# Design of First Year Integrated Courses based on Constructive Alignment

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## Abstract

A design of chemical engineering 1st year integrated courses based on constructive alignment is presented. Introduction to Engineering (ITE) course is designed to stimulate students' passion, strengthen their motivation, as well as enhancing their technical knowledge and relevant professional skills. ITE course is integrated with an Industrial Seminar and Profession (ISP) course to support the inclusion of stakeholders by inviting them to give presentations and bringing students for related site visits. Although the ISP is a one-credit course, it is very important to plan and execute the activities hand-in-hand with the ITE course. In this study, reflection and meta-reflection journals which have been designed to integrate both courses have been analysed thematically to evaluate students' response on the integration part. Besides that, other activities in ISP such as workshops, industrial visit etc that are integrated with the design and implementation of cooperative problem based learning (CPBL) activities in ITE are highlighted and discussed. All of the above mentioned integrated CPBL are constructively aligned to achieve both course and program outcomes. Such integrated CPBL activities following constructive alignment saves time and effort among lecturers to fulfil the course and programme objectives.

**Keywords:** Constructive alignment, student centred learning, introduction to engineering, Industrial Seminar & Profession

## Introduction

Global rapid development has resulted to university graduates especially in the engineering field facing challenges to remain relevant and competitive in this 21st century. Important soft skills such as communication skills, teamworking, entrepreneurship and life-long learning skills were reported to be among the most highly seek skills in the workplace (Spinks et al., 2006). To prepare engineers for the global workplace, it is clear that an improvement in engineering education is essential. Cooperative Problem based Learning (CPBL) has been widely implemented in engineering courses and has proven to instil qualities desired for graduates of the 21st Century.

Constructive alignment is an important concept that was proposed by Biggs in 1996 which highlight the alignment of learning objectives with the learning activities and assessment tasks. Thus it should be the starting point in course designing for the successful of CPBL implementation. Unlike traditional classroom, CPBL is known to enhance motivation and engage learners in deep learning (Mohd-Yusof et al., 2016). In CPBL, students need to explore or inquire for the information, exchange ideas and opinions and proactively debate what others think while working in a cooperative learning climate. Nevertheless, these distinctive features of CPBL make students feel uncomfortable and unsecure especially at the early stage of implementation. Apart of theoretical knowledge taught in ITE course, there is a need to provide an insight and practical perspective on the real working environment in industry. For instance, students can visit to industrial sites to enhance their existing knowledge.

Industrial visit also gives students a platform to improve their interpersonal skills such as teamwork and communication skills. This is important for students' career in pursuing their professional degree. Therefore, an appropriate learning environment must be implemented to support the development of deep learning in CPBL. The approaches in constructive alignment is known to focus on the activities that lead to deep and transformational learning rather than surface learning of facts and information (Walsh, 2007).

The redesign of an undergraduate course by explicitly applying the principles of constructive alignment was reported by Reaburn et al. (2009). The research was focusing on the effects of student engagement and learning in blended spaces upon implementation of constructive alignment as a result of

course redesign. The results indicated significant improvement in terms of student interaction, engagement with learning and assessment tasks, and achievement of higher order outcomes when the course was redesigned. Various methods or tools have been reported to help the implementation of CPBL in classroom. Hisham et al. (2018) reported the use of E-Learning to help assessing student's understanding of learning through CPBL. In 2017, the use of real world problem to integrate the three pillars of sustainable development among first year chemical engineering students in Universiti Teknologi Malaysia was reported (Aziz et al., 2017). Related industries and agencies are also included in the problem to make it more realistic. Besides, the use of integrated lesson study among the engineering lecturers has proven to improve classroom teaching in the implementation of CPBL (Mohd-Yusof et al., 2019 and Simon Howell et al., 2020).

**Learning Environment Design**

Chemical Engineering students in the School of Chemical Engineering, Universiti Teknologi Malaysia are required to take the Introduction to Engineering (ITE) course as part of the effort to enhance student's first year experience. The course is designed to stimulate students' passion, strengthen their motivation, as well as enhancing their technical knowledge and relevant professional skills (Mohd-Yusof et al., 2016).

Student-centered teaching and learning approaches are implemented; starting with cooperative learning (CL) leading up to a problem based learning (PBL)(Mohd-Yusof et al., 2015).

Real problems related to the current sustainability issues are designed with input and cooperation with industries and/or other related agencies.

