INTEGRATING AWARENESS OF CAREER PROSPECTS INTO YEAR-1 CHEMICAL ENGINEERING CURRICULUM

Sin-Moh CHEAH

Singapore Polytechnic

ABSTRACT

This paper explains the effort from the Diploma in Chemical Engineering (DCHE) from Singapore Polytechnic in contextualizing education and career guidance (ECG) efforts to strengthen students' understanding of career prospects in their chosen discipline.

This paper introduces a national initiative from the Singapore Government called SkillsFuture aimed at providing Singaporeans with the opportunities to develop their fullest potential throughout life, regardless of their starting points. This paper specifically focuses on the first of four strategic thrusts, which is to help individuals make well-informed choices in education, training and careers. More specifically, the paper shares our experience in designing a new activity for the Year 1 module *Introduction to Chemical Engineering* using the CDIO Framework that exposes our fresh intake of students to various job functions that can be performed by chemical engineering graduates. It firstly outlines ECG in Singapore's context, as articulated by the Ministry of Education, existing approaches to expose students to various job functions of chemical engineers, and some notable shortcomings. Secondly, it presents the outcome of a CDIO self-evaluation process for the module that highlighted the need to align student learning with requirements of ECG. The paper then focuses on detailing the design of the learning task, entitled "A Day in the Life of a Chemical Engineer". An innovative feature of this activity is that we created a scenario whereby the entire class of 20-24 students are all employees of a fictitious chemical company, focusing on several department and/or divisions where chemical engineers are employed, including process design, technical support, operation, quality assurance, maintenance and EHS (environmental safety and health). The activity simulates a 'typical' day in a chemical engineering company in which students also need to situationally interpret and respond appropriately to elements of change introduced into the task scenario. The use of cooperative learning is employed to facilitate individual accountability as well as a focus on developing communication and team-working skills.

Next, the paper shares our findings from students regarding their learning experience in this activity. Although the results are largely positive, there is clearly an area for improvement in the most important aspect of the activity: career awareness. This is followed by our reflection of the learning points gained and concludes with several ideas for moving forward.

Keywords: *Chemical Engineering, Active Learning, Education and Career Guidance, CDIO Standards 1, 4, 7, 8*

INTRODUCTION

At the national level, the Singapore Government introduced a new initiative in 2015 known as SkillsFuture (http://www.skillsfuture.sg/) that has far-reaching impact on all educational sectors, in particular the polytechnics, which aim is to prepare graduates for the workforce. SkillsFuture is spearheaded by the SkillsFuture Council, whose task is to develop an integrated system of education, training and career progression for all Singaporeans, promote industry support for individuals to advance based on skills, and foster a culture of lifelong learning. SkillsFuture strives to provide Singaporeans with the opportunities to develop their fullest potential throughout life, regardless of their starting points. Through this movement, the skills, passion and contributions of every individual will drive Singapore's next phase of development towards an advanced economy and inclusive society. There are four key thrusts under SkillsFuture: (1) Help individuals make well-informed choices in education, training and careers, (2) Develop an integrated high-quality system of education and training that responds to constantly evolving needs, (3) Promote employer recognition and career development based on skills and mastery, and (4) Foster a culture that supports and celebrates lifelong learning.

This paper focuses on the first strategic thrust, sharing the experience from the Diploma in Chemical Engineering (DCHE) from Singapore Polytechnic (SP) in designing a new activity for Year 1 students using the CDIO Framework to complement the Education and Career Guidance (ECG) introduced by the Ministry of Education (MOE) in support of SkillsFuture. The aim is to retain existing students who enrolled into our program to provide an understanding of the type of jobs a chemical engineer can engage in. DCHE is a 3-year program with annual intake of 120-125 students. The course aim is "to produce Chemical Engineering technologists equipped with a solid foundation in Chemical Engineering qualified to assume responsible positions in the chemical process industries and with the ability to continue learning after their formal training." Example of positions and responsibilities that are held by DCHE graduates in various sectors of the chemical process industries are as shown in Table 1.

Table 1. Profiles of DCHE Graduates in Chemical Process Industries

Industries	**Profiles of DCHE Graduates**
Chemical, Petroleum and Petrochemical	Graduates operate and supervise process plants, assist engineers in process development, quality control, effluent treatment, and waste and energy management.
Pharmaceutical, Bioprocessing, Healthcare, Fine & Specialty Chemicals	Graduates assume positions in the production and quality assurance of pharmaceuticals, biopharmaceuticals, healthcare products and other fine and specialty chemicals.
Environmental, Safety & Health	Graduates provide support in environmental management and pollution control, management of hazardous substances, NEWater production, and can assume technical positions in the area of process safety and industrial hygiene.
Process and Computer Control	Graduates provide technical support in the areas of instrumentation, control systems design and information management.
Process Design & Development	Graduates provide process system design support and customer services.
Semiconductor and LCD Industry	Graduates assume positions in production and/or plant utilities, and provide technical support in the areas of process instrumentation & control.
Allied Industries	Graduates assume positions in technical project management, sales and marketing. Given adequate working experience and skills upgrading, it is anticipated that DCHE graduates will progressively take on roles as senior technologists, engineers, shift team leaders or supervisors, and eventually management related positions.

