

## **MAPPING OF SDGS IN THE ENGINEERING AND COMPUTER SCIENCE CURRICULUM AT UNIVERSITI TEKNOLOGI MARA**

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## MAPPING OF SDGS IN THE ENGINEERING AND COMPUTER SCIENCE CURRICULUM AT UNIVERSITI TEKNOLOGI MARA

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### ABSTRACT

*Higher Education Institutions (HEIs) are central players in the achievement of the SDGs. As many HEIs strive to embrace sustainability as one of the university's core values and increase the visibility of the institutions globally, there is a need to explore the embedded curriculum framework of SDGs into programs and courses offered at Universiti Teknologi MARA (UiTM). This study is to determine the percentage of SDGs elements that have been incorporated into the university curriculum. The methodology used includes data collection using the university online syllabus system for the science and engineering and technology fields, namely all the engineering fields, Civil, Mechanical, Electrical, and Chemical Engineering, and Computer Sciences, and analyzing the results for in-depth interpretation and dimension analysis. A total of 520 courses were analyzed. The results showed that three SDGs were not addressed by the curriculum. The highest percentage of courses were mapped to SDG9 (25%) followed by SDG4 (15%), SDG 11 and SDG12 at 12%. The SDGs elements were found to be highly incorporated in mechanical engineering compared to other disciplines. The finding helps the understanding of the baseline status of sustainability in the university curriculum and opportunities to improve. It is suggested that another review needs to be executed to include the three SDGs which were addressed in the current curriculum. When all SDGs are addressed, the outcomes of the curriculum will be global graduates who are knowledgeable and responsible in ensuring a harmonized and peaceful future.*

**Keywords:** *SDG-embedded curriculum, SDG-mapped courses, university curriculum*

## INTRODUCTION

The United Nations 17 Sustainable Development Goals, or known as SDGs, were developed in the hope of eradicating poverty by the year 2030. The goals are accepted plans to achieve global peace and prosperity for everyone and everything on the planet and highlight a global vision of sustainability for the future. Among the goals are on zero hunger (SDG2), quality education (SDG4), gender equality (SDG5), decent work and economic growth (SDG8) and sustainable cities and communities (SDG11). It is therefore imperative that young generations, specifically university graduates, be fully aware of valuing and embracing SDGs to be a responsible global workforce. Education has a decisive impact on changing how societies cope with national, regional, and international challenges and opportunities brought about by sustainable development (Fleacă et al., 2018). Indeed, education itself is a stand-alone goal in the SDGs (SDG 4: quality education). As many higher education institutions strive to embrace sustainability as one of the university's core values, there is an urgent need to explore how far the university curriculum is embedded with SDGs elements.

Undeniably, higher education is one of the main drivers of the progress of a country, allowing universities to play a more prominent role in shaping the future. Thus, universities need to respond quickly and appropriately to the rapid development and changes (Utama et al., 2018) in all aspects of life. Setó-Pamies & Papaoikonomou (2020) saw that following the 2030 Agenda for Sustainable Development — academic institutions assume a much bigger responsibility to become the think tank to provide solutions and execute relevant actions on pressing social and environmental issues. Universities should be fully committed to supporting and implementing the 2030 Agenda for Sustainable Development to be effective. The SDGs are an essential vehicle for creating a positive impact by embedding sustainability into university business strategies, decision-making processes, and practices and improving their accountability to stakeholders (Mori Junior et al., 2019).

Thus, an understanding of the baseline status of sustainability in the university curriculum provides opportunities for universities to plan their strategies for sustainability and prioritize the allocation of resources accordingly Chang & Lien (2020). Universities are essential to achieving the SDGs because they can equip the next generation with the skills, knowledge, and understanding to address sustainability challenges and opportunities and perform research that advances the sustainable development agenda (Mori Junior et al., 2019). The UN Sustainable Development Solutions Network (SDSN) has recommended that universities contribute to the SDGs through four aspects, namely, education, research, governance and operations, and external leadership, to help universities engage with the SDGs.

This study aimed to investigate the number and percentage of courses at UiTM which are mapped to the UN 17 SDGs. It was guided by a previous study Chang & Lien (2020) which stated that the number of SDGs covered by a program reflects the diversity of sustainability topics covered by the course. Hence, results of the study will indicate whether the distribution of SDGs in university courses is specific or diverse. The incorporation of SDGs in the curriculum can be in the program outcome statements where it is reflected in a course or a topic in a course, a project or research. The SDG elements can also be incorporated in into a student's extra-curricular activities and get recorded.

All courses in a curriculum are possible to get embedded with SDGs.

