

Sustainable Development Goals based Thinking Skills Development Course for Engineering Students – A Case Study

Heba Y. M. Soliman¹

¹Faculty of Electrical Engineering, Port Said University, EGYPT.

ABSTRACT

“Thinking Skills Development TSD” is a major course presented to engineering students in Port Said University. The main aim of the course is to help students understanding the core concepts of creativity and critical thinking with the help of applications in everyday life. In September 2015, the General Assembly of the United Nations embraced the 2030 agenda for sustainable development that includes 17 goals to be achieved for all. These SDGs could be considered as a global plan that should be well understood by our students. Accordingly, the main application considered as a case study in the academic year 2020/2021 is the sustainable development goals. Each student was allowed to choose a certain development goal to make a development action plan concerning the Egyptian society. The action plan depended mainly on the traditional, cognitive, critical, and creative types of thinking. The students’ action plans were classified according to the SDGs chosen. Each SDG was planned to be discussed with one of the Egyptian society experts. Discussions were held according to the students’ points of view and suggestions. In this paper, we will give a complete description of the course teaching methodology, outcomes, and students satisfaction measures. A case study of SDG 3 will be presented as a practical example of our methodology.

Keywords: Sustainability, SDGs, Thinking Skills Development

1. INTRODUCTION

Port Said University is an Egyptian public university established by a republican decree in 2010 in Port Said Governorate. The establishment of Port Said University in one of Egypt's most important economic sites has had a significant impact on its strategic plan, making sustainability one of its most important goals, whether the sustainability of its educational services or spreading awareness of the principles of sustainability in general for university students or the local community. The university may offer, through its various educational programs, independent courses on the concepts of sustainability. However, it is excellent to integrate the principles of sustainability with the various study programs [1]-[3] as case studies whenever the nature of the subjects and their descriptions allow.

The course, Thinking Skills Development TSD, is taught to students of the second academic year at the Faculty of Engineering in its various scientific departments to give students the necessary knowledge about the different types of thinking and their importance in mental and cognitive processes, and the suitability of each type of thinking for various future jobs. As for a link to one of the important international issues and challenges, the sustainable development goals were taken as a case study to link their development to different types of thinking. Each student was allowed to choose one of the sustainable development goals to shed light on its current global and local situation with a vision for its development. Students should consider traditional, cognitive, critical, and creative types of thinking to analyze the chosen goal and give suggestions for improvement. Discussions with local community experts were held as a part of the case study.

*Corresponding Author: hebayms@eng.psu.edu.eg

The paper is organized as follows, some important information about Port Said university is presented in section II. In section III, the teaching and learning details of the TSD course are shown. Section IV focuses on the Sustainable Development Goals as the case study considered for effective practice of the different types of thinking. The assessment and students' feedback are discussed in section V, while conclusion is presented in section VI.

2. PORT SAID UNIVERSITY

Port Said University started with the decision of the president of Republic on 24/2/2010 to transfer Suez Canal University branch in Port Said to an independent university [4]. Port Said University is located on the north side of Egypt as shown in Fig. 1. The decision of the President of Republic, for establishing Port Said University in 2010, was the result of the continuous increase of the faculties outreaching nine educational institutions. Now, Port Said University consists of thirteen faculties including: Faculty of Engineering; Medicine; Pharmacy; Science; Commerce; Education; Physical Education; Specific Education; Nursing; Education for Early Childhood; Arts; Law and Faculty of Management Technology and Information Systems. Over 25,000 students in the undergraduate and post graduate studies are served.



Figure 1. Port Said University geographical location.

The University seeks continuous development of the educational process through assessing the educational programs and ensuring sustainable quality to obtain a prominent position and accreditation amongst local, regional, and international universities. It prepares generations of distinguished scientists, thinkers, and literary figures to be able to effectively participate in the community service, culture- building and development of environment to push the production sectors to sustainable performance.

3. THINKING SKILLS DEVELOPMENT COURSE

The Thinking Skills Development TSD course is taught to the second academic year students of all engineering specializations. In the academic year 2020/2021, four hundred and three students were targeted. The course aim is to help students to behave professionally to necessary thinking skills for Engineering standards and work to develop the profession and the community under realistic constraints such as economic, environmental, and social sustainability. Three learning outcomes are intended; communicate effectively with colleagues to recognize the basic types of thinking, use the different types of thinking to give innovative improvements of daily problems and apply the different types of thinking to give modifications of a case study as the Sustainable Development Goals.