EDUCATION AND CAREER GUIDANCE

Education and Career Guidance (ECG) is about equipping students with the necessary knowledge, skills and values to make informed decisions at each key education stage for successful transition from school to further education or work, and hence to manage their career pathways and lifelong learning throughout their lives (MOE, 2015). The aims of ECG are to:

1. nurture student’s self-awareness, self-directedness and life skills for continuous learning and training; (Skills)
2. enable students to explore viable education and career options through the provision of accurate and comprehensive information; (Knowledge)
3. inculcate an appreciation for the value of all occupations and how they contribute to the well-functioning of society; (Mindsets) and
4. equip students with skills and means to positively engage their parents and other career influencers (Engaging the community).

Table 2. Key Features of MOE ECG

<table>
<tr><th>Education</th><th>Emphasis</th><th>Goal</th><th>Lessons</th></tr>
<tr><td>Primary</td><td>Awareness</td><td>To introduce students to the wide array of occupations, including new jobs created in this ever-changing world-of-work. Students will develop an awareness on their:
• interests, abilities and career aspirations.
• relation of self to others and work.
• initial preferences in career roles assumed in play.</td><td>ECG lessons for the Primary 3 to 6 levels have been part of the Form-Teacher Guidance Period (FTGP) package since 2012. These lessons and interaction activities are designed to:
• raise students’ awareness of their strengths and interests.
• help them plan their educational pathway and select secondary schools.
• provide more opportunities to explore different careers and nurture their aspirations for the future.</td></tr>
<tr><td>Secondary</td><td>Career Exploration</td><td>To deepen students’ understanding of self and relate schooling to different education and career pathways. Students would:
• explore the career world.
• understand the relevant courses of study.
• develop awareness of their skills, interests and values.</td><td rowspan="2">For secondary schools, ECG lessons are conducted as a module under the Character and Citizenship Education (CCE) curriculum. These lessons are progressive in nature, with each lesson building upon previous lessons, and cover the following areas:
• 3 Big Ideas: Identity, Choices, Relationships
• 4 themes: Self-awareness and self-management, Awareness of relational support and decision influencers, Exploring the education landscape and planning pathways, Career sectors exploration
• 3 ECG questions: Who am I? Where am I going? How do I get there?
The pre-U syllabus focus on 'being ready for the future', and covers 3 themes: My career identify, Working in a globalized world, Preparing for the changing landscape</td></tr>
<tr><td>Upper / Post Secondary</td><td>Career Planning</td><td>To enable students to gather information from various sources to make informed educational and career decisions. Students would learn to:
• clarify their career self-concept.
• develop skills in gathering information.
• develop decision-making skills.</td></tr>
</table>

MOE noted that awareness, exploration and planning are necessary for all levels of students, and also acknowledged that there would be different emphases at the different levels to meet varying developmental needs. This is shown in Table 2. MOE also prefers that ideally, schools should be rolling out ECG through a multitude of platforms, in order to ensure good implementation of the total curriculum for ECG.

In our context, ECG will be implemented into all diplomas based on the framework shown in Figure 1 below.

