility is to provide applied research for working life. Even though CE has been charted globally (Forslund, 2018), the authors of this paper wanted to carry out a deeper analysis of the integration of CE in the different disciplines of the Finnish UASs.

2 MATERIALS AND METHODS

The status of CE education was studied at the Finnish UASs in two phases. In the first phase, in 2018, the status of CE was studied with a questionnaire. The questionnaire was prepared with the Webropol software (v. 2.0). The questionnaire was sent to the key actors among the personnel working with CE at 19 UASs. Both teachers and RDI personnel were invited to answer the questionnaire.

A total of 104 staff members from 18 UASs answered the survey. The response rate varied from 0.1 to 3.4 % per UAS. The median respondent was a female (of 51 to 60 years of age) with a master's degree and a good understanding of CE. Moreover, the median respondent worked in the field of Technology, Industry or Construction.

The quantitative data results were analysed statistically with the SPSS (ver. 25) program, and a content analysis was made of the qualitative data by clustering the answers under the same theme. Spearman's correlation analysis was used to measure possible relationships between the variables, together with crosstabs and Chi-Square Tests in SPSS. The answers were compared to the respondents' background data. The results obtained with the questionnaire were used for the development of novel CE education, consisting of new methods, such as learning environments and e-learning platforms at the UASs in 2018–2020.

In the second phase, all the CE education activities at the 19 Finnish UASs were collected and summarized. This was done in collaboration with the partners in "Circular economy competence to universities of applied sciences" project funded by the Finnish Ministry of Culture and Education. The project was a multidisciplinary development project, in which the UASs developed common ways to promote education in circular economy, learning environments, and methods for implementing education in circular economy at the UAS's. In addition, the project produced new teaching material for open access. In addition, the methodological workgroup put together innovative teaching and learning methods related to the circular economy.

During the project, a shared understanding of circular economy learning environments was built through joint discussions, workshops, and analyses. At the same time, concrete co-operation and cross-learning between learning environments was enhanced and documented. In addition, circular economy learning environments were made more accessible to students and companies by systematically describing them and improving communication among the various stakeholders. Eventually, the work done in the project was qualitatively analysed and summarized in the present article. Finally, the current state of CE education at the Finnish UASs at the end of 2020 is presented in this paper.

3 RESULTS AND DISCUSSION

3.1 CE questionnaire

According to the results, CE was moderately known amongst the UAS staff members in 2018 (Figure 1). The results show that the integration of CE in different disciplines in 2018 was relatively strong especially in the Engineering, Natural Resources, and Business education of the UASs. However, there was a lack of knowledge in Humanities, Education and Health and Wellbeing, as most of the respondents represented Civil Engineering and Natural Resources (Table 1). In general, the respondents thought that CE was especially well integrated in Energy and Environmental Technology (N= 12) and Agriculture and Forestry (N=5). On the other hand, the respondents felt that CE was poorly integrated on material-related courses (e.g., rock and concrete), in Hotel and Catering, as well as in Marketing and general Business Economics. Statistically significant differences ($p < 0.05$) between the variables of the UASs were not found.

Due to their close relationship with working life, the role of the UASs is crucial for the development of CE education. It is also important to give the teachers enough resources for becoming familiar with the concept. CE needs to be quickly integrated into education, so that working life experts and stakeholders will get relevant information to mitigate climate change and to implement CE in practice.

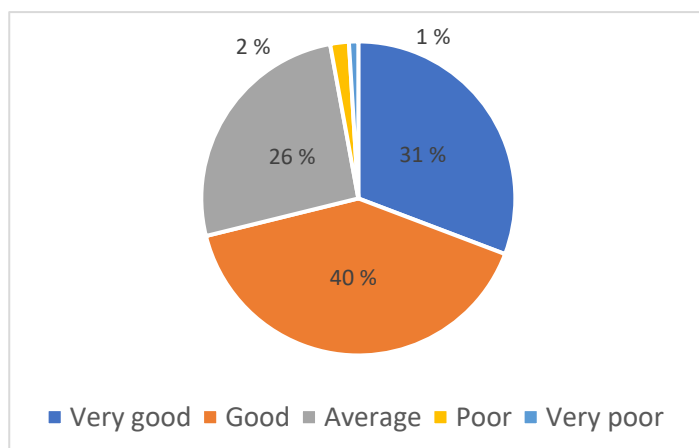


Figure 1. The respondents' level of knowledge of CE.

