EVALUATING THE IMPLEMENTATION OF CDIO PROGRAMS AT SINGAPORE POLYTECHNIC: THE FIRST YEAR

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ABSTRACT

This paper describes the evaluation of the large scale implementation of the CDIO initiative in engineering programs in 4 schools in Singapore Polytechnic. Changes were made to the syllabuses to incorporate the CDIO skills to develop the students' personal and professional skills and attributes; interpersonal skills of teamwork and communication; and system and product building skills. Existing courses were reorganised and linked and an "Introduction to Engineering" course aimed at stimulating students' interest in, and strengthening their motivation for, the field of engineering was introduced.

This longitudinal study of the implementation of CDIO focused on the impact of the curriculum changes on students' learning and acquisition of CDIO skills. The research questions were:

1. Were the learning outcomes, learning activities and assessments aligned
2. Were the learning of the courses integrated in the Introduction to Engineering Module?
3. How has the integration of the CDIO skills into the syllabuses impacted the students?
4. What were the lecturers' perception of the curriculum changes and their impact on students' competence in the selected CDIO skills and interest in subject?

Data for the evaluation was collected through document checks, student co-participant blogs, student surveys, and focus group interviews with students and lecturers. The paper will report on the findings of the first year of implementation and conclusions of the evaluation. It will discuss the support provided and make recommendations on improvements that can be made to the implementation

KEYWORDS

Program evaluation, personal skills and attributes, communication skills, teamwork skills, Introduction to Engineering, integration of skills,

INTRODUCTION

In October 2006, work began on revising and restructuring 13 engineering programmes from the Schools of Architecture and Built Environment, Chemical and Life Sciences, Electrical and Electronic Engineering, and Mechanical and Manufacturing according to the CDIO framework. Some of the revisions made include the integration of the CDIO skills of personal and professional skills and attributes; interpersonal skills of teamwork and communication; and basic system and product building skills into the syllabuses. In all programmes, an Introduction to Engineering module was instituted to provide students' with the opportunity to develop the selected skills; link and integrate knowledge across the courses; and stimulate interest in, and strengthen students' motivation for, the field of engineering through real world

design build activities. Existing assessment schemes were also reviewed and revised accordingly to include the assessment of the skills. The revised programmes were implemented in April 2008.

The CDIO evaluation was initiated to provide a structured research driven approach to monitor and review the implementation of the CDIO Framework at Singapore Polytechnic. The purpose and approach of the evaluation is consistent with that identified by Kemmis (1989):

> Evaluation is the process of delineating, obtaining and providing information useful for making decisions and judgements about educational programmes and curriculum. (p.117)

The evaluation activities were designed to address three broad research questions central to understanding the impact of key aspects of the CDIO implementation:

1. Are the learning outcomes, learning activities and assessments aligned?
2. How has the changes in the curriculum, learning activities and assessments impacted the students?
3. What are the lecturers' perception of the curriculum changes and their impact on students' competence in the selected CDIO skills (thinking, teamwork and communication) and interest in the subject?

These three broad research questions were subsequently broken down to more specific questions within each area (Table 1):

Table 1: The broad and specific research questions

Broad Research Questions	Specific Research Questions
1. Are the learning outcomes, learning activities and assessments aligned?	• Are the CDIO skills sufficiently incorporated in the learning outcomes, learning activities and assessments? • Are the learning designs appropriate? • Are the assessments appropriate and valid?
2. How has the changes in the curriculum, learning activities and assessments impacted the students?	• Are the students showing competence in the CDIO skills? • Are the students more engaged and interested? • Do students find the lessons more meaningful?
3. What are the lecturers' perception of the curriculum changes and their impact on students' competence in the selected CDIO skills and interest in the subject?	• In what ways, do the activities help develop the selected CDIO skills? • In what ways do the activities encourage interest and learning? • What are the difficulties and areas for improvement?