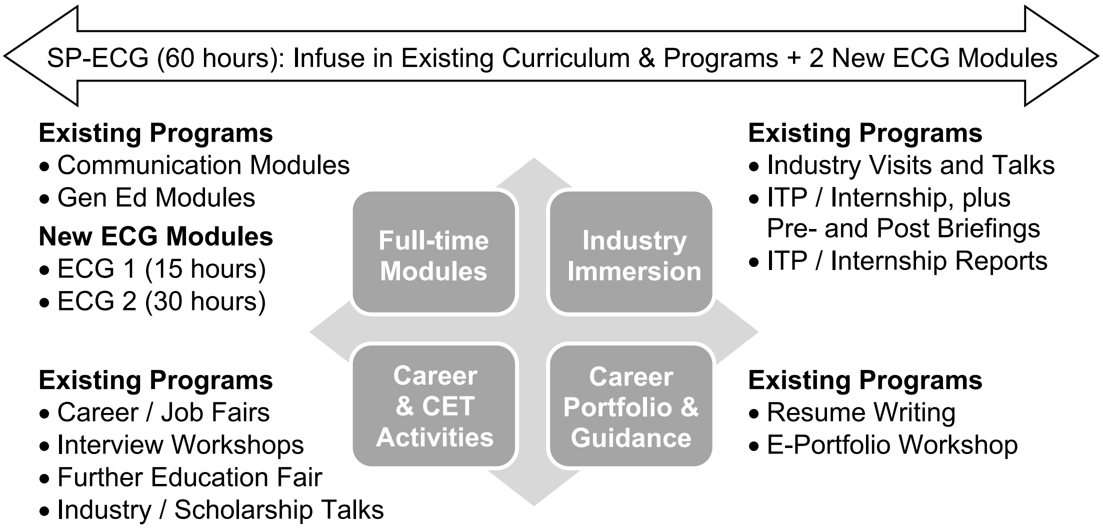

Figure 1. SP Framework for Integrating ECG into its Diplomas

EXISTING DCHE EFFORTS AT CREATING CAREER AWARENESS AMONG STUDENTS

Consistent with CDIO Standard 1, we used a variety of approaches aimed at instilling in DCHE students awareness of what chemical engineering is really all about. The existing efforts are mostly conducted within the diploma, where we explicitly expose students to the chemical engineering profession via core modules in all three years of study; and supplement these with Year 2 Industrial Training Program (ITP); Year 3 industry-sponsored projects as well as co-curricular activities (CCAs) such as industry talk, etc. For our Year 3 students, we also leveraged on the SP-wide Career Fair to introduce students to potential employers. In addition, we also hold career talks for companies on as-needed basis. The following paragraphs explain in greater details the within-diploma efforts conducted over the diploma's 3-year duration. Broadly, the effort can be categorised as follows:

- Year 1 – awareness of chemical process industries, roles and responsibilities of chemical engineers, technologists and technicians.
- Year 2 – in-depth experience in generic areas of chemical engineering professions in core modules via a variety of simulated work environment in the laboratories, which we termed 'engineering practice' (Cheah & Yang, 2013).
- Year 3 – more in-depth experience in generic areas via the remaining core modules, as well as specialized topics in free-elective modules from 3 Concentration Paths (Petrochemical Engineering, Biopharmaceutical Engineering and Environmental Engineering) which introduces students to specific nuances in these areas; or alternatively via real-world immersion in a chemical company for a minimum of 15 weeks in the Internship Path.

Year 1 students are first introduced to the chemical process industries by a dedicated core module, *Introduction to Chemical Engineering* which is taught to all students in Semester 1. The module aims to provide students with basic understanding of the profession of chemical engineering and fundamental of chemical engineering principles and applications of engineering measurements. It is a 75-hour module, of which 11 hours is devoted to introduce students to the profession, as noted by the following General Learning Outcome statements under the very first topic, Topic A "World of Chemical Engineering":

1. Understand History, Evolution and Achievements in Chemical Engineering
2. Describe Roles and Responsibilities of Chemical Engineers

The other 4 topics in the module are:

B. Chemical Engineering Calculations
C. Chemical Engineering Processes and Process Variables
D. Unit Operations of Chemical Engineering
E. Introduction to Chemical Engineering Laboratory

It is worth noting that Topic E comprises of 15 hours of laboratory activities that serve to provide hands-on application of the concepts learnt in Topics B, C and D. There is no activity to support Topic A, and students only get to appreciate what chemical engineering is all about during lectures and tutorials.

As for CCAs, our Year 1 students take part in ChemEx, the annual Jurong Island Open Day. Our students partnered with the Singapore Chemical Industry Council (SCIC) in organising educational games for secondary school students who visited the event. We also invited SCIC as well as the Economic Development Board to deliver industry awareness talks to our students. In addition, we also organized plant visits for our Year 1 students.

In Year 2, our students are heavily involved in various laboratory activities which had been re-designed using CDIO Framework to simulate real-world working environment. Through scenario-based learning, students took on various roles and responsibilities in tackling industry-type work challenges such as troubleshooting plant operations, dismantling and assembling a pump, making recommendations of suitable packing material, writing technical memos, evaluating the performance of a heat exchanger, etc. In addition, our students need to complete a 6-week ITP either at a local company or at the Chemical Process Technology Centre (CPTC), a professional training company that offers live plant training that include working in shift teams. Students who successfully completed the CPTC training will be awarded the Singapore Workforce Skill Qualification (WSQ) Certificate in Process Technology (Chemical Production).

In Year 3, in addition to the SP-wide Career Fair mentioned previously, we also organize our own diploma-specific career talks for our students. However, it is usually done on an ad hoc basis, at the request of companies from the chemical processing industries. Specific career roles may also be emphasized in relevant core modules by the lecturer teaching the module (core or free electives), although this approach may not be consistently used by all lecturers.

DESCRIPTION OF THE NEW INITIATIVE

The motivation for the new activity came from the recent focus in Singapore to improve career guidance to our students. Even though DCHE ranked favorably in the annual Graduate Employment Survey, the DCHE Course Management Team (CMT) nonetheless felt that more could be done in this aspect. This is consistent with the spirit of continual improvement that we adopted to further strengthen our curriculum. We need to complement our DCHE training hallmark – engineering practice – as mentioned in earlier section.