## METHODOLOGY

This study employed a quantitative research method. The data were collected solely from the existing curriculum system of the university managed by the Curriculum Affairs Department, Department of Academic Affairs. The inclusion of SDGs elements into the curriculum of a program was through the curriculum review exercise. A curriculum review exercise is in accordance with the requirements set forth by the Malaysian Quality Assurance Agency (MQA). All information pertaining to the university academic curriculum is available in the above-mentioned academic system. Currently, UiTM has more than 10,000 courses registered in the system. The courses considered for this study were those in the engineering and computer science disciplines. The mapping analysis took into consideration whether the SDGs were specific as a stand-alone compulsory course or embedded as a topic or subtopic of a course. Other elements studied include if the SDG content is found in a student's assessment, such as in capstone projects, case studies, or other types of assessments. The analysed data are presented as tabulated data or graphs.

## RESULTS & DISCUSSION

This study analyzed 520 courses offered in the six different programs under engineering and computer science disciplines. This number includes all courses offered for the undergraduate (UG) and postgraduate (PG) programs. The mapping of courses to SDGs is shown in Table 1 and Fig. 1

*Table 1: SDGs numbers vs. number of courses in Engineering and Computer Science*

SDG ELEMENTS	SDG NO.	NO. OF SDGs MAPPED COURSES
No Poverty	1	0
Zero Hunger	2	0
Good Health & Well Being	3	46
Quality Education	4	79
Gender Equality	5	0
Clean Water & Sanitation	6	13
Affordable and Clean Energy	7	18
Decent Work & Economic Growth	8	37
Industry, Innovation & Infrastructure	9	132
Reduced Inequalities	10	7
Sustainable Cities & Communities	11	66
Responsible Consumption & Production	12	63
Climate Action	13	25
Life Below Water	14	5
Life On Land	15	11
Peace, Justice & Strong Institutions	16	5
Partnerships for the Goals	17	13

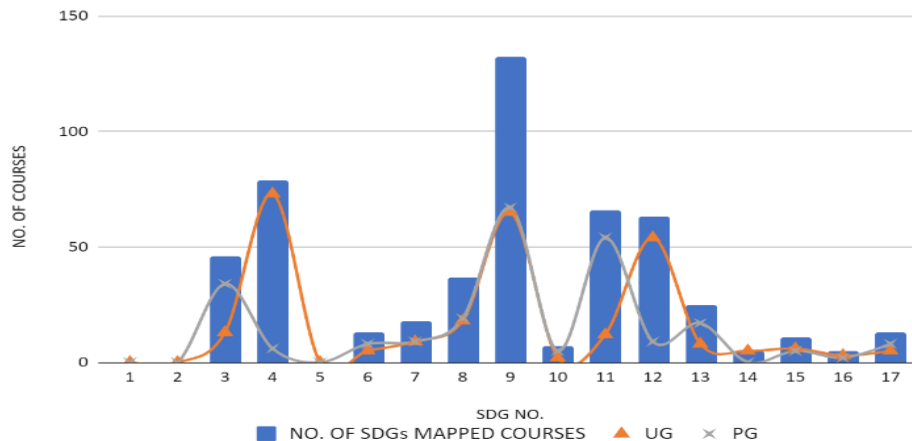


Figure 1 The distribution of SDG-mapped courses to the overall programs and to undergraduate (UG) and postgraduate (PG) programs

From Table 1, pg 216, we can see that there were three SDGs that were not mapped with any courses in the engineering and computer science disciplines. The three SDGs were SDG1, SDG2, and SDG5. Out of the 520 courses analyzed, 25% of them mapped to SDG 9, which is on industry, innovation, and infrastructure. SDG9 is obviously very much related to the hard skills engineers are expected to have. There were three other SDGs which had quite a high percentage of courses mapped to them, which were SDG4 with a percentage of 14%; SDG 11 and SDG12 at about 12% each. The engineering and computer science disciplines obviously saw the importance of having a good quality in education, hence the many courses that addressed the issue. However, there is a need for these disciplines to include SDG1, SDG2, and SDG5 in their next course of curriculum review so that no one SDGs is left behind in their curriculum.).

The distribution of courses between the UG and PG is almost equal for SDG7, SDG8, SDG9, SDG10, SDG15, and SDG16 (Fig. 1). The PG curriculum has more courses mapped to SDG3 and SDG 11 compared to the UG curriculum. On the other hand, the UG curriculum emphasized more on SDG4 and SDG12 as compared to the PG curriculum. So far, no studies have reported the mapping of engineering, and computer science courses to SDG elements. None have also reported on the distribution of courses related to SDGs between the UG and PG. Most other studies focused on reporting specific SDG elements and the related teaching and learning activities which align to the SDG elements.