METHODOLOGY

The methodology is eclectic, utilizing the strengths of the methods chosen for their potential to provide useful data and insights. Most were identified and systematically planned prior to the data collection activities. However, certain modifications were made in response to emergent data. As Cronbach (1988) points out:

> Designing an evaluation is a continuing process, what variables deserve close attention will be discovered as the fieldwork proceeds. (p.7)

Where appropriate, triangulation of data is employed to generate multiple framing and the possibility of enhancing validity in relation to some questions. However, as Hammersley & Atkinson (2008) caution:

> One should not adopt a naively 'optimistic' view that the aggregation of data from different sources will unproblematically add up to produce a more complete picture. (p.199)

Table 2 below summarizes the data collection methods and evidence sources utilized. For the qualitative data sources, a broad grounded theory approach (Glasser & Strauss, 1976; Straus & Corbin, 1990) is employed in that theory generated will be emergent from the data rather than researcher determined constructs. In the case of the student focus groups, a more phenomenographic approach was adopted after the initial round of interviews. This was in response to recognizing the potential of the research situation to explore more rigorously how student experienced certain key skills of the CDIO curriculum (e.g., thinking) and their perception of how these were being taught.

Table 2: Data collection methods

Broad Research Questions	Data collection Methods (evidence sources)
1. Are the learning outcomes learning activities and assessments aligned?	• Examination (in collaboration with participating faculty) of a range of curriculum materials (e.g., course documents, module documents, learning plans, schemes of assessment, assessment items)
2. How has the changes in the curriculum, learning activities and assessments impacted the students?	• Student questionnaire for all students in the sample • Student Blog • Focus group interviews with a sample of students
3. What are the lecturers' perception of the curriculum changes and their impact on students' competence in the selected CDIO skills and interest in the subject?	• Focus group interviews with lecturers teaching on CDIO programmes • Observation of selected lessons (e.g., those incorporating activities related to selected CDIO skills)

The data collection methods employed, their rationale in context and how they were used in practice are outlined below.

Examination of a range of curriculum materials

As identified in Table 2, this involved the examination of a range of related curriculum materials (e.g., course documents, module documents, learning plans, schemes of assessment, assessment items). The aim was to ensure that the curriculum materials met the conditions of an aligned curriculum (e.g., Biggs, 1999) and were consistent with relevant CDIO standards (Crawley et al, 2007).

In practice, this involved ongoing collaborative work with lecturers (who are the subject specialists) and Educational Development staff (who provided the pedagogic guidance) in producing the necessary materials and to the standard required.

Student Questionnaire

This was administered to all the students online at the end of each semester (Sept 08 & Feb 09).The response rate was approximately 45% of the total population cohort.

The student questionnaire provided quantitative data relating to a number of the research questions across the full student sample. Care was taken in the design of the questionnaire items to ensure clarity, appropriate focus and efficiency, as well as incorporating the wider principles of good questionnaire design and implementation identified in the literature (e.g., Oppenheim, 2000).

It is to be noted that there are some key differences in the questions posed between the two administrations (e.g., Sept 08 and Feb 09) as well as between schools. For example, for year long courses, there was interest in identifying the extent to which student were aware of the infusion of the selected CDIO skills in the first questionnaire. In the second questionnaire, the focus was more on establishing the extent of application of the skills in the module context.

(See Appendix 1 for examples of the student questionnaires used)

Student co-participants and Blog
It was decided to engage students as "co-participants" (a terms used by Lincoln (1990, p.78), to blog their experiences of the lessons taught. Forty-seven student co-participants were involved semester 1 and 55 for semester 2, with representation across schools. The selected students were given a full briefing on the research purpose and their role and responsibilities. It was made very clear to the potential student groups that they should only participate if they felt that they could meet the responsibilities in an authentic and conscientious manner. They were specifically required to:

- Chat to classmates and identify some broad experiences relating to learning the selected CDIO skills and the teaching approaches used
- Make personal notes and/or blog their experiences in relation to both structured and open questions in the designated student blog
- Meet with the researchers at least once a semester for group sharing

A student blog, incorporated into the Blackboard learning management system, was employed as a means of providing regular, ongoing communication and feedback with the student co-participants. Students were typically presented with specific questions relating to their experience of lessons taught, and asked to provide their responses with examples to illustrate where possible.