This paper focuses on a new initiative implemented for *existing* Year 1 students. It aims to better familiarize these incoming students with what a career in chemical engineering is all about. With this, we hoped that any students who came in with different (or wrong) expectations will either see the value and opportunities this course offers and hence stay on; or make an informed decision to transfer to another course. Granted, attracting the 'right' students in the first place would be a better strategy, rather than dealing with students with mismatched expectations after they enrolled into the course. Indeed we have also been active in this area. However, we are all very familiar with the challenges one faced in today's digital age, and initiatives by the CMT in these areas are beyond the scope of this paper. There are already many publications on the need to interest secondary school students in pursuing careers in engineering (see for example, Reynolds et al, 2009; Prieto, et al, 2011; Klimovski, et al, 2012; Andrews and Clark, 2013). This initiative focus on existing Year 1 students, and is aimed at complementing existing campus-wide ECG initiative, by providing our students with understanding ECG in the disciplinary context for chemical engineering.

The initiative started with a review of the Year 1 core module *Introduction to Chemical Engineering*, as part of the annual module review exercise. This module was introduced into the DCHE curriculum for the first time in 2008, when we rolled out our CDIO-type curriculum. The module is meant to satisfy CDIO's Standard 4 Introduction to Engineering, which is "an introductory course that provides the framework for engineering practice in product and system building, and introduces essential personal and interpersonal skills." The review of this module is worth special mention. In the case of DCHE, with our adoption of the CDIO Framework, we had integrated the 12 CDIO Standards into the AQMS to drive our continual improvement efforts (see Cheah, Koh & Ng, 2013). We subsequently adapted the 12 Standards for use at module-level, both for review of existing modules (Cheah & Lee, 2015) as well as design of new modules (Cheah & Koh, 2014). A major outcome of the review of this module is an insight that students lacked learning experiences where they can better appreciate various other career prospects in chemical engineering besides the obvious manufacturing environment. This led to the need for a new activity to promote greater awareness on career options for chemical engineers. Consistent with CDIO Standard 7 Integrate Learning Experiences, it is ascertained that the design of this activity must permit students to immerse themselves in a simulated real-world work environment in which chemical engineers of various job functions, technologists and technicians work together and interact with each other in a typical working day. The activity is aptly named "A Day in the Life of a Chemical Engineer".

From the onset, we decided to inject a different learning experience into this new activity, to make it distinct from other activities in the module that emphasized applying technical knowledge learnt in class. Drawing on our previous work experience in the chemical processing industry and referencing the relevant section of the SP-CDIO Syllabus (see Table 3), we came up with the following desired learning outcomes for the new activity:

- Explain employment opportunities in a variety of job functions in chemical engineering
- Explain career progressions in the field of chemical engineering
- Explain importance of communication in technical coordination
- Explain importance of teamwork – within team and across teams
- Explain importance of staying current in latest chemical engineering practice
- Explain importance of managing and responding to change
- Explain importance of self-directed and independent learning

Table 3. Selected Section of the SP-CDIO Syllabus

2.5	PROFESSIONAL SKILLS AND ATTITUDES
2.5.2	*Demonstrate professional behavior at work and in society*
	Use ethical reasoning on issues relating to human conduct in personal and professional contexts
	Identify behaviours that demonstrate social responsibility
	Demonstrate behavior consistent with agreed codes of ethics and values systems
2.5.3	*Staying current on emerging research and practices*
	Analyse current research and practices in own professional field
	Identify the impact of new research and technology on engineering practices
4.2	ENTERPRISE AND BUSINESS CONTEXT
4.2.4	*Understand Organizational Structure and Dynamics*
	Define the function of management and organizational structure
	Describe various roles and responsibilities in an organization
	Describe the roles of functional and program organizations
	Describe working effectively within hierarchy and organizations
	Describe change, dynamics and evolution in organizations

In the design of the learning activity, we used cooperative learning to promote student engagement. According to by Felder and Brent (2003), several definitions of cooperative learning have been formulated, and the one most widely used in higher education is that of David and Roger Johnson of the University of Minnesota (1999). In this model, cooperative learning is instruction that involves students working in teams to accomplish a common goal, under conditions that include the following elements:

1. **Positive interdependence.** Team members are obliged to rely on one another to achieve the goal. If any team members fail to do their part, everyone suffers consequences.
2. **Individual accountability.** All students in a group are held accountable for doing their share of the work and for mastery of all of the material to be learned.
3. **Face-to-face promotive interaction.** Although some of the group work may be parcelled out and done individually, some must be done interactively, with group members providing one another with feedback, challenging reasoning and conclusions, and perhaps most importantly, teaching and encouraging one another.
4. **Appropriate use of collaborative skills.** Students are encouraged and helped to develop and practice trust-building, leadership, decision-making, communication, and conflict management skills.
5. **Group processing.** Team members set group goals, periodically assess what they are doing well as a team, and identify changes they will make to function more effectively in the future.

We created a scenario whereby all students are employees of a fictitious chemical company. We created a partial organization chart with several departments; and divided the students into 5 groups of 4-5 students, and each group belongs to a different divisions of the same department, or in different departments, as shown in Figure 2.

