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Assessing the alignment of educational programmes in tertiary education with the Sustainable Development Goals

oanna Mandilara, Eleni Fotopoulou, Christina-Maria Androna, Athina Thanou, Anastasios Zafeiropoulos, Symeon Papavassiliou

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Assessing the alignment of educational programmes in tertiary education with the Sustainable Development Goals

Ioanna Mandilara, Eleni Fotopoulou, Christina-Maria Androna, Athina Thanou, Anastasios Zafeiropoulos, Symeon Papavassiliou
ioannamand@netmode.ntua.gr, efotopoulou@netmode.ntua.gr, andronaxm@netmode.ntua.gr, athanou@netmode.ntua.gr, tzafeir@cn.ntua.gr, papavass@mail.ntua.gr
Network Management and Optimal Design Laboratory, School of Electrical and Computer Engineering, National Technical University of Athens, Athens, Greece

Abstract

The development of education programmes that integrate information in accordance with the targets defined in the Sustainable Development Goals (SDGs) is considered crucial for the development of innovative solutions for a more sustainable and climate-resilient future. In our work in this manuscript, we detail an approach for assessing the relationship of the teaching material in tertiary education with the SDGs, aiming to provide insights for adapting it -where required- to introduce information that is aligned with the SDGs. The assessment is automated through the usage of a software library that can provide text analysis with regards to the SDGs by taking advantage of machine learning techniques. A case study in the teaching material of a school within a polytechnic university is detailed.

Keywords: Sustainable Development Goals, tertiary education, software library, Natural Language Processing

Introduction

The Sustainable Development Goals (SDGs) regard an urgent call for action by all countries to achieve a more sustainable future for the people and the planet. They are specified by the United Nations (UN) based on the 2030 Agenda for Sustainable Development (Lee, 2016). They are a set of seventeen goals that aim -among others- to end poverty, improve health and education, reduce inequality, while tackling climate change. Each SDG has a set of targets with detailed objectives to be achieved, while each target is tracked by a set of indicators. Strong relationships among SDGs, targets and indicators appear, making inherent the need to follow holistic approaches for achieving the specified objectives.

Integration of the SDGs within educational programmes at all educational levels is considered crucial to equip future generations with the knowledge, skills, and mindset needed to tackle sustainability challenges and work towards a more equitable, prosperous, and sustainable world (Adams, 2023). Education plays a vital role for increasing the awareness over the global challenges that we face. By introducing information related to the SDGs in the educational programmes, students have the opportunity to learn about them, get accustomed to the challenges that have to be faced, their significance and the need for collective action to tackle them (Cottafava, 2023). Students can improve their sense of responsibility within our society by understanding the interlinking between social, economic, and environmental issues, while they can better assess how their choices and actions can contribute towards the achievement of the targets posed in the SDGs. Development of critical-

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thinking and problem-solving skills can help students and educators to analyze problems and promote research solutions. The latter is even more important in the case of tertiary education, given that the development of innovative solutions that can better address sustainability aspects in the various sectors can be more easily connected with their adoption by industry. Cultivation of an entrepreneurial mindset that embraces sustainability can be achieved. Collaboration among students and scientists and development of interdisciplinary approaches can be promoted, leading to solutions for tackling the identified problems from a holistic approach. This is an important element towards the design of efficient solutions to tackle and/or mitigate the climate change impact.

In this manuscript, we provide an assessment of the alignment of existing teaching material of courses in tertiary education with the description of the SDGs. To do so, we take advantage of a software library that we have developed, called as SDGDetector (Mandilara, 2023). SDGDetector gets as input text and provides as output indexes for the relationship of the text with the SDGs. A case study is detailed based on the abstracts of the teaching material of courses that are targeted to specific technological areas of the School of Electrical and Computer Engineering (ECE) of the National Technical University of Athens (NTUA).

The SDGDetector Software Library

The SDGDetector software library provides the relationship of a given text with the SDGs (Mandilara, 2023). To achieve so, it combines two machine learning techniques; a keywords extraction and mapping technique, and a deep learning Natural Language Processing (NLP) technique. In the first technique, mapping of the keywords identified in the given text is provided with existing well-known keywords classifications for the SDGs (Mandilara, 2023). In the second technique, transfer learning is applied based on a transformer-based model. Both techniques provide as outcome indexes (probability, average cosine similarity) for the association between the text and the SDGs. The results from both techniques are combined into the r_{SDG} index that provides the final indexes per SDG. A high-level view of the functionality offered by SDGDetector is depicted in Figure 1.

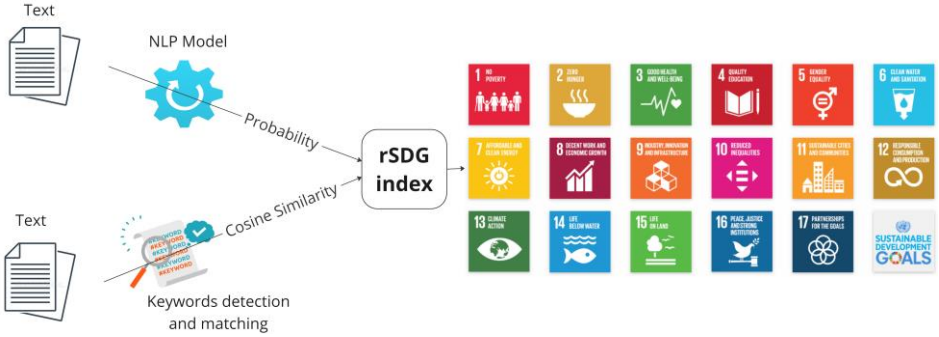

Figure 1. High-level view of SDGDetector

Case Study and Results

An analysis of teaching material has been realised, based on the abstracts of the courses provided by the ECE School of NTUA that are offered from the 6th to the 10th semester. In these semesters, specialized courses are offered that are classified under the following scientific areas (called as flows): Flow Y (Computer Systems), Flow L (Computer Software),

Flow H (Electronics, Circuits, Materials), Flow D (Telecommunication Systems and Computer Networks), Flow T (Electromagnetic Waves and Telecommunication), Flow S (Signals, Automatic Control and Robotics), Flow Z (Energy Conversion, High Voltages and Industry Applications), Flow E (Electric Power Systems), Flow O (Management and Decision Support Systems), Flow I (Bioengineering), Flow F (Physics), Flow M (Mathematics), Miscellaneous, and Humanities.