Industrial Seminar and Profession (ISP) course is integrated with ITE to support the inclusion of stakeholders by inviting them to give presentations and bringing students for related site visits. Although the ISP is a one-credit course, it is very important to plan and execute the activities hand-in-hand with the ITE course. This study describes the design and implementation of an integrated cooperative problem based learning (CPBL) activities between the ITE and ISP course. The design approach follows the formative assessment principal as well as the underlying principles of constructive alignment to improve students learning. Both ITE and ISP course consist of 5 parallel sections whereby lecturers from both courses work together starting with the planning phase, implementation of those sessions and assessment. Besides, the responsibility of the lecturers to act as facilitators are very important to assist the learning of the student through activities and assessment that are aligned with the learning outcomes to enable students to construct meaning in a particular learning event as suggested by constructive component itself.

The integrated CPBL activities mentioned above are constructively aligned with assessment to achieve both course learning outcome (CLO) and program learning outcomes (PLO). There are 5 CLO and 5 PLO for ITE but only CLO 3-5 involved CPBL teaching and learning approach as tabulated in **Table 1**.

**Table 1. CLO, PLO and Assessment method for the teaching and learning employing CPBL method for ITE course.**

| C | CLO Description | P | Activities | Assessment Method |
|---|---|---|---|---|
| 3 | Ability to analyse sustainability related problem & recommend engineering based solutions to overcome the problem based on the three pillars of sustainability development using Cooperative Problem-Based Learning. | 4 | Sustainability-based CPBL case studies:<br>(a) Familiarization of the problem<br>(b) Understanding the problem in depth (Literature study & prior data collection)<br>(c) Collection of data of interest for the particular study and analysis<br>(d) Recommendations for the solutions to the problem of the case study | (a) Problem restatement and Problem Identification (PR&PI form)<br>(b) Individual peer teaching note<br>(Stage 1)<br>(c) Report & Presentation (Stage 2)<br>(d) Report Presentation / Exhibition (Stage 3) |
| 4 | Ability to communicate with confidence in oral and written modes to convey ideas to experts and peers through e-learning forum & presentations. | 9 | Class presentation, e-learning & forum | Rubrics, lecturer & peer assessment, reflection.<br>Involvement & maturity of contents, submission of assignments, reflection |
| 5 | Ability to explain topics learned independently & with peers, yielding insight & information indicating interest in the subject. | 11 | Group peer teaching in and outside class | Problem Restatement, Problem Identification, Peer Teaching Note |

*C = CLO, *P = PLO

The CLO for ISP that supported the CPBL activity in ITE course is summarized in **Table 2**. All CLOs were expressed with suitable activities and assessment method. For instance, in CLO 3, student was intended to commit actively in all the seminar and workshop sessions. This CLO was constructively aligned with several activities and assessment method such as explanation on the activities conducted and application of attendance sheet in order to make sure that all students were presence during seminar and workshop session. Another example is in CLO 5 in which students were required to commit in preparation of meta-reflection in a learning portfolio based on the overall workshops, seminars and industrial visits conducted throughout the semester using the standard given format. Apart from the explanation by the lecturer, this CLO was constructively aligned with an assessment which requires student to write meta-reflection journal. Such integrated PBL activities following the constructive alignment saves time and effort among lecturers to fulfil the course and programme objectives.

Activity planning for CPBL begins before the semester starts. Since there were 5 parallel sections, there were 10 lecturers' involved (2 lecturers per section). All lecturers discussed to come out with a suitable sustainable CPBL theme for that particular semester. The sustainable CPBL theme will be the basis for the CPBL implementation where students will have to do problem restatements & problem identifications, peer teachings, report preparations, presentations, reflection journals, individual and group assessment as well as industrial visit observation and report. An example of constructive alignment would be the reflection journal assignment, which falls under the ISP course, but students are required to perform reflection on both ITE and ISP classes, reflecting the activities, processes and assignments that were given to them. All of the above activities are constructively aligned to achieve both course and program outcomes. **Figure 1** illustrates part of the CPBL activities where students conduct peer teaching and report presentation in class.

