

# INCULCATING CDIO SKILLS AT PRE-DEGREE LEVEL

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## **ABSTRACT**

CDIO engineering programmes aim at producing engineers who are ready to add value to their employers and the society at large. This is typically achieved through a balanced combination of theory and hands on practice. A key to the success of any educational programme is the quality of students' intake. In Malaysia, students planning on joining engineering programmes need to take science subjects at their pre-university studies. Good performance at subjects like Mathematics, Physics and Chemistry is highly desirable entry qualification. As a result, students who join an engineering programme may have very little preparation for the hands-on project-based learning nature for a CDIO based engineering programme.

In order to address this, the school of engineering at Taylor's University (Malaysia) has developed a one-year Foundation in Engineering programme that contains a suitable hands-on component and aims at developing students' global awareness and ability to think and take ownership of their own development.

## **KEYWORDS**

Project based learning, curriculum design, foundation in engineering.

## **INTRODUCTION**

The School of Engineering at Taylor's University (Malaysia) is the first and currently the only school in the country that is a collaborator in the CDIO initiative. The School offers three undergraduate programmes in chemical engineering, electrical & electronic engineering and mechanical engineering. These three programmes are designed to be project based and students work in teams on projects starting the first semester. To qualify for these programmes, a candidate needs to successfully complete a year 12 or equivalent qualification with mathematics, physics, and English modules. Majority of the secondary school programmes that feed into Taylor's University programmes focus on preparing the students to pass the exams with little preparation in project-based learning. This poses a challenge to some students to adapt to the School's environment. Against this background, the School decided to introduce its own Foundation in Engineering (FIE) programme that will prepare students for success at the engineering programme of their choice. CDIO principles are chosen to be the guiding principles for the curriculum design. Crawley et al [1] mapped the CDIO syllabus to the UNESCO four pillars of learning [2] and the mapping is shown in Table 1.

Table 1. Mapping of CDIO Syllabus to UNESCO's Four Pillars of Learning.

	CDIO Syllabus Categories	UNESCO Four Pillars of Learning
1	Technical Knowledge and Reasoning	Learning to Know
2	Personal and Professional Skills and Attributes	Learning to Be
3	Interpersonal Skills, Teamwork and Communication	Learning to Live Together
4	Conceiving, Designing, Implementing and Operating Systems in the Enterprise, Societal and Environmental Context	Learning to Do

## FOUNDATION IN ENGINEERING PROGRAMME OUTCOMES

At the end of the programme, successful candidate will

1. Appreciate the role engineering & technology plays in developing and sustaining human civilization.
2. Exhibit thinking skills and triumphing over challenges abilities.
3. Communicate effectively.
4. Effectively search for information from different sources including online sources and reference them properly.
5. Apply team strategies and contribute positively to team objectives.
6. Use science and mathematics to describe real world phenomena.
7. Analyse various challenges using the Scientific Method.
8. Conceive, Design, Implement and Operate simple engineering systems and products.

These programme outcomes are mapped against the CDIO syllabus in Table 2 and against the UNESCO's four pillars of learning in Table 3.

Table 2. Foundation in Engineering Programme Outcomes Mapped against CDIO Syllabus.

CDIO Syllabus	Programme Outcomes							
	1	2	3	4	5	6	7	8
1.1 Knowledge of Underlying Mathematics, Science						✓		
1.2 Core Engineering Fundamental Knowledge						✓		
1.3 Advanced Eng. Fundamental Knowledge, Methods, Tools						✓		
2.1 Analytical Reasoning and Problem Solving		✓				✓	✓	
2.2 Experimentation, Investigation and Knowledge Discovery						✓		
2.3 System Thinking		✓						
2.4 Attitudes, Thought and Learning	✓							
2.5 Ethics, Equity and Other Responsibilities				✓				
3.1 Teamwork					✓			
3.2 Communications			✓					
3.3 Communication in Foreign Languages			✓					
4.1 External, Societal and Environmental Context	✓							
4.2 Enterprise and Business Context								✓
4.3 Conceiving, Systems Engineering and Management								✓
4.4 Designing								✓
4.5 Implementing								✓
4.6 Operating								✓

Table 3. Foundation in Engineering Programme Outcomes Mapped against UNESCO's Four Pillars of Learning.

UNESCO Four Pillars of Learning	Programme Outcomes							
	1	2	3	4	5	6	7	8
Learning to Know				✓		✓		
Learning to Be	✓	✓	✓					
Learning to Live Together					✓			
Learning to Do						✓	✓	✓

## PROGRAMME STRUCTURE

The Foundation in Engineering programme is a 50 credit hour programme that runs for 2 semesters (18 weeks each). Table 3 shows the different modules that the students are going to take over the two semesters.

Semester 1		Semester 2	
Module	Credits	Module	Credits
Physics 1	5	Physics 2	5
Chemistry	5	Engineering Design	4
English 1	4	English 2	5
Engineering, civilization and future of humankind	3	Calculus	5
Algebra & Geometry	5	Malay Language	3
Malaysian Studies 1	3	Malaysian Studies 2	3
Elective 1	3	Elective 2	3
	25		25

Besides the standard mathematics, science and language modules, modules such as "Engineering, Civilization and the Future of Humankind" and "Engineering Design" are used to integrate the other modules and put them into an engineering perspective allowing for the development of the programme outcomes. This is done through involving groups of students in carefully prepared design and build projects. Students will not only design and build their projects but also make economic, social and environmental analysis of their impact.

This programme is envisaged to provide a solid foundation that will well prepare students to undertake a CDIO based engineering programme.

## CONCLUSIONS

A project-based Foundation in Engineering programme is designed based on the CDIO syllabus and the UNESCO's four pillars of learning. The programme is aimed at preparing the students well to study an engineering programme of their choice in a hands on a project based environment.

## REFERENCES

- [1] Edward F. Crawley, William A. Lucas, Johan Malmqvist, Doris R. Brodeur. "The CDIO Syllabus v2.0 An Updated Statement of Goals for Engineering Education". Proceedings of the 7th International CDIO Conference, Technical University of Denmark, Copenhagen, June 20 – 23, 2011.
- [2] The Four Pillars of Learning. <http://www.unesco.org/new/en/education/networks/global-networks/aspnet/about-us/strategy/the-four-pillars-of-learning/>

### ***Biographical Information***

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