They were also at liberty to post comments at any time if they felt this information would enhance our understanding of their learning experience in the classroom context. Apart from the collection of data per se, the use of the blog was seen as a useful and novel way to help build rapport with the students, encouraging more authentic and open communication – hence increasing the possibility of more valid situated data.

(See Appendix 2 for examples of the blog questions used.)

Focus Groups
The use of focus groups was employed for the following main reasons:

- Enables the collection of data relatively quickly from a larger number (as compared to individual interviews) of research participants

- Provides a more naturalistic context than the individual interview in that it is closer to the everyday conversations that people typically participate in

- As a synergistic effect in that it allows participants to react to and build upon the responses of other group members, producing richer accounts of the experience being investigated

The focus group interview typically lasted from between 1-2 hours for both lecturers and students, depending on situated factors (e.g., the number of participants involved and time commitments, etc). In practice the process worked well and it was felt that sufficient time was available to encourage a wide range of participation and achieve a sufficient depth of exploration of key areas (e.g., attain "theoretical saturation", Glaser and Strauss, 1976; Strauss and Corbin, 1990).

The lecturer participants in the focus groups comprised those teaching courses in which selected CDIO skills were infused. Twenty-one lecturers, representing all schools, participated in 4 focus group sessions. In the interview sessions, an opening scenario of 3 main areas was presented to lecturers to offer their experiences and reflections on:

- What have you been involved in doing, in terms of CDIO implementation?
- What have you specifically done and how?
- What is your perception of its impact on student learning, based on your experience with student groups?

Where necessary points of clarification are offered, and lecturers encouraged to ask their own questions to each other and to participate in the kind of dialogue arrangements that they feel comfortable with. The advice of Douglas, 1984, who argues for more 'creative interviewing' in which the interviewer must establish a climate for *mutual* disclosure, is interesting in this context:

> Creative interviewing…involves the use of many strategies and tactics of interaction, largely based on an understanding of friendly feelings and intimacy, to optimize cooperative, mutual disclosure and a creative search for mutual understanding. (p.24)

The interviews were facilitated by two members of EDU staff, one acting as main facilitator and the other doing the summary recording of key responses.

In the case of the student focus group interviews, questions were asked specifically focusing on their subjective experience relating to aspects of CDIO. It was made clear to the students that we were not looking for 'right' or 'better' answers, only the best representation of their experience as they could recall it. The typical interview process for each area of interest involved:

- A standard opening scenario is presented to the students (e.g. have you experienced your lecturer explicitly teaching thinking in any of the classes; what does thinking mean to you; how have you responded to this learning experience; why did you experience it in this way?)

- No new features are introduced – only encouragement to students to explain and provide examples

- Clarification of meaning and checking understanding where appropriate

Observation of Lessons

The purpose of observing selected lessons taught by lecturers involved in the CDIO implementation is to obtain a more ethnographic insight into what is actually occurring in the

situated context of the classroom and what might be useful for enhancing understanding of how students experience learning activities related to the selected CDIO skills. Such insights might prove important in deciding what is of most value in this curriculum and how it is best negotiated in a range of learning contexts.

The process for conducting this part of the evaluation is as follows:

- The classes to be observed are mutually agreed by lecturers and EDU staff
- The lesson must incorporate a significant component relating to the teaching/assessment of a CDIO skill area
- There is opportunity to ask student questions (at the end of the observation) pertaining to their experience of the particular learning activity and CDIO skill areas

Eight lessons were observed. This process is likely to continue in the next semester and modifications (e.g., duration, form or focus, etc) will be made as appropriate.

DATA ANALYSIS & FINDINGS

Data analysis techniques were selected on the basis of appropriateness to the data types generated from the various collection methods. Table 3 summarizes the approaches taken.