**Implementation**

ITE and ISP courses were conducted simultaneously by integrating them in one semester. As shown in **Figure 2,** before the semester starts, lecturers teaching ITE and ISP course meet up to discuss on the suitable sustainability theme. An improvement was made in previous year (2019) whereby ISP lecturers assigned for each section are also ITE lecturers, so that they are well verse of the activity and progress of both ITE and ISP courses. Before 2019, ISP and ITE lecturers are not associated and therefore ISP lecturers lack the information on activities happening in ITE class, thus slightly affecting the integration of both courses. Once the sustainability theme was decided, stake holder was identified and a weekly activity lecturer's guide was carefully crafted. A sample fraction of the Lecture's guide is shown in **Table 3**. Lecturers from every section will follow the lecturer's guide closely. The lecturer's guide is very helpful in assisting the lecturers of all sections and in both courses to be well-prepared for the next class. Especially for a very tight schedule and full of activities courses like the ITE and ISP, such guide is highly in need. ISP program closely supported the planned ITE CPBL sustainability problems in a precise timely manner. For instance, students must attend a specific workshop/seminar such as Effective Public Speaking, Problem Solving using TRIZ etc to suit the need for ITE course. As a result, students are well introduced and learned on how to prepare themselves for next assignment. **Figure 3** illustrates the scenario in the ISP sessions that were designed to support CPBL.

**Table 2. CLO, PLO and Assessment method for ISP course that are will support CPBL teaching approach**

| C | CLO Description | P | Activities | Assessment Method |
|---|---|---|---|---|
| 3 | Choose to commit actively in all the seminar and workshop sessions | 6 | Workshops, seminar and industrial visit relating to the CPBL topic | Attendance Sheet, Lecturer, participation |
| 4 | Choose to commit in preparation of reflections based on seminars/ workshop/forum which elaborate the responsibilities and skills of engineers, chemical engineering program curriculum and the desired behaviours and attitude required to succeed in the undergraduate studies (Every 3 weeks) | 11 | ISP course: workshops, seminar and industrial visit<br><br>ITE course: in class activities (presentations, peer teaching etc), CPBL case studies | Reflection Journals |
| 5 | Choose to commit in preparation of meta-reflection in a learning portfolio based on the overall workshops, seminars and industrial visits conducted throughout the semester using the standard given format | 11 | ISP course: workshops, seminar and industrial visit<br><br>ITE course: in class activities (presentations, peer teaching etc), CPBL case studies | Industrial visit report, Meta Reflection Journals |

*C = CLO, *P = PLO

**Figure 1. Class activities in the ITE course: (A& B) Group Peer Teaching, (C & D) Class Presentation**
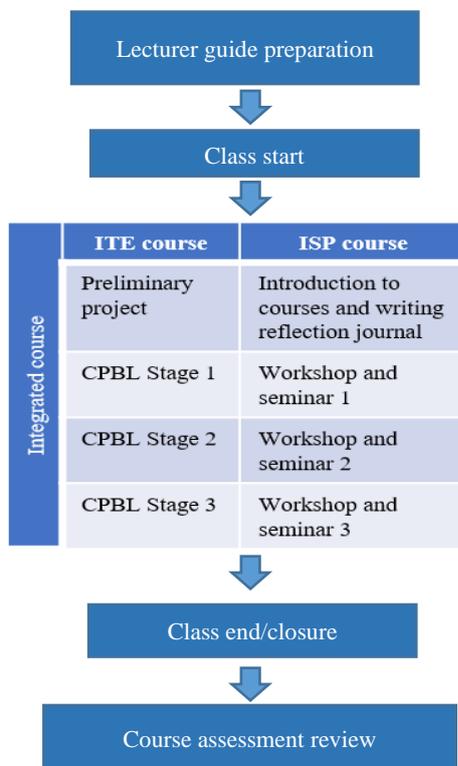


**Figure 2. Flowchart of teaching planning for integrated ITE and ISP course**

For every section, students in a group of 4 are given 3 stages of sustainability problems that require innovation engineering solutions. At each stage, students are required to write a reflection journal for the purpose of reflecting their learning through CPBL. At the end of all stages, students are required to write meta-reflection journal to reflect all CPBL activity in a whole semester. During class closure, lecturers are required to give a feedback on student learning. The feedback is crucial as it gives student some guidance on how to improve their learning and achieve their goals (Mamoon-Al-Bashir et al., 2016). Furthermore, course assessment review was done to evaluate the effectiveness of CPBL for improving student's learning.

Having five sections running in parallel is very challenging. Hence, a systematic well-coordinated lecturer's guide has been prepared and followed. The guide carefully considers sustainability related activities conducted via CPBL mode in both ITE and ISP courses that are constructively aligned. For example in Week 6, ITE course introduced a new sustainability related problem titled "Love Our River Campaign" (LORC). Students were required to understand the problem related to river conservation and conduct benchmarking with other countries. At the same time ISP course arranged speakers from relevant stake holders, which in this case the representatives from local authority Majlis Bandaraya Iskandar Puteri (MBIP) who delivered a talk on River Conservation in the vicinity of Skudai, Johor (as shown in Figure 3(D)). The problem assigned in ITE course require students to seek for information and ISP course provided good information and direction for them to perform the CPBL assignment.