Some of the unique features of this activity are:

- Each group will have, within the broad general scenario, a specific scenario that focus on a particular work/functional area within the Department and/or Division
- All members within each group will have his/her own respective roles and responsibilities

- Cross-interaction between Departments and Divisions, which necessitates some memo writing
- Some of the process log data and laboratory test results were deliberately manipulated so that they are erroneous – this is to inculcate critical thinking among students
- “Unexpected” events being injected into the tasks, to simulate scenarios where the students need to deal with changes in routine/protocol
- Ethical dilemma where personal favour is being solicited using positional power
- Apply Excel in preparing technical charts, thereby making use of the skills taught during ‘Excel Day’ (one of the several ‘white space’ activities, organized the staff and/or DCHE Student Chapter)
- Need for information not-yet-taught in class or will not be taught in class: to inculcate information literacy skills essential for independent learning in support of lifelong learning

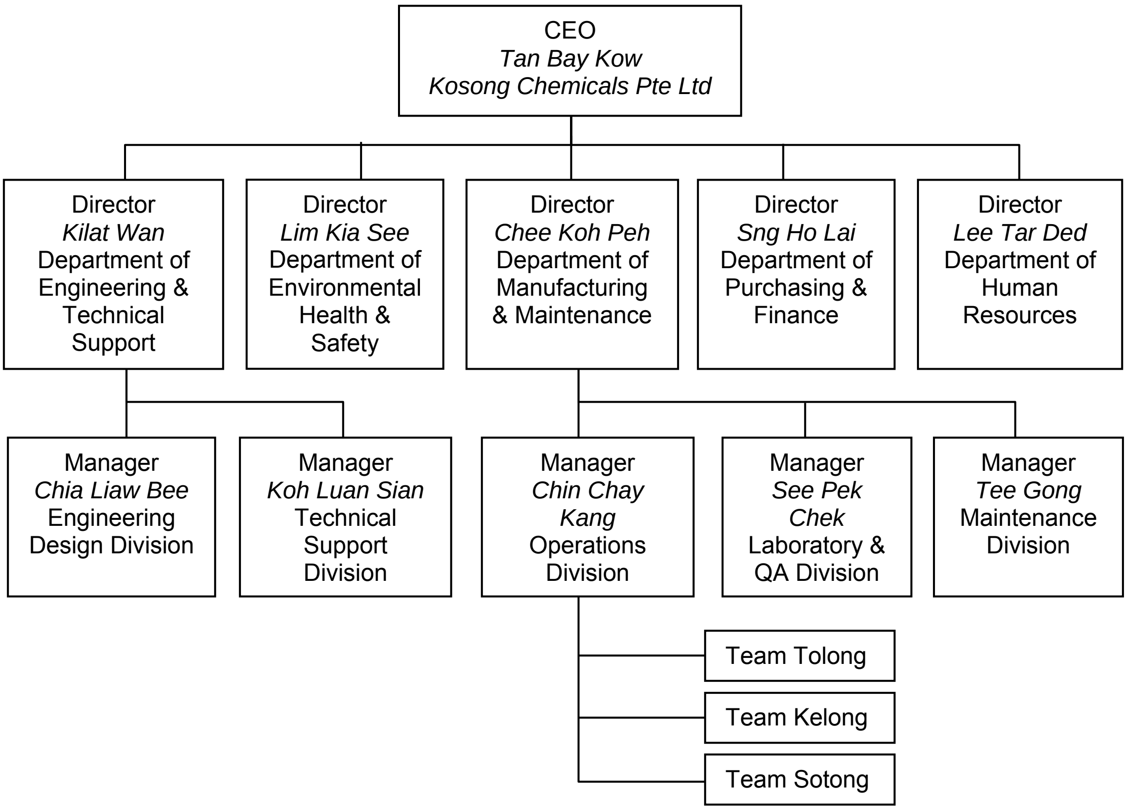

Figure 2. Organization chart (partial) for a fictitious chemical company

DISCUSSION: EVALUATION OF STUDENT LEARNING EXPERIENCE

We conducted a simple survey to ascertain students’ learning experience after they completed the activity. We use a 5-point Likert scale ranging from ‘1’ for ‘Strongly Disagree’ to ‘5’ for ‘Strongly Agree’; for the following questions:

1. The activity gives me a good overview of work life of a chemical engineer.
2. The activity improved my understanding of different job functions available for chemical engineer.
3. The activity improved my understanding of possible career paths for chemical engineer.
4. In addition to technical knowledge, it is equally important to possess “soft“ skills such as communication, coordination, team-working, etc

5. The documents used in the activity (e.g. data logging sheet, work order request, test result sheet, etc) add realism to the learning task.
6. I am able to carry out independent learning on topics that are required in the activity but not taught to me in class.
7. It is important to be able to deal with change or disruption that can happen in seemingly routine work.
8. It is important to understand the different perspectives of co-workers from other departments or divisions.

We also asked for comments from 3 open-ended quesitons:

- Name one aspect of the activity that you find **most** interesting, and explain why.
- Name one aspect of the activity that you find **least** interesting, and explain why.
- Suggest one area of improvement in the activity. Please be as detailed as possible.