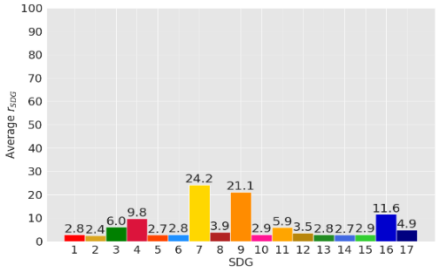

Figure 2. Average relationship of all the considered courses with the SDGs

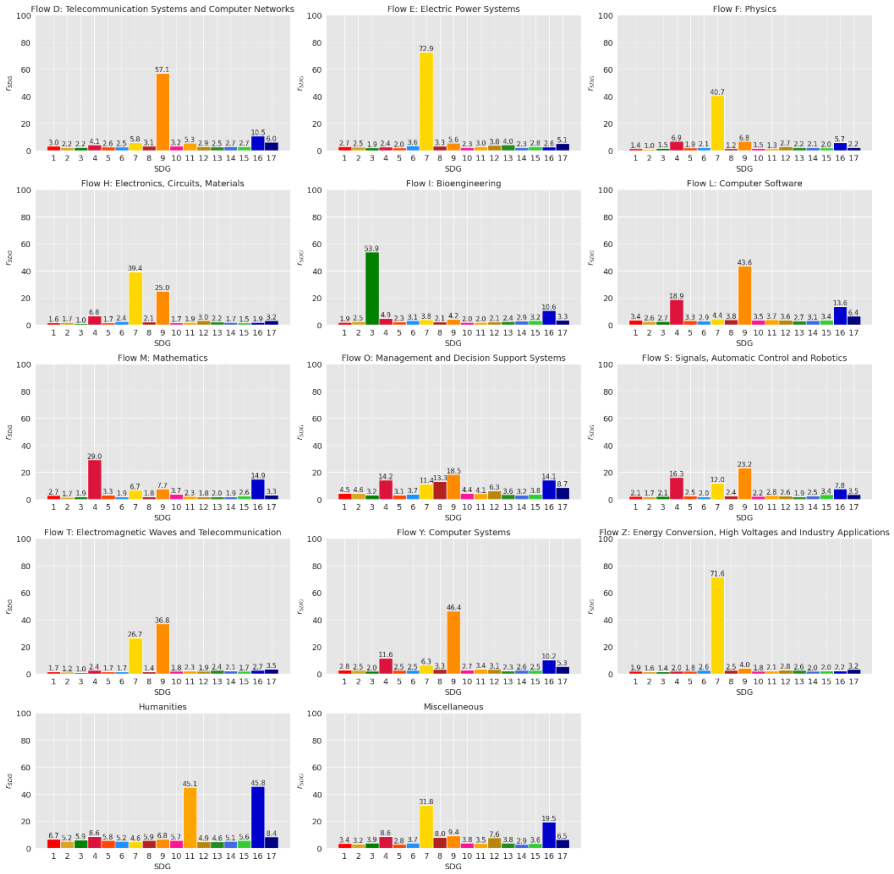

Figure 3. Average relationship of the courses per flow with the SDGs

The produced results from the usage of the SDGDetector software library are provided in Figures 2 and 3. In Figure 2, the average results for all the considered courses (153 courses in total) are provided. We notice that the highest relevance is provided for the SDGs #7 (Affordable and clean energy) and #9 (Industry, innovation and infrastructure), followed by SDGs #16 (Peace, justice and strong institutions) and #4 (Quality education). In Figure 2, the average results are provided per flow of the courses. SDG #7 is dominant in the flows E (72,9%), Z (71,6%) and F (40,7%). SDG #9 is dominant in the flows D (57,1%), Y (46,4%), L (43,6%) and in the courses under the category Humanities (45,1%). In this category, SDG #16 is highly represented (45,8%). SDG #3 (Good health and well-being) is dominant in the flow I (53,9%). Flow O seems to have a larger distribution of mappings, mainly with SDGs #4 (14,2%), #7 (11,4%), #8 (Decent work and economic growth) (13.1%), #9 (18,5%) and #16 (14,1%). The produced results seem reasonable, given the technical nature of most of the courses and the business direction of the courses offered under the flow O. However, under-representation of content aligned with the SDGs #11 (Sustainable cities and communities) and #12 (Responsible consumption and production) is noticed, since someone would expect higher percentages in these SDGs. Such an outcome can be helpful to the academic personnel of the ECE school in NTUA to integrate relevant material in the provided courses.

Conclusions

In this manuscript, we have detailed an approach for assessing the association of the content of courses in educational institutes with the SDGs, taking advantage of an open-source software that we have developed, called as SDGDetector (SDGDetector, 2023). SDGDetector can provide meaningful insights regarding the mapping of courses with the SDGs and can be considered as an enabler for realising relevant studies in the future. The results provided by the SDGDetector can accompany existing or emerging methodologies that consider the integration of content related to the SDGs into the educational programmes.

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