Table 3: Data analysis approaches

Data Type	Data Analysis Approach
Curriculum Materials	Analysis of curriculum documents and materials (e.g., module documents, learning activities, learning designs, assessment schemes, assessment items and scoring systems) Recording of the numbers of appropriately completed (and non-completed) document/material types
Student Blog	Quantitative tabulation and analysis of responses to questions Qualitative data analysis (e.g., categorization and generation of themes)
Student Questionnaire	Quantitative tabulation and analysis of responses to questions
Focus Groups	Qualitative data analysis (e.g., categorization and generation of themes)
Observation of Lessons	Qualitative data analysis using designated recording categories (e.g., tasks relating to thinking, teamwork and communication)

The analysis of the qualitative data components provided the greater challenges in terms of collation and analysis. As Marshall & Rossman (1989) point out:

> Data analysis is the process of bringing order, structure and meaning to the mass of collected data. It is a messy, ambiguous, time consuming, creative, and fascinating. Qualitative data analysis is a search for general statements about relationships among categories of data; it builds grounded theory. (p.112)

The following headings summarize the main findings from the various data sources obtained in the evaluation to date.

1. Are the learning outcomes learning activities and assessments aligned?

Analysis of curriculum documents and material

This part of the evaluation was a valuable learning experience, both for lecturers and EDU staff. It readily becomes apparent, through the collaborative activity, that some courses needed significant revision in terms of the writing of learning outcomes generally (e.g., rationalization, performance focus, clarity of intent, etc). Hence, the initial challenge was to both revise and rewrite existing learning outcomes and appropriately infuse selected CDIO skills.

Once this was achieved, a similar process of review and revision was made to key learning tasks and assessment activities (including the scoring systems). This process of collaborative work continued until the module curriculum was fully aligned and the various components appropriately designed (e.g., learning outcomes, learning designs, assessments). This whole collaborative process led to much rapport building and sharing between lecturers and EDU staff.

2. How has the changes in the curriculum, learning activities and assessments impacted the students?

Student Questionnaire

The Student Questionnaires were designed to gather feedback from students at the end of the semester. Due to differences in implementation across schools and across semesters, different variants of the questionnaire were used. Students were required to submit their responses to the questions on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

Table 4 shows the frequency distribution (with percentages in parenthesis), mean and standard deviation (SD) of students' responses by module for Semester 1. Nearly 50% agreed and 25% strongly agreed, in favour of the implementation of CDIO. The mean scores ranged from 3.73 to 4.03, with an overall mean of 3.90 (SD = 0.90). The Cronbach alphas were 0.93, 0.96, 0.96, 0.94, 0.96, and 0.94, respectively, showing high internal consistency in student responses.

Table 4: Frequencies, percentages (in parenthesis), means and SD of students' responses for the six courses in Semester 1

Module	1	2	3	4	5	Mean	SD
BE710Y	1 (0.3)	12 (3.2)	80 (21.1)	195 (51.3)	92 (24.2)	3.91	0.73
BE715Y	19 (3.3)	73 (12.6)	103 (17.8)	235 (40.5)	150 (25.9)	3.73	1.07
CP5009	12 (1.4)	31 (3.7)	168 (20.2)	413 (49.6)	208 (25)	3.93	0.83
CP5045	15 (1.3)	38 (3.3)	162 (14)	624 (54)	316 (27.4)	4.03	0.78
ET101Y_SP0302	121 (3.2)	244 (6.4)	731 (19)	1652 (43)	1092 (28.4)	3.87	0.98
MM1028	13 (0.8)	56 (3.6)	289 (18.7)	790 (51.1)	397 (25.7)	3.97	0.79
Overall	181 (2.2)	454 (5.4)	1533 (18.4)	3909 (46.9)	2255 (27.1)	3.90	0.90

Similarly, Table 5 shows students' responses for Semester 2. Although slightly lower values than those in Semester 1, nearly 50% agreed and 25% strongly agreed, in favour of the implementation of CDIO. The mean scores ranged from 3.74 to 4.10 i.e. agree, with an

overall mean of 3.85 (SD = 0.93). The Cronbach alphas were 0.97, 0.97, 0.94, 0.94, 0.96, and 0.96, respectively, showing high internal consistency in student responses.