**Figure 3. Activities in the ISP course that supports CPBL: (A) Engineering Overview Sharing (B) How To Use Google Search Workshop (C) Effective PowerPoint and Communication Presentation (D) Situation of Water in Iskandar Puteri Sharing by MBIP Representative**

In **Week 7 and 9**, ISP course organized talks entitled Effective Communication and Presentation which is another perfect example of the integration of ITE and ISP, which is a topic that the students need to rapidly improve. This is in line with ITE Course CLO4 which stresses on the ability to communicate with confidence in oral, written and presentation. Students commended and appreciated the two seminar sessions related to Effective Communication themes conducted. The students have significantly improved their slide presentation visual and oral presentation skills after attending the successfully and effectively executed talks. These rapid positive changes were witnessed by all ITE course lecturers. It can be deduced that most of the students regarded these two seminar sessions (effective communication theme) as the best and the most impactful one which highly improved their communication and presentation skills.

In **Week 7**, representative from Syarikat Air Johor (SAJ) delivered a talk regarding waste water characteristics and waste water treatment was an eye opener for the students as the seriousness of waste water towards the environment was revealed. SAJ representatives also tentatively explained and demonstrated how waste water is being treated and how expensive the operation cost is. The talk was timely presented when the students were given related sustainable problem on river conservation and strategies to overcome it that was associated to the sustainable development goal (SDG).

Towards the end (**Week 12**), students are asked to perform a technical visit to a waste water treatment facility in UTM to increase their comprehension and awareness on the importance of water treatment, which was under ISP course schedule (**Figure 4**). This exercise has provided them clearer view on how the process of cleaning the waste water is done within the facility. The ISP arrangement came timely with the moment where ITE course assigned the students to come out with solutions for the improvement of river conservation. Students appreciated the site visit experience as they were given practical real industrial and engineering exposure. **Table 4** tabulates some of the feedbacks from the technical visit report submitted by students in their respective teams, which mostly were positive feedbacks.

**Table 3.  Lecturer's guide combining ITE and ISP**

| Date/Day | What Lecturers Should Do | |
|---|---|---|
| | *Introduction to Engineering* | *Seminar* |
| **1/10/19** **Tue/2-4pm** CPBL 1 | **STAGE 1 – Phase 1** <br>• Post Problem - "*Individual meets the problem*". <br>• Students do individual PI & PR <br>• Team discussion & consensus in PR & PI <br>• Class discussion on problem analysis <br>• Self-directed learning on learning issues | **2/10/2019 – Wednesday – 3 Hrs** <br>Workshop on: <br><br>**Workshop 1:** <br>• Introduction to Microsoft Excel and Basic Engineering Calculations |
| **3/10/19** **Thu/2-3pm** CHAPTER 2 | • Flip Class Room Explanation <br>• Pair reading on Chapter 2 <br>• Section 2.1 until section 2.4 in class <br>• Reminder: Students to do read and do exercise on Section 2.5, 2.6, 2.7. <br>• Reminder: Individual peer teaching notes due on Monday, and team peer teaching discussion must be done before class on Tuesday (Brief notes and questions on learning issues must be written in logbook – to be checked on Tuesday) | **Workshop 2:** <br>• Introduction to Microsoft PowerPoint and Basic Presentation Skills <br><br>Requirements: Students need to bring laptops or workshop will be conducted in the computer labs (N11a, N15 and N21) |
| **8/10/19** **Tue/2-4pm** CPBL 1 | **STAGE 1 – Phase 2** <br>• Overall class peer teaching. <br>• Group leading the class discussion need to show slides to lecturer or the group can write in mahjong papers and present during class <br>• Report writing/technical writing. | **9/10/2019 – Wednesday – 3 Hrs** <br>Seminar on **Effective Public Speaking** <br><br>**Speaker:** <br>• Dr. Abdullah Mohd Nawi (Language Academy UTM) |
| **10/10/19** **Thu/2-3pm** CPBL 1 CHAPTER 2 | **STAGE 1 – Phase 2 (cont'd)** <br>• Progress check on team synthesis & application for formulation solutions – check on how students implement benchmarking and selection of countries for benchmarking <br>• Team consensus on final solution generation <br>Exercise on Section 2.5, 2.6, 2.7. <br>**Reminder:** <br>Submit Stage 1 Report by Monday (14/10/19). | |
| **15/10/19** **Tue/2-4pm** CPBL 1 | **STAGE 1 – Phase 3** <br>• Presentation#2 (7 minutes ONLY) & closure. <br><br>**Reminder:** <br>• Submit Peer Evaluation #2 – 19/10/19 <br>• Submit Reflection #2 – 19/10/19 <br>• Post *CPBL 2* in e-Learning on Oct 16 "*Individual meets the problem*". <br>• Submit PR&PI - (17/10/19) in class. | **16/10/2019 – Wednesday – 3Hrs** <br>Seminar on **Solid Waste Issue and Experience Sharing 1** <br><br>**Speakers:** <br>• Engineers/representatives from MPJBT (Session 1), SWM (Session 2), <br>• Engineers/representatives from I2M Ventures (Session 1), MP Kulai (Session 2) <br><br>Note: Student needs to submit their 2nd reflection journal. |
| **17/10/19** **Thu/2-3pm** CPBL 2 CHAPTER 2 | **STAGE 2 – Phase 1** <br>• Team discussion & consensus in PR & PI <br>• Overall discussion & consensus in PR & PI <br>• Tutorial Chapter 2 <br>• **Quiz #1** <br>**Reminder**: <br>• Peer Teaching Note due 22/10/19 <br>• Create online discussion on elearning forum | |
| **22/10/19** **Tues/2-4pm** CPBL 2 | **STAGE 2 – Phase 2** <br>• Overall class peer teaching on learning issues <br>• Brainstorm and planning <br>• Class discussion | **1/11/2019 – Wednesday – 3Hrs** <br>Seminar on **Solid Waste Issue and Experience Sharing 2** <br><br>**Speakers:** <br>• Engineers/representatives from I2M Ventures (Session 1), MP Kulai (Session 2) |
| **24/10/19** **Thu/2-3pm** CPBL 2 | **STAGE 2 – Phase 2 (cont'd)** <br>• Progress check for self and student audit <br>• Team synthesis & application for formulation solutions, Team consensus on final solution. | |