The results are shown in Figures 3 – 10. Overall, our students felt that the activity gave them a good overview of working life of a chemical engineer (Figure 3), and the different job functions that a chemical engineer can engage in (Figure 4). Majority of the students felt that there is sufficient realism in the learning task (Figure 7). We are quite pleased with the response to this question, as it showed that our effort in painstakingly designing the various documents e.g. safety data sheet, log sheet, test result report, etc looked authentic, even though the company itself is fictitious.

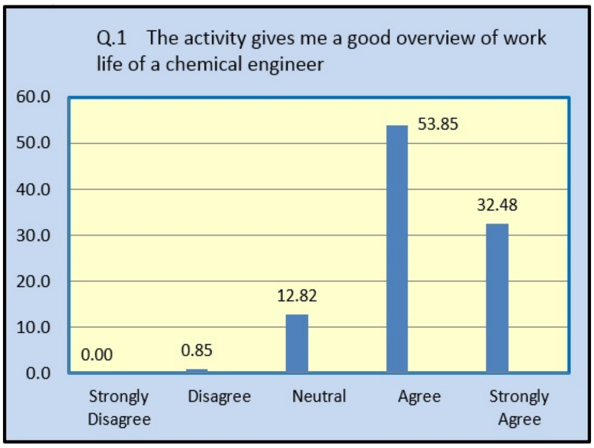

Figure 3. Response to Question 1

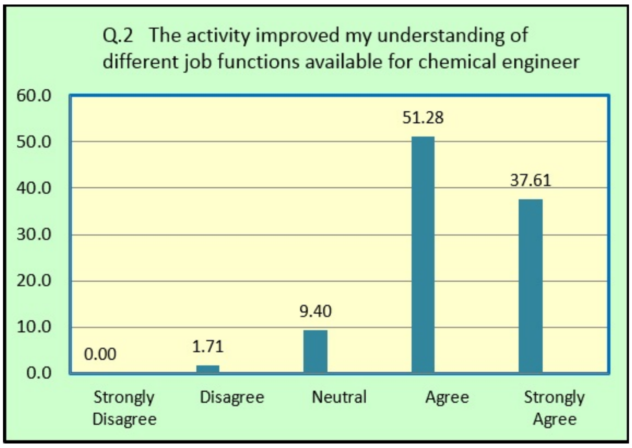

Figure 4. Response to Question 2

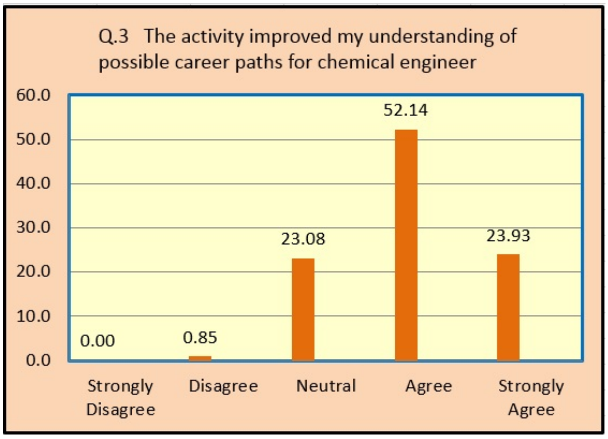

Figure 5. Response to Question 3

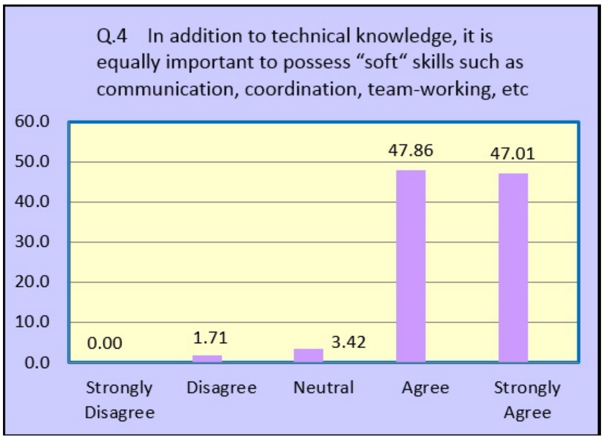

Figure 6. Response to Question 4

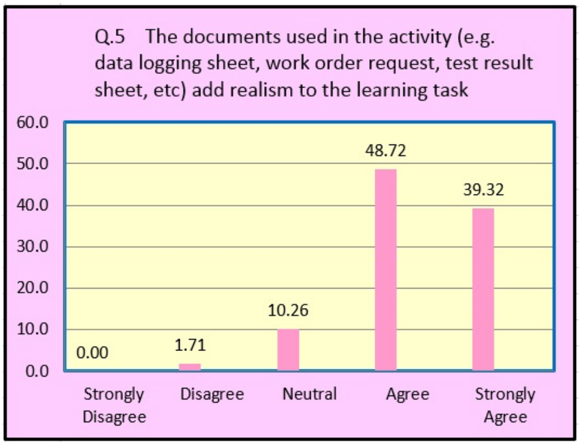

Figure 7. Response to Question 5

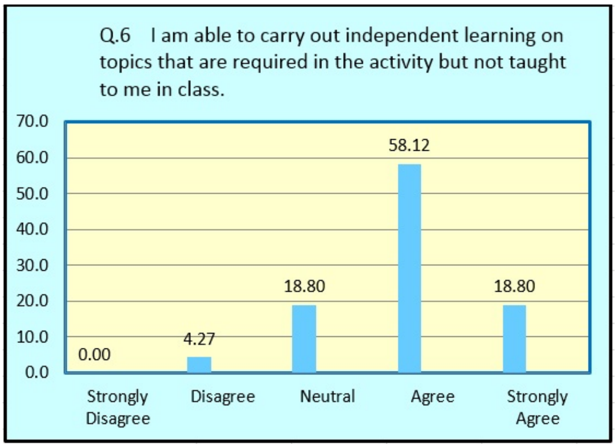

Figure 8. Response to Question 6

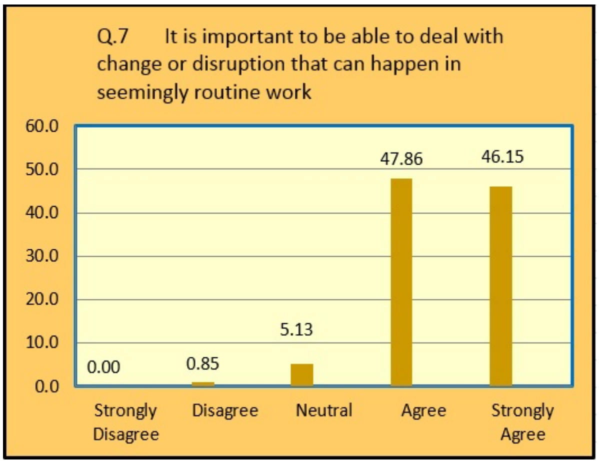

Figure 9. Response to Question 7

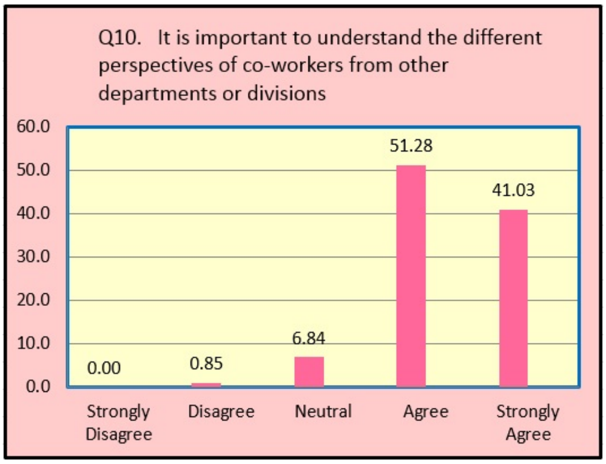

Figure 10. Response to Question 8

The students also agreed that it is important to possess the necessary soft skills such as teamwork, communication and coordination skills, in addition to sound technical knowledge (Figure 6), in particular, being able to see an issue from different perspectives (Figure 10). The students also understand the importance of being able to deal prompt with issues that may arise out of seemingly routine work (Figure 9). However, a significant number of students gave a neutral feedback about their ability to learn independently (Figure 8). We take this to mean that they are - at this early stage of study - still lacking in confidence in their own ability in this area, and this is certainly an area that we will continue to develop in our students in subsequent semesters.