Table 5: Frequencies, percentages (in parenthesis), means and SD of students' responses for the six courses in Semester 2

Module	1	2	3	4	5	Mean	SD
BE710Y	12 (1.6)	28 (3.7)	104 (13.8)	378 (50.0)	234 (31.0)	4.05	0.87
BE751Y	26 (1.1)	98 (4.0)	457 (18.8)	1194 (49.1)	655 (27.0)	3.97	0.87
CP5008	1 (0.3)	18 (6.1)	46 (15.5)	116 (39.1)	116 (39.1)	4.10	0.86
CP5009	3 (0.4)	12 (1.5)	171 (21.4)	474 (59.3)	140 (17.5)	3.92	0.67
ET101Y_SP0302	231 (3.7)	474 (7.5)	1512 (23.9)	2557 (40.5)	1546 (24.5)	3.74	1.00
MM1028	50 (3.4)	71 (4.9)	343 (23.4)	631 (43.1)	368 (25.2)	3.82	0.96
Overall	324 (2.7)	703 (5.8)	2636 (21.4)	5354 (44.3)	3064 (25.4)	3.85	0.93

Student Blog

The data from the student blog over the two semesters were collated and analysed. The following are the more generic findings:

- The great majority of students who blogged, perceived the importance of the CDIO skills as a valuable part of the curriculum. The explicit teaching of the selected skills seems to vary from module to module and across lecturers. The overall data indicates that the majority are not consistently teaching the skills explicitly. A number of responses are consistent with the response from one student who blogged, "Teacher never teaches what is good thinking". However, there is evidence that some lecturers, while not teaching the skills explicitly, are creating authentic learning opportunities for such skills to be fostered. The following response is not untypical, "The teacher give us the problem for us to do the thinking and produce a good idea to get the answer".

- The responses to specific real world tasks introduced to students in the courses, strongly suggests that such tasks link theory to practice, make the learning experience more meaningful and interesting. It is evident that such tasks, when well designed and managed, are effective in both the teaching of CDIO skills as well as consistent with good pedagogic practice generally. One student captured the essence of many when he/she blogged, "We finally made use of what we learnt in class. It is an experience that is different because what we learnt came alive".

Student Focus Groups

The generic findings from the student focus group interviews are:

- All students who participated in the focus groups felt that the selected CDIO skills (e.g., thinking, communication and teamwork) were relevant and important to learn. The experience of learning these skills seems to be significantly mediated by the particular practices of individual lecturers. For example, in some cases, students are clearly experiencing these skills being taught in an explicit manner ("…lecturer poses questions during the practical to probe our thinking. It is on a regular basis"; Mr X challenges us all the time, he wants us to present our thoughts and answers."). In particular, students who

had completed the Teamwork and Communication module were able to articulate what constitutes good teamwork and communication.

- While some lecturers were teaching the skills explicitly, this did not seem to be the majority practice in most classrooms. In many cases students were provided with learning activities that involved the skills, but were expected to learn experientially without sufficient guidance and scaffolding ("We are told to think well but since we are not guided, we just thinking in the way we want")

3. What are the lecturers' perception of the curriculum changes and their impact on students' competence in the selected CDIO skills and interest in the subject?

Lecturer Focus Groups

The responses to the questions and issues raised are diverse across schools and individual lecturers. The following represent some of the more salient and general findings across the data:

- Lecturers saw the relevance of the CDIO framework (e.g., need to make engineering more practical and interesting). Some have experienced positive impact of the changes made to the curriculum on student attention and interest, especially when doing hands-on activities (e.g., building and racing a car).

- The lecturers also observed that while the more motivated students coped better with the more challenging integrated learning tasks, the less competent students required more help and time.

- There was a range of practices concerning the explicit teaching of the selected CDIO skills. Some lecturers were explicitly teaching the skills and following up with relevant performance-based activities. However, in other situations, skills were not being taught explicitly.