## Table 3. Sample fraction of lecturer's guide combining ITE and ISP (Continued)

| Date/Day | What Lecturers Should Do | |
|---|---|---|
| | Introduction to Engineering | Seminar |
| **5/11/19** **Tue/2-4pm** CPBL 2 | **STAGE 1 – Phase 2** • Students to read Chapter 3 and do exercise • Progress Check for Stage 2 | **6/11/2019 – Wednesday – 3 Hrs** Workshop on: • **SWM's Landfill** • **Kualiti Alam's Incinerator** |
| **7/11/19** **Thu/2-3pm** CPBL 2 | • Tutorial on Section 3.1 - 3.5. • Quiz #2 • Progress Check for Stage 2 | |
| **12/11/19** **Tue/2-4pm** CPBL 2 | **STAGE 1 – Phase 2** • Overall revision for Chapter 2 and 3 • Discuss quiz solution • Progress Check for Stage 2 | **15/11/2019 – Wednesday – 3 Hrs** Seminar on **Problem solving using TRIZ (The Theory of Inventive Problem Solving)** **Speakers:** • Prof. Dr. Khairiyah/ Lecturers/Researchers from Centre of Engineering Education UTM • Note: Student need to submit their 3rd reflection journal. |
| **14/11/19** **Thu/2-3pm** CPBL 2 | **STAGE 1 – Phase 2 (cont'd)** • Overall revision for Chapter 2 and 3 **Reminder:** Submit Stage 2 Report by Monday 19/11/19 | |
| **19/11/19** **Tue/2-4pm** CPBL 2 | **STAGE 2 – Phase 3** • Presentation #3 and closure **Reminder:** • Submit Peer Evaluation #3 (23/11/19) • Submit Reflection #3 (23/11/19) • Post Problem Stage 3 via e-Learning (19/11/19) • Submit PR & PI - due next class. | **20/11/2019 – Wednesday – 3Hrs** Seminar on: • **Sustainable Development** Speaker: • Mr. Chau Loon Wai (FAB) • Mr. Ismail Mahmood (back-up) |
| **21/11/19** **Thu/2-3pm** CPBL 3 | **STAGE 3 – Phase 1** • Team discussion & consensus in PR&PI • Class discussion on problem analysis **Reminder:** • Submit Peer Teaching Note due next class | |
| **26/11/19** **Tues/2-4pm** CPBL 2 | **STAGE 3 – Phase 1** • Collect peer teaching notes • Facilitate students in developing criteria for selection of final solution and learning for each group • No overall class peer teaching for Stage 3 | **27/11/2019 – Wednesday – 3Hrs** Seminar on **Engineering Code of Ethics** **Speaker:** • Assoc. Prof. Ir. Hayati (background) • Representative from IEM or BEM (experience sharing) |
| **28/11/19** **Thu/2-3pm** CPBL 2 | **STAGE 3 – Phase 1** Revision Chapters 2 & 3 TEST 8.00 – 10.00 PM N29 | |
| **3/12/19** **Tues/2-4pm** CPBL 3 | **STAGE 3 – Phase 2 (cont'd)** • Team synthesis & application for formulation solutions • Team consensus on final solution generation • Discussion on Final Report • Draft Report due on 9/12/18 (Monday) **Reminder** • Post BEM code and case study next week • Remind students to bring ethics code | **(4/12/2019)  Workshop on:** • Success and Failure Factors in University o What is success & Purpose of university education o Preparation required to be a successful engineer **Speakers:** • Alumni and senior students of FKT Note: Student need to submit their 4th reflection journal. |
| **5/12/19** **Thu/2-3pm** | • Introduction to engineering ethics • Ethics case study | |
| **10/12/19** **Tue/2-4pm** CPBL 3 | **STAGE 3 – Phase 3** Presentation#4 (10 min presentation + 5 min Q&A per group) | |
| **12/12/19** **Thu/2-3pm** CPBL 3 | **Presentation#4 - cont'd if all groups have not finished** Reminder: • Submit Peer Evaluation #4 by 20/12/19 • Submit Final Report by 20/12/19 | Session Ended |
| **17/12/19** | META REFLECTION due on Friday (20/12/19) | |