Table 1. CE-related courses at 18 Finnish UASs in 2018.

| Discipline | Number of courses or programmes | Bachelor level | Master level | Average ECTS credits | Median ECTS credits |
|------------|---------------------------------|----------------|--------------|----------------------|---------------------|
| | | | | | |

| | | | | | |
|--|----|--------------|--------------|--------------|--------------|
| General CE | 28 | 25 | 3 | 8 | 5 |
| Technology, Industry and Construction | 23 | 23 | - | 6 | 5 |
| Agriculture and Forestry | 20 | 18 | 2 | 15 | 6 |
| Trade and Administration (Business Economics, Management Assistant and Languages) | 13 | 10 | 3 | 5 | 5 |
| Arts and Culture | 5 | 5 | 1 | 11 | 10 |
| Services (Beauty Care, Library and Information Services, Transport and Transportation, Sport, Tourism, Shipping, Security) | 1 | 1 | - | 3 | 3 |
| Social Services | 1 | not reported | not reported | not reported | not reported |
| Not correctly reported or identified | 6 | 4 | 1 | 27 | 6 |
| Total | 97 | 86 | 10 | 11 | 5 |

3.2 Summarizing the CE work at the Finnish UASs by the end of 2020

After 2018, CE education was systematically developed at the Finnish UASs in the project titled “Circular economy competence to universities of applied sciences“. The development work of CE done at the Finnish UASs in 2018–2020 can be divided into four different categories: 1. Pedagogical development, 2. Development of learning environments, 3. Development of learning materials, and 4. Development of new cooperation models between UASs. These different sections and the achieved results are described in table 2.

Table 2. Summarized and selected CE education development work at the Finnish UASs done in the project “Circular economy competence to universities of applied sciences” in 2018–2020 (Tyni et al., 2020, p. 12 - 23).

| Task | Purpose | Results |
|---|---|---|
| Pedagogical development | To improve the quality and volume of CE education – both teaching and studying at the UASs | Listing more than 20 innovative teaching methods on the home page of the project concerning CE pedagogy; Improving the quality of CE online courses (assessment, implementation, pedagogical solution); Active participation in national and institutional sustainable development programmes of the UASs to harmonise and enhance top-down CE education; Promoting the accessibility of CE education materials via aoe.fi web pages; Expansion and diversification of the CE education curricula at the UASs; Implementation of the “Circular Economy School” (5 ECTS) course for UAS teachers and related CE competence badge (Open Badge for teachers); Internal information sessions and seminars to raise the UAS staff’s awareness of circular economy; Several project publications on pedagogy and CE |
| Development of learning environments | To increase the number of CE learning environments at the UASs | Eight pilots of different CE learning environments at the UASs; 15 existing CE learning environments were described on the project website; The definition of the CE learning environment on the UAS scale was described; An analysis of the learning environments of the project and their activities was carried out; An assessment tool and communication tip list for the developers of the CE learning environment was built up; Several publications related to the learning environments |
| Development of learning materials | To increase the number of CE education materials, modules, and courses at the UASs | New CE education materials and courses produced (235 ECTS); The materials are mostly in Finnish, and about 40% of the teaching material produced in English (minor materials also in Swedish) |
| Development of new cooperation models among the UASs. | To increase cost effectiveness, knowledge sharing, and further cooperation among the UASs to develop CE education | 33 described business cooperation models used by the UASs to help CE education; Increasing transparency and interaction between CE professionals and society; Open access and agreement on the fair use of CE education materials between UASs; Contract templates and common practices to enable cooperation in CE education between the UASs; Over 150 publications related to the project; Social media updates, i.e., establishment of a Circular Economy UAS group in LinkedIn |

3.3 General conclusions and future outlook

UASs have an important role in disseminating CE as a new sustainability paradigm in education. The Finnish UASs have systematically developed their CE education in the past few years (Table 2). This process has created new types of sustainable and more resource-efficient cooperating models, increased the number of learning environments and materials while supporting regional development. Recently, following the “Circular economy competence to universities of applied sciences” (2018-2020) project, Turku University of Applied Sciences undertook to set up a website where universities can enter their circular economy courses. The site helps UASs to share information about individual CE courses to the public.

One of the most important tasks of education is to promote CE competencies for working life, so the education sector must actively follow sustainable development and renew its skills. This process is a constantly changing phenomenon at higher education institutions. Circular economy education will remain in the agenda of the Finnish UASs and it will support the green transition of the European Union at a national level in Finland.

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