Lastly, and most importantly, quite a large number of students (27, to be precise; out of 117 who responded to this survey, or 23.08%) noted that they are not very clear of career path available for a chemical engineer (Figure 5). Although there were clear instructions on allocation of roles among students within each Department, Division or Team, this does not appear to bring across the understanding of career pathways for employees in a chemical company that we had hoped for. This is perhaps because we did not explicitly highlight this in the activity but left it to the students to infer this for themselves from the organization chart.

As for the open-ended questions, almost all students cited the realism of real-world experience in working on the reverse osmosis (RO) pilot plant and collecting water samples for analysis as the most interesting part of the activity. Other interesting aspects of the activity include working together as a whole class, communicating using walkie-talkies, and being able to work out a solution for the RO pilot plant even though they had not learnt that topic. On the other hand, on aspects of the activity that they enjoyed the least, students mentioned report writing and other paperwork such as filling out test reports, data logging sheets, etc. Some found the preparation needed to get ready for the activity takes too much time, while others felt that for certain roles they did not interact enough with others.

Lastly, on areas of improvement, many students indicated that they wanted more interactions between the different groups. They also felt that some of the instructions are not clear and in fact requested for more information. And perhaps not surprisingly, many of them asked for less report writing. Many students also felt that they need more time to complete the tasks. A handful of students even asked for the tasks to be made more challenging.