**Figure 4. Student Site Visit to the Sewage Water Treatment Facility (a) Visit Sewage Treatment Plant 1 (STP 1); (b) Clarifiers; (c) From left (Anoxic tank, Pre-Aeration tank and Membrane tank)**

It is worthy to note that besides improvement observed by the lecturers in class, from reports and student presentation, the reflection journal appears as a proof that students acknowledged the scaffolding support and integration of the arrangement of talks in ISP course that greatly complement their comprehension on the problems given in the CPBL mode in ITE course. By writing reflection, students are taught to acknowledge their thinking and learning process that they have experienced based on Gibb's reflective cycle (Gibbs, 1988). Making a good reflection is very important to enhance students' learning through the learning experiences that they have went through.

**Table 4. Some of the student's feedbacks extracted from the technical visit report**

| Feedback 1 | *By witnessing the sewage treatment plant in real life, it gives better understanding about the processes than doing learning theoretically through the books* |
|---|---|
| Feedback 2 | *This visit gave us our very first real life experience of visiting a site. We also able to know more about the structure of sewage treatment plant in UTM and the advantages and disadvantages of the sewage treatment plant.* |
| Feedback 3 | *We also connected the dots between the information we learned during seminar and ITE class like how the STP is not enough to handle all the waste coming to it. We can see by the small size and complexity of the process.* |
| Feedback 4 | *Our team gained so much knowledge from this visit and hoping for more site visit in the future so that we could see more chemical plant as we are students of chemical engineering* |
| Feedback 5 | *Thanks to this visit, we, as students were given a chance to know more about the process and understand how the wastewater can be filtered into clean water.* |

**Evaluation Method**

As part of the assessment for both ITE and ISP, first year engineering students need to submit a 3 weekly reflection journals (after each Phase 1-3 problems) as well as meta-reflection at the end of the semester as the individual assignment. Reflection is designed to help in developing metacognitive skills so that students are

able to evaluate and analyse their own performance, thus continuously learning and improving themselves. Thematic analysis was used in this study as the chosen method to analyse reflection written by students from 5 different sections (Terry et al., 2017). Thematic analysis is a widely useful tool for analysing qualitative data especially for experiential type of data. This method involves a six-phase analytic process which are i. Familiaring with the data, ii. Generating codes, iii. Constructing themes, iv. Reviewing potential themes, v. Defining and naming themes, and lastly vi. Producing the report.

**Result and Discussions**

The themes or key elements of responses from student's reflection which were thematically extracted and categorised into creativity, understanding concept, problem solving, lifelong learning, reflection and time management were shown in **Table 5**. Most of the students recorded positive and encouraging comments which indicated they receive substantial values in their character and soft skill building.