The mechanical and civil engineering have the greatest number of courses mapped to the SDGs with 76 and 80 courses respectively (Figure 2, pg 218). The electrical engineering showed the least number of courses that mapped to the SDGs with just 8 courses, followed by computer science (12 courses) and chemical engineering (14 courses). For this reason, there is a need for these disciplines to revisit their curricula and adjust embed more SDGs into their curricula. As suggested by Romero et al. (2020), engineering education should focus its efforts on training engineers to be active agents of sustainability globally. Since there are three more SDG elements that have not been addressed, it is suggested that the three SDGs (SDG1, SDG2 and SDG5) should be included in their curricula. It is also to ensure that all graduates of the disciplines are well rounded in their knowledge and experience in all the SDGs.

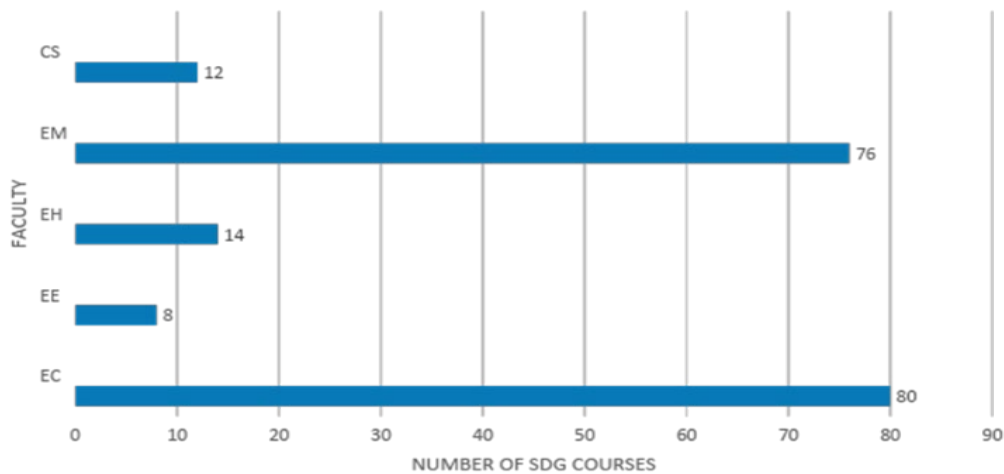


Figure 2 Number of SDG-mapped courses by the faculties. (EC - Civil Engineering, EE - Electrical Engineering, EH - Chemical Engineering, EM - Mechanical Engineering and CS - Computer Science)

In Figure 3, pg 219, it shows that among all the engineering disciplines, civil engineering has the greatest number of courses embedded with SDG elements. Mechanical engineering has more courses addressing quality education (SDG4) compared to all other disciplines. On the other extreme, electrical engineering showed the least number of courses embedded with SDG elements with just 4 SDGs (SDG7, SDG9, SDG11 and SDG12) and only 8 courses (refer to Fig. 2). For chemical engineering, although the curriculum addressed 11 SDGs out of the 17, the number of courses were still small compared to civil and mechanical engineering. The highest number of courses in chemical engineering mapped to SDG12. Computer science curriculum addressed 8 SDGs with just 12 courses (Fig. 2). The discipline will have to review more of their courses to ensure that their graduates have what it takes to be a more responsible citizen of the world. SDG10 (Reduced Equalities) was only covered by two disciplines which were civil engineering and computer science.

It was observed that the course and SDG mapping depends on the subject areas of the disciplines. The same trend was also reported by Chang & Lien (2020). They suggested that the number of SDGs covered by a course reflects the diversity of the sustainability topics covered in the course. This indicated variability within the same disciplines which Chang & Lien further suggested that the variability could provide an opportunity for trans-disciplinary development. SDGs content allows more lively class environment as real life issues can be brought to class for discussion, opening minds and enabling critical thinking, creativity and teamwork and leadership skills development.

The current study also analyzed data on how early SDGs embedded courses are introduced into a curriculum. The results are shown in Figure 4, pg. 219, where SDG-embedded courses were taught as early as in the first year of the curriculum. This indicated that there is a heightened awareness on the importance of SDGs in the curriculum and that the disciplines took serious effort in introducing SDGs to the students as early as possible. Zizka (2019) suggested that higher institutions must ensure an effective means of exposing students to the principles and concepts that reflect the students' engagement with sustainability practices. At UiTM, these aspects were reflected in the engineering and computer science

disciplines as the courses were implemented as early as the first year of studies and continued until the postgraduate level of studies.