REFLECTIONS AND MOVING AHEAD

Putting together an activity involving the entire class of 20-25 students with each one of them taking on different roles is a new challenge for the team. This effort is rather different from our past approaches. In the past, all our core module with lab component typically have 5 experiments, and each experiment requires students to work in group on a given pilot plant on a rotational basis. This is due to the very high cost of our pilot plants (each one is over S$100,000), and also due to scarcity of real estate (lab spaces). Unlike chemistry bench-top or electrical circuits stations whereby everyone gets to work on the same unit at the same time, we are not able to replicate identical units for training our students. The typical way laboratory sessions are executed in DCHE is as follows: a class of 20-25 students is divided into 5 groups, so that each group consists of 4-5 students. Each group of students is assigned to work on one particular pilot plant, and they take turns to work on the rest of the other pilot plants at different dates during the semester. Each pilot plant tend to focus on a specific subject matter in the module, and each is designed around a specific task scenario to bring out a specific aspect of working life of a chemical engineer.

This activity, on the other hand, need to involve all 20-25 students in one, single inter-related task. Drawing on our own previous experience working in the chemical industry, we henceforth conceived of the learning task mentioned in the earlier section. In designing the learning task, our foremost concern is that some of the students may not be fully engaged not so much because they are free-riders but more because there not enough activities to engage everyone. On the other hand, we were worried that we might "over-design" the learning task and it became too taxing on the students. We were also worried that students may get overwhelmed by the large amount of background materials that they need to read up to prepare for the activity. Lastly, in designing this learning task, we also need to always be mindful to ensure that all groups are given challenges of more-or-less equal difficulty. Likewise, within each group, care is taken so that no one group member is overly burdened with completing bulk of the group activity. Despite the best of intentions, obviously this challenge still remains, based on the feedback obtained.

Due to time constraint, we are able to repeat this activity only once, which means that each group of students only get to experience a different role once. We take the request from students for more sessions to mean that the students actually quite enjoyed this activity, and they wished that they can experience all the different roles.

Based on the feedback we obtained from students, plus a review by the module team, we identified several areas of improvement in the activity. We now more explicitly connect the activity to Topic A by giving a 10-minute pre-activity talk, so that students are made more aware of the learning outcomes from the activity, and also revised some of the questions posed. We also added in an extra session so that the students can experience 'working' in 2 different department/division. In addition, we created an e-book for the activity to help student manage the information needed for each learning task. More importantly, we also emphasized the importance of writing reports and other paperwork as part and parcel of real-world working environment, and that is something that students need to learn to manage.

On reflection, one challenge is that we ourselves as lecturers may lack up-to-date career information. As noted by Cohen and Patterson (2012), in their study on role of science teachers in promoting career awareness among students, that "job definitions in biology are evolving rapidly ...difficult for teachers to keep apprised of prospective career descriptions and the new skills necessary to enter these fields". Given the fact that lecturers are already heavily burdened with academic and administrative workload, perhaps the Department of Students Services or the Library can play a bigger role in assimilating the latest information from latest available resources and re-package these as ECG tools that lecturers can use to keep abreast of the rapidly changing STEM careers and pathways, and in turn better advise the students of the various possibilities, especially in the context of the topics that one lectured on.

CONCLUSIONS

Students cannot become interested in a career or a field, particularly highly technical ones, without some awareness of the field's existence and the possibilities it offers (Dorsen, et al, 2006). Ekevall et al (2009) concluded from their study that "university student survey demonstrates that school-based educational experiences ***can*** (bold and italic in original) influences pupils' decision-making about their further study and career choices". This paper shared our approach to create better awareness among the incoming Year 1 students the possible job nature and career progression that awaits them. We hoped that this will help to stimulate interest in all students, especially those who did not really understand what chemical engineering is when they signed up for the course. Also, we will also need the secondary schools to do their part in instilling in students the proper mindset on ECG before joining the polytechnics.

ACKNOWLEDGEMENTS

The first author would like to thank the CP5045 module team comprising of Ms Jessy Yau, Mrs Choo-Ong Chin Ling, Ms Oh Ai Ye, Ms Ong Lay Choo for their enthusiasm in assisting to design this learning task, and in conducting the learning task.

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BIOGRAPHICAL INFORMATION

Sin-Moh Cheah is the Senior Academic Mentor in the School of Chemical and Life Sciences, Singapore Polytechnic; as well as the Head of the school's Teaching & Learning Unit. He spearheads the adoption of CDIO in the Diploma in Chemical Engineering curriculum. He currently teaches the module *Plant Safety and Loss Prevention*. His academic interests include curriculum revamp, academic coaching and mentoring, and using ICT in education. He has presented many papers at the International CDIO Conferences.

Corresponding Author

Mr. Sin-Moh Cheah
School of Chemical & Life Sciences,
Singapore Polytechnic
500 Dover Road, Singapore 139561
+65 6870 6150
smcheah@sp.edu.sg