The students highlighted the concept of integrating ITE and ISP. It is important to note that there was no prior instruction or requirement to specifically mention about commenting on the integrating ITE and ISP in the meta-reflection journal, but several students sincerely highlighted it constructively and receptively. In brief, it can be inferred that students appreciated the unknowingly well carefully planned integration of the ITE and ISP course. This has clearly proven the achievement of constructive alignment in designing the 1st year ITE and ISP integrated course using student centred learning approaches.

The meta-reflection journal written by the students at the end of the semester summarizes not only specifics on other content, analysis, reflective thinking, evaluation and feedback, but also some of them disclose how ISP has actually provided great support in their quest to deliver PBL assignments. The extracted themes as mention earlier i.e. problem solving, lifelong learning and time management also proven the successful of this integrated courses to instil important soft skills for the 21st century students (Spinks et al., 2006).

**Table 5. Student's Responses on the Integrated Courses Between ITE and ISP**

| Key element of response | Student's response |
|---|---|
| Creativity | Feedback 1:<br><br>'I'm looking that next lecture that I am going to challenge my thinking and creativity and push me to get the best of me.' |
| Understanding concept | Feedback 1:<br><br>'Attending seminar helped me in learning how to grasp on a concept based on the learning issues discussed in ITE.'<br><br>Feedback 2:<br><br>'The information that I obtained from the seminar truly helped me in completing my ITE course and also broaden my knowledge in chemical engineering field.' |
| Problem solving | Feedback 1:<br><br>'ITE course has teaches me skills and knowledge that gives me an opportunity to shine brighter as a person when it comes to solving real life problems.'<br><br>Feedback 2:<br><br>'I had a clearer image on the criteria to become a professional and successful engineer as well as the ways to solve a problem'<br><br>Feedback 3:<br><br>'I have improved my problem solving skills. I believe that I could overcome the problems by applying what I have learnt from these two courses.' |
| Lifelong learning | Feedback 1:<br><br>'ITE class and seminar will always be my life-long learning lessons as there are so many important interpersonal soft skills that I cannot gain from the academic lessons.'<br><br>Feedback 2:<br><br>'ITE class and seminar prepared us mentally and physically in order to never get beaten by any hardships face in life and fulfil my own life goals to make my life later more meaningful.'<br><br>Feedback 3:<br><br>'From these 2 courses which are ITE and Seminar, I know that grades are not everything. The more important thing is the skills we developed such as leadership skills, communication skills, and time management skills.' |
| | Feedback 4:<br><br>*This course is the most effective course that I have been through for now. I have acquired skills and knowledge related to engineering.*<br><br>Feedback 5:<br><br>*I have developed soft skills such as communication skills, team working and report writing skill which will accompany my career towards success.*<br><br>Feedback 6:<br><br>*The course of ITE and seminar has shown me the other side of academic that I have not exposed to so much, such as teamwork and project that forces me to challenge myself to a new height all in the preparation for me to become a good and competent engineer in the future.*<br><br>Feedback 7:<br><br>*In ITE classes and Seminar session, I found that the main goal of this semester is develop the working, thinking and cooperating skills inside me. I can said that the way of leaning session by making CPBL as the main reference is the best and suitable action in order to produce an engineer that suitable with this era of development and fast moving towards the IR 4.0.*<br><br>Feedback 8:<br><br>*I am happy that I have the chance to take these two courses, which allow me to have better understanding on engineering with plenty soft skills like communication skills, leadership, team working and social skills, which I can apply in my daily life and not limited to an engineer.* |
| Reflection | Feedback 1:<br><br>'This reflection journal helps us to reflect on what we have done for each event or activity on ITE class and seminar class. It basically is a learning process on reflecting thing we had done to learn from mistake.' |
| Time management | Feedback 1:<br><br>'I have to really manage my time well in order to complete the assignments in such short period of time. The class has taught me how to manage my time well during our presentation.'<br><br>Feedback 2:<br><br>'I found myself became more organized and could complete more tasks in tight deadlines.' |
| Course integration | Feedback 1: |

*'The perfect thing about ITE and seminar are well integrated the seminar class will always illustrate the ITE assignment.'*

Feedback 2:

*'Through the seminar, we can obtain the information related to the LORC 2019 (ITE project) directly from the professionals and apply it in doing our project.'*

Feedback 3:

*'In my point of view, the two subjects were always related and benefited me so much. From the both effective speaking seminar and public speaking seminar we could improve our speaking and presentation skill which related to our presentation for three stages of LORC.'*

Feedback 4:

*'The ITE class is like a medium where we improved and used our skills that related to engineering to complete all the group projects meanwhile the seminar class is a medium where we will be given information how to complete our group projects and how we could improve our skills.'*

## Lecturer's Perspective

From the lecturers' point of view, the integration of the ITE and ISP brings a lot of advantageous as the planning of both classes can be done together in order to complement the needs of both courses. By basing the ITE as the main 'pillar' for both courses, basically the content of the ISP course is designed in such a way to support what needs to be elaborated further for the ITE course.