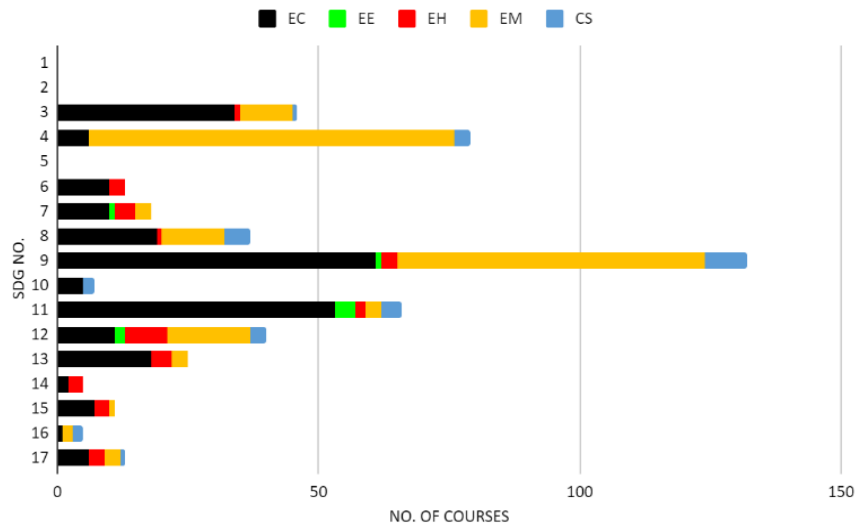


Figure 3 Distribution of SDG-mapped courses according to faculties. (EC - Civil Engineering, EE - Electrical Engineering, EH - Chemical Engineering, EM - Mechanical Engineering and CS - Computer Science)

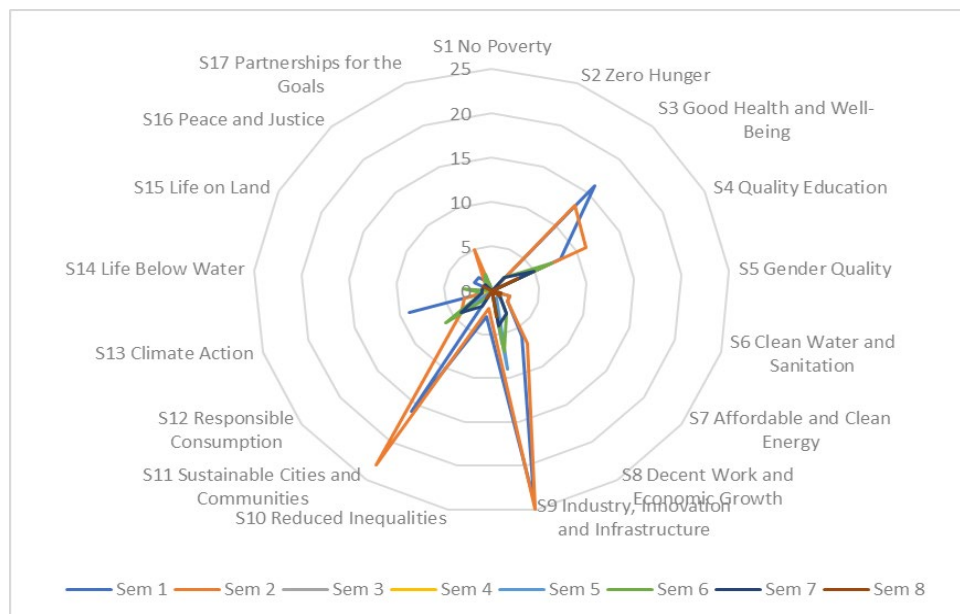


Figure 4 The mapping of SDG-courses to the period of studies in the semester where they are offered

## CONCLUSION

To conclude this report, in support of achieving the 17 UN SDGs by 2030, UiTM ensures that the curricula embed elements of SDGs at both the UG and PG levels of studies. All the engineering and computer science disciplines have taken steps during their curriculum review exercise to include SDG elements in their curriculum. However, this is the first-time report was made on the mapping of courses in the university curriculum to SDG elements. All the 520 courses under the curriculum of the engineering and computer science disciplines have elements of the SDGs embedded in them. Almost all SDGs were somehow mapped to the curriculum except for three SDGs (SDG1, SDG2, and SDG5). The civil and mechanical engineering disciplines have their highest courses mapped to SDGs, while the other three disciplines are suggested to review their curricula and embed SDGs into more of their courses in order to produce a more rounded and global graduates who embrace SDGs as their mission in life. The fact that the students were exposed to SDG elements as early as in their first year is actually a commendable effort and should be continued.

### *Author's Contribution*

Dr. Rozzana Mohd Said - main writer  
Dr. Zainab Mohd Noor - editor and lead researcher  
Dr. Masria Mustafa - data analysis

### *Conflict of Interest*

Nil

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