- Lecturers were universally agreed that CDIO implementation has resulted in an increase in workload, resulting from the preparation and assessment involved, especially when cohort size is large and there are a number of assessment components. There was concern that teaching creativity and other CDIO skills was beyond the existing capability of some lecturers.

Observation of Lessons

The main findings from the classroom observations are:

- Some learning tasks provided opportunities for the development of types of thinking, teamworking and communication skills.
- Students were generally positive about the learning activities, some needing more support than others.
- The actual skills and what were involved in developing them were not seen to be taught explicitly in most observations. The relative lack of the explicit teaching of these skills is supported by the data obtained from the student focus group interviews.

RECOMMENDATIONS

As Kemmis (1989) once argued:

> The quality of the evaluation may be judged by the quality of its contribution to informing and improving the critical debate about the programme. (p.120)

The following summary statements and recommendations are those deemed most pertinent in relation to the research questions, and other significant learning derived from the evaluation experience to date:

1. Are the learning outcomes, learning activities and assessments aligned?

The collaborative work between schools in evaluating the present curriculum materials (e.g., course documents, module documents, learning activities and assessments) has led to significant improvement in these areas. This is likely to continue as more courses are revised to incorporate the CDIO standards.

2. How has the changes in the curriculum, learning activities and assessments impacted the students?

The data from all the evaluation activities suggest that there is extensive acceptance of the relevance of the infused CDIO skills into the engineering content curriculum. This has been consistently articulated in the focus groups and from the blog responses in particular. The wider quantitative data further verifies this across the wider student sample.

In terms of student engagement, interest and perceived meaning, it seems to be the case that many of the introduced real-world projects and tasks support a positive frame in this context. Many students have communicated that these tasks have made the learning more meaningful, supporting the development of understanding and competence. However, it is also apparent that some students have found the tasks difficult and feel that not enough time is available to fulfill the requirements adequately. This was corroborated through dialogue with lecturers in their focus groups. It is recommended, therefore, that lecturers consider ways to make such tasks more differentiated in terms of requirements.

3. What are the lecturers' perception of the curriculum changes and their impact on students' competence in the selected CDIO skills and interest in the subject?

Lecturers across schools see the relevance of the underlying purpose and practices of the CDIO Framework. Generally, the data from the various evaluation components supports the view that engineering education should focus more on practical applications and incorporate generic skills such as thinking, teamwork and communications.

There is general agreement that many of the tasks introduced have led to greater student interest and engagement, though again recognizing that students cope to varying degrees with the demands set. Furthermore some lecturers have expressed concern about their own competence in teaching these skills, especially creativity. It is recommended, therefore, that module teams consider carefully who is best able to teach specific areas of the curriculum and try not to put lecturers in situations that challenge their existing skill set, where possible. It is further recommended that specific training and online support materials are made available to support lecturers in the most effective and efficient ways possible.

CONCLUSION

Firstly, the eclectic methodology employed in the evaluation has provided a range of insights into aspects of teaching and learning relating to both CDIO implementation and the student experience of teaching and learning in SP. For example, the qualitative data, made possible through the ongoing blog activity and focus group meetings with co-participants, clearly highlights the importance of the lecturer as the active agent in curriculum implementation. The experiences of the curriculum changes that have been initiated are significantly mediated by the way individual lecturers conduct their practices. As a consequence, a major consideration in the success of CDIO implementation will be to ensure the necessary

competence of the lecturers involved. It is recommended that training and support in good pedagogic practices and instructional methods use (e.g., facilitation skills, student project design and management, etc) are made readily available and delivered flexibly.

It is certainly now established that the selected CDIO skills implemented so far have been sufficiently well received by both students and lecturers. The next focus is likely to be more on verifying and extending the range of pedagogic and assessment practices necessary for effectively meeting the range of CDIO standards.