The ITE course is quite hectic in its arrangement, contents and planning. The 3 hours per week of the ITE course alone is not enough especially to provide students with the supports they need from what they learnt in the ITE class. For example, when they did the assignment on 'Engineering Overview' in the ITE class, they searched for various literatures on the definition of engineering, its branches, roles of an engineer and others. But that are just theories. Hence, we invited panels of professional engineers for a lively forum session on the related topic during the ISP session. Same goes to, when the students learn about engineering ethics. They were given the list of codes of ethics, real case studies related to engineering ethics to solve and discuss in the ITE class. Panels of professionals and practitioners that have vast experiences related to ethics at workplace (engineers) are invited for a live discussion session in the ISP course. By doing this, students are able to connect and relate what they learn theoretically from books, literatures and ITE class with actual real-life experiences shared by the invited speakers/ panels.

Lecturers also feel very happy and glad that, because of this integration approach, the case studies for the ITE course can be designed in a much interesting and realistic way. For example, for the case study related to river pollution within the areas close to the university campus, speaker from the responsible City Council was invited during the ISP session, sharing the issues related to river within the area of concern, the efforts made to improve the quality of the river, their constraints and others. For this year, the case study designed for the ITE course is on consumer behaviour and its effect on carbon emissions and environmental impacts. Hence, speakers from the industry who are certified energy manager and an environmentalist, as well as prominent researcher in carbon footprint are invited to give talk during the ISP class. Overall, the courses become way more effective due to the close integration done between these two courses and the lecturers cannot be happier to see how such decision has benefitted the students a lot in many different ways in shaping them to become an excellent future professional engineer.

## Students Perspective

Students also shared the pros and cons of their experience and perspective after taking this integrated ITE and ISP course. They agreed that the ISP course is an extension to the ITE course which complimented to each other very well. Due to the nature of this integrated class, they found that the class was very helpful in managing their assignments and projects. For example, In ITE course, students were given a project which needs some technical skills such in Microsoft excel and finding information effectively through Google platform. These two skills are taught in ISP course and students acknowledged the skills by applying them in ITE course. In addition, students also shared that ISP course were helpful for developing essential skills in engineering prospect. The ISP talk has covered many important topics such as job scopes of chemical engineer, effective report writing, effective public speaking, problem-solving using the theory of inventive problem solving (TRIZ) and many more, which were really helpful in preparing students to become a better chemical engineer in the future. Students also found that this integrated course really helps them to manage their time effectively. The ITE course trained students to set their learning goals so that they can manage their work and time wisely.

Besides the pros learning experience, a minority of students also shared the cons of their learning experience. Some of them shared that the integrated course was really a burden since both of the course requires student to submit many reports and reflection journals. Besides, the class was always full with activities with problems to solve which needs them to think rather than just sitting and listen in the class. They also need to discuss with team member outside of the class after spending two hour ITE class. Students also complained that the three hours class of ISP course

is really tiring since they have others classes to focus as well. Due to the packed schedule, they always lost focus and sleepy during the three-hour ISP course. The 3-hours seminar was sometimes packed with two series of seminars resulting themselves to be very stressful to follow the talks given. Although the reflection journal is useful for them to recall the memory and reflect to become better students, the submission of the report and reflection journal was sometimes in hurry since students need to complete both assignments at almost the same period.

All feedbacks from students are imperative for improving the course integration. New efforts and strategies will be implemented in the upcoming semesters to provide better and lively learning experiences for students.

## Conclusions

The study revealed that ITE course has successfully implemented CPBL which is successfully aligned, integrated and supported with ISP course. The impact of this integrated course leads to enhancement on students' interpersonal skills and technical knowledge which were assessed mainly through students' reflection journal. Deep analysis on students' reflection journal revealed that students became more passionate and acquire internal motivation to become an excellent engineer after went through all the activities designed for them in the course. Their reflection journal showed how the students have matured from being a novice, just-go-with-the-flow student who is mandatory to take this course, into a more responsible individual who learns things to be a better person and to make things better for the others (surrounding, environment, communities etc.). Besides, their technical knowledge and relevant professional skills also were well-enhanced especially on the presentation and team-working attributes.

## Acknowledgement

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