The course is divided into eight integrated topics distributed over fifteen weeks. The course begins with the concept of thinking where creativity and memory as thinking requirements are discussed. Also, the characteristics of developing thinking skills are discussed between groups of students in an interactive way. The second topic is the components of developing thinking skills where students are directed to the importance of the educational process in developing thinking skills. As a result, the difference between thinking, creativity and innovation become clear. The types of thinking, basic traditional thinking, creative thinking, and critical thinking are included in the third topic with their different characteristics. This is the most suitable time to present the concept of sustainability and sustainable development goals for our students. After understanding the different types of thinking, students are directed to choose anyone of the seventeen SDGs to put an improvement plan for the chosen goal for the Egyptian community. In the fourth topic, the meaning of scientific thinking as a mixture of the types of thinking is presented. Students are encouraged to give examples related to their different specializations in an interactive way.

In the fifth topic, we reach the knowledge of the difference between a bad thinker and a good thinker. Planning is the sixth topic where solving problems related to the student's field of specialization in planned steps could be tested. As an extension of the sixth topic, the seventh topic discuss the different thinking strategies. The final topic gives plenty of time for the groups of students to interactively discuss various exercises in their fields of specialization to develop thinking skills. The topics and their timing are listed in table 1.

Table 1 TSD course topics

No.	Topics	Week
1	- The concept of thinking. - Creativity. - Memory. - Developing thinking skills. - Difference between thinking and developing thinking skills. - The most important characteristics of developing thinking skills.	1-2
2	- The components of developing thinking skills. - The importance of thinking in our life. - The role of the educational process in developing thinking skills. - The difference between thinking, creativity and innovation.	3
3	- Types of thinking. -Basic thinking. -Basic thinking skills. - Creative thinking.	4-6

	- Creative thinking skills.	
	- Critical thinking.	
	- Stages of the creative process.	
	- A case study on Sustainable development goals.	
4	- The meaning of scientific thinking.	
	-Complex thinking.	7
	-A map of basic thinking skills.	
	-Examples of each type of thinking skills from the field of specialization.	
5	- The difference between a good thinker and a bad thinker.	8
	- Traits and characteristics of a critical thinker.	
	Midterm	9
6	- Planning.	
	-The method of solving problems in a scientific way.	
	-Steps for feeling a problem and how to solve it?	10
	-Training in the method of problem solving through problems in the field of specialization.	
	-A case study on the future required jobs 2030-2050.	
7	- Thinking strategies and how to apply this strategy in the field of specialization.	11-12
8	- Various exercises in the field of specialization to develop thinking skills (Highly required future jobs case study).	13-15

Different teaching and learning methods are used in the teaching process. Online/ In-class lectures, presentations, tutorial, problem solving, and projects are the methods used. The assessment methods used are also diverse. Midterm examination, quizzes, presentations, and reports are examples of the methods used for students' assessment.

Two case studies are used as practical practices to examine thinking skills and practice the different types of thinking. The first case study, which will be described in detail in this paper, is to give suggestions for improving the expected outcomes of a certain Sustainable Development Goal SDG in the Egyptian community. The second one is to choose one of the expected highly required future jobs 2030-2050, making an action plan for gaining the required skills.

4. THINKING SKILLS DEVELOPMENT COURSE

The Sustainable Development Goals were adopted by all UN member states in 2015 as an international call to end the world's problems of poverty, deteriorating environmental situation, and economic and social problems by 2030 [5]. The seventeen sustainable development goals are integrated among themselves. Achieving progress in one of the goals leads to direct or indirect progress in the rest of the goals and thus achieving social and economic balance and environmental sustainability. The sustainable development goals are shown in Figure 2.

And since each individual member of the international community is required to try to achieve these ambitious goals within the limits of his ability and the responsibilities entrusted to him. This will only be done with creative efforts, skills, and the provision of technological and financial resources to achieve these goals. Based on what was mentioned previously, we found it very appropriate to activate a practical activity for students that depends on each student's choice of one of the sustainable development goals to study [6] and submit proposals to develop the chosen SDG and enhance the expected outcomes for the Egyptian society.

Our four hundred and three students were divided among the different SDGs according to their choice. Figure 3 shows the distribution of students on SDGs. The students prepared their reports on the selected sustainable development goals, answering the following questions:

- 1- What is the current international position for the selected sustainable development goal?
- 2- What is the current Egyptian position for the same goal?

- 3- What are your suggestions for developing performance commensurate with the Egyptian society classified according to the types of thinking that were previously studied?
- 4- What are the unclear matters that you want to discuss with the experts?



Figure 2. Sustainable Development Goals SDGs

The distribution of students on the various sustainable development goals varied, with a value range from twelve students interested in the goal of clean water and thirty-four students interested in the goal of good health. Accordingly, the goal of good health was chosen to be analyzed and discussed more broadly by experts from the local community. It was encouraged because Port Said governorate, in which the university is located, is the first governorate in the Arab Republic of Egypt to implement the new health insurance system known as the Universal Health Insurance UHI system, which provides health service at the highest level for all without discrimination.

