HELMeTO 2022

4th International Conference on
Higher Education Learning Methodologies and Technologies Online
HELMeTO2022

September 21-23, 2022
Palermo, Italy

Book of Abstracts

Sponsored by

Introducing sustainability themes in STEM education: evidences from some European countries

Dario Antonelli[1] [0000-0002-0118-0424], Paolo Minetola [1], Paolo C. Priarone [1],
Antonio Maffei[2], Michele Lanzetta[3], Dorota Stadnicka[4] and Primož Podržaj[5]

[1] Politecnico di Torino, DIGEP, Torino, Italy, dario.antonelli@polito.it
[2] Royal Institute of Technology, Stockholm, Sweden
[3] University of Pisa, Pisa, Italy
[4] Rzeszow University Of Technology, Rzeszow, Poland
[5] University of Ljubljana, Ljubljana, Slovenia

1   Introduction

The Sustainability Development Goals (SDGs) adopted by United Nations in the 2030 Agenda for Sustainable Development will modulate the efforts toward a better world considering the pillars of economic, social, and environmental sustainability [1]. The Industry 4.0 (I4.0) framework is emerging from the introduction of several advancements in a way that substantially and rapidly transforms the design, manufacturing, operation and services related to manufacturing systems or products [2]. I4.0 technologies are expected to have a significant impact on the achievement of the SDGs. The 'MAnufacturing Education for a SusTainable fourth Industrial RevOlution' project (MAESTRO, E+ 2019-1-SE01-KA203-060572) is an ongoing research collaboration where experts from diverse engineering disciplines and seven European institutions from Sweden, United Kingdom, Italy, Portugal, Poland, and Slovenia are putting together efforts to define and deliver the key new competences required by the future engineers who will be part of the I4.0 revolution, focusing on SDGs [3, 4].

The SDGs relevant to the teaching of I4.0 were introduced in different academic courses, mainly taught online, by strictly following the Constructive Alignment (CA) principles. CA was devised [5, 6] as a paradigm for the design of effective and efficient pedagogical activities in higher education. CA is based on two main concepts: the constructivist understanding of the learning process, and the practical need for aligned and outcome-based curricula design. Teaching and Learning Activities and Assessment Tasks are therefore planned in a way that is aligned with their Intended Learning Outcomes. The underlying hypotheses that were verified were related to:

1. the sensitivity of people from different countries to sustainability themes
2. the different degree of confidence in the possibility of learning a sustainable use of technologies
3. the different perception of the proactive role of digital technologies in achieving sustainability goals.

2   Design of the survey and discussion of results

A survey aimed to verify and quantify the possibility of communicating the impact of Industry 4.0 on sustainability, through new didactic modules, has been conducted in different European universities. The survey, inspired by [7], was created for the purpose of testing the hypotheses listed in section 1 and was distributed to students after reaching a consensus on the questions to be presented. The main sections of the survey are pertaining to the evaluation of I4.0 technology impact on education profile, the evaluation of sustainability awareness as well as the evaluation of course alignment with the overall education profile. A four-point Likert scale is used to produce a forced choice of the respondents between agreement and disagreement. Data collection is going on, with 132 forms analyzed by now from Italy, Poland and Sweden (63 female and 69 male students). Results passed the consistency test. Krusk Wallis one way ANOVA by ranks was used for testing the significance of the different factors. There is a strong country factor while all the I4.0 technologies have a similar influence on SDG goals, as can be seen in Fig.1. Learning a sustainable use of technology is considered effective only by the students of some countries. Student perception about the impact of I4.0 technologies was compared to the experts' opinion about the impact of I4.0 technologies on main SDG goals [4]. I4.0 technologies mainly affect the SDGs related to health, industry, growth, production and consumption. Another result is the lack of confidence among the students on the effectiveness of reaching sustainable goals through professional training. This is just the starting point of an improvement process that will align stakeholders' expectation with the actual course embodiment.
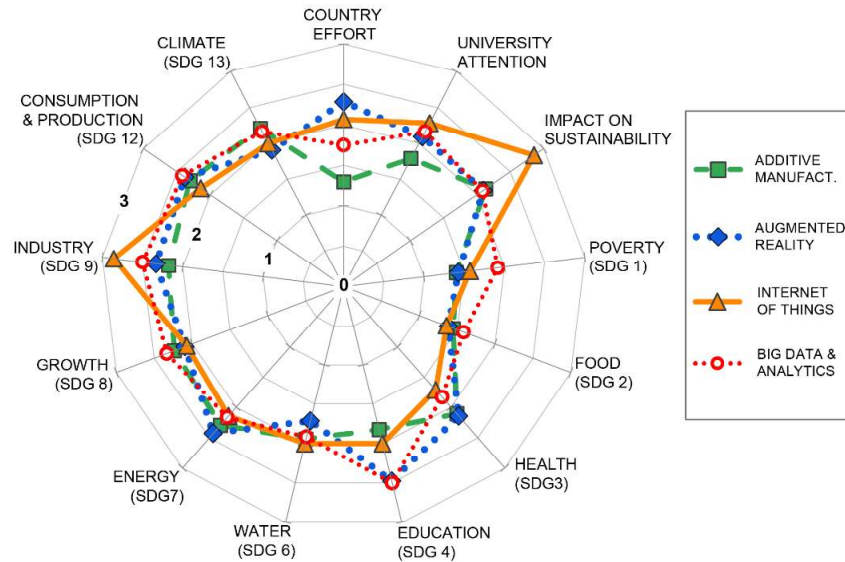

Fig. 1. Radar diagram showing the mapping of specific I4.0 technologies on selected SDGs

313

References

1. UN. 2015. "Sustainable Developement Goals." United Nations Department of Public Information. Retrieved (https://sustainabledevelopment.un.org/?menu=1300).
2. Davies, Ron. 2015. Industry 4.0 Digitalisation for Productivity and Growth.
3. Stadnicka, D., Litwin, P., Antonelli, D. Human factor in industry of the future: Knowledge acquisition and motivation. FME Transactions, 47(4), 823-830 (2019).
4. M. Mabkhot, M., Ferreira, P., Maffei, A., Podržaj, P., Mądziel, M., Antonelli, D., ... & Lohse, N. (2021). Mapping industry 4.0 enabling technologies into united nations sustainability development goals. Sustainability, 13(5), 2560.
5. Biggs, J. What the student does: teaching for enhanced learning. Higher education research & development, 18, 57-75, (1999).
6. Boffa, E., Lupi, F., Lanzetta, M., & Maffei, A. (2021, September). The Digitalization of Engineering Curricula: Defining the Categories that Preserve Constructive Alignment. In International Workshop on Higher Education Learning Methodologies and Technologies Online (pp. 333-346). Springer, Cham.
7. Minetola, P., Iuliano, L., Bassoli, E., & Gatto, A. (2015). Impact of additive manufacturing on engineering education–evidence from Italy. Rapid Prototyping Journal.