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APPENDIX 1
EXAMPLE OF STUDENT QUESTIONNAIRE
CDIO Evaluation Survey (ET101Y/Z Introduction to Engineering)

Dear Students,
Over the past semester, your lecturers have been attempting to teach you teamwork, communication and thinking skills that would be relevant to you as a technologist. The following questions are to gather feedback for your experiences in learning these skills. In order to improve the teaching of these skills, we would appreciate your most honest feedback. These questions present some statements relating to learning in your courses. Please think about these statements and consider how they relate personally to you, with 5 being Strongly Agree, and 1 being Strongly Disagree.
(SD = Strongly Disagree, D = Disagree, N = Neutral, A = Agree, SA = Strongly Agree)

		SD		N		SA
1	I am aware that the following skills are being practised in my lessons.	1	2	3	4	5
	a) thinking	o	o	o	o	o
	b) teamwork	o	o	o	o	o
	c) communication	o	o	o	o	o
2	I understand the usefulness of the following skills in my learning and development as a technologist.					
	a) thinking	o	o	o	o	o
	b) teamwork	o	o	o	o	o
	c) communication	o	o	o	o	o
3	The activities in my Introduction to Engineering lessons make my learning more interesting and motivate me to learn more about my course.	o	o	o	o	o
4	I am participating more actively during my Introduction to Engineering lessons.	o	o	o	o	o
5	As a result of the activities in the Introduction to Engineering lessons, I am able to think more creatively and generate ideas.	o	o	o	o	o
6	As a result of the activities in the Introduction to Engineering lessons, I am able to use a range of critical thinking skills more effectively in problem-solving (e.g. analyse, compare & contrast, evaluate).	o	o	o	o	o
7	As a result of the activities in the Introduction to Engineering lessons, I am able to manage my learning more effectively (e.g. keep to deadlines, organise notes and prioritise learning activities).	o	o	o	o	o
8	In doing the project/s in the Introduction to Engineering module, I understand the importance of having initiative and the willingness to take thoughtful risks.	o	o	o	o	o
9	The activities in the Introduction to Engineering module gave me a greater understanding of the importance of team roles and their impact on team performance.	o	o	o	o	o
10	As a result of the activities in the Teamwork and Communication Skills module, I am able to design and deliver more effective oral presentations in my IDEA/IE courses	o	o	o	o	o
11	I am able to connect and see the relevance of the concepts in PEEE and DE to the IE module contexts.	o	o	o	o	o
12	I am able to connect and see the relevance of the concepts in TCS to the IE module contexts.	o	o	o	o	o

APPENDIX 2
EXAMPLES OF BLOG QUESTIONS

Week 7

1. Did the Voltage Level Detector project help you understand the core fundamental courses (PEEE & DE) better and/or deeper? Please elaborate.

2. Did the Voltage Level Detector project help you to understand and practice the Core CDIO skills of Teamwork, Communication Skills and Thinking? Please elaborate.

3. What changes do you think could be made to the Voltage Level Detector project to make it a better learning experience? Please elaborate. You may choose to highlight more than one point.

4. Is the lab layout, seating arrangement, equipment & component level etc conducive for IE/IDEA discussions and project work? Please elaborate.

Week 14

1. Having been introduced to engineering, are you aware of what it means to be an engineer? What do you think is the purpose and goal of an engineer?

2. What skills and attributes do you think is required of engineers in this 21st century?

3. Do you feel that the module, Introduction to Engineering give you the opportunity to develop the skills which you have mentioned in Question 2. Briefly explain.

Week 15

1. The semester will be ending in a few weeks. List down the skills which you think you have developed through the Introduction to Engineering module in this semester. (E.g.: ability to troubleshoot problems, teamwork, etc)

2. What do you think are some of the ethical issues facing engineers in your field of engineering? Were these issues discussed in the lessons?

3. Is there anything else which you like to improve regarding the lessons (lecture, tutorial & workshops/labs)?

4. Having gone through 2 semesters, how would you rate (1-5) your interest in your field of engineering? (1 being Not Interested and 5 being Very Interested) Briefly explain your rating.