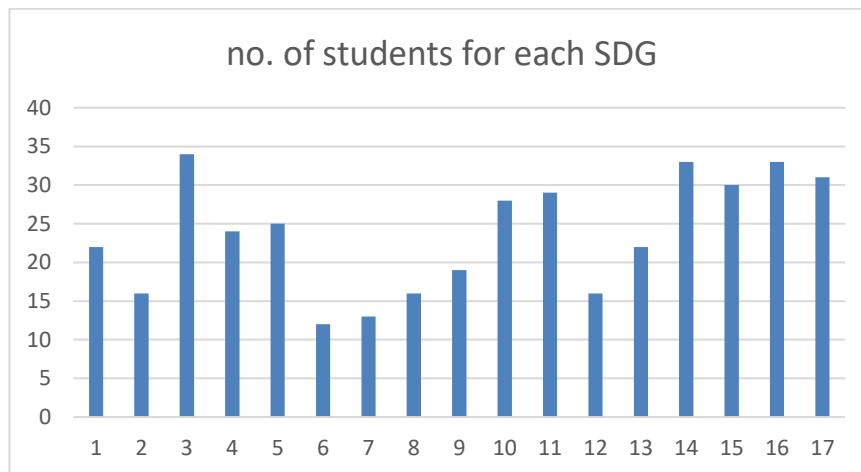


Figure 3. Distribution of students on different SDGs

Accordingly, all student reports were analyzed and their questions and suggestions were arranged. The students' reports were presented to a health development expert in Port Said Governorate, Dr. Mohamed Imam, the Cardiology consultant and former director of one of the units of the UHI system, who expressed a big interest to the students' suggestions, discussed with them, and answered their questions in an extensive panel discussion attended by the university

president and the dean of the faculty, supporting the idea of integrating sustainable development goals into the university's educational curricula. Figure 4 shows the screen shots of the online panel discussion of healthcare SDG.

The students' discussions in this context revolved around linking the SDG of achieving healthy development with the SDG of non-discrimination as it is the concept provided by the UHI system. The health initiatives were highlighted for their innovative solutions used to achieve the desired goal. They also discussed the performance criteria of the UHI system, including the importance of accrediting health units and hospitals that provide health services to citizens. The students showed great interest in the media channels of the UHI system, which enabled them to obtain the necessary information to prepare their reports.

Also, one of the important points discussed was the mechanism of raising the level of health workers through continuous training and permanent preparedness to deal with emergencies. And one of the students put forward a mechanism to redistribute workers in the medical sector according to the new conditions such as the Covid 19 pandemic.



Figure 4. Panel discussion of the healthcare SDG

The students of the Computer Department were interested in the mechanism of dealing with dense medical data and the readiness of medical information systems for this matter. They were also interested in scientific research on the health status of the Egyptian society and periodic monitoring of the health system. And through discussions in the presence of most of the students, all the goals of sustainable development and their impact on the goal of healthy development were linked. In view of the importance of health of the individual as he is the cornerstone of the development process, health improvement of students during their different life stages was also discussed.

5. ASSESSMENT AND STUDENTS FEEDBACK

Students' assessment depends on many different techniques such as midterm exam, quizzes, presentations, reports and final exam. All the assessment techniques involved use the different types of thinking as standards for qualifying the students. Beside the ordinary quality and accreditation students' satisfaction surveys, a final discussion with students on our official face-book page was held. The students' opinions were very effective and encouraging for more interaction with the society. Figure 5 shows samples of the students' opinions on face-book.



Figure 5. Samples of the students' satisfaction discussion on official face-book page.

6. CONCLUSION

Thinking Skills Development TSD is a course taught to all engineering students of Port Said University in their second academic year. All thinking types and strategies are discussed with the students in different teaching and learning methodologies. A case study to apply all thinking types is applied on development of the Sustainable Development Goals SDGs. Students' feedback was encouraging. They showed big interest in being involved in SDGs discussions and using the different thinking skills in.

REFERENCES

- [1] G. Valentin and I. Nagore, "The Sustainable University- A model for the sustainable organization", *Management of Sustainable Development Sibiu, Romania*, Vol. 6, No. 2, December 2014.
- [2] R. Lukman, P. Glavic, "What are the key elements of a Sustainable University?", *Clean Technologies and Environmental Policy*, Jan. 2007.
- [3] B. Nicolescu, "The transdisciplinary evolution of the university condition for sustainable development", Springer, 2018.
- [4] Port Said University official website, <https://psu.edu.eg/>
- [5] United Nations official website, <https://www.undp.org/sustainable-development-goals>.
- [6] J. Sachs, "The age of sustainable development", Columbia University Press, 2015.