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Engaging Students through Project Design (PD) Education at Kanazawa Institute of Technology

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＜Abstract＞Active learning can be employed in classroom through various educational methods, such as Blended Learning and Flipped Classroom. These methods enable students to learn using online media and technology. However, these learning styles could easily distract them from the learning content to other matters, such as social media, due to the lack of supervision. The Project Design (PD) Education System developed by Kanazawa Institute of Technology (KIT) can be an effective solution to such problems. In PD Courses, the students are encouraged to be actively engaged in their learning activities with job roles rotations to accustom them to future working environment. Students are required to complete individual and group assignments, share their works in a group setting, conduct interviews to obtain data, write reflection reports, and present their results. The results of the PD I Course show the improvement of their presentation scores. Based on the completed self-check questionnaires, students' sense of achievement gained over time.

＜Keywords＞ Active learning Project Design Education Soft-skills

1. Introduction

Effective and active learning in classroom is available through various methods. It is incorporated in the classroom not only to ensure the teachers and students are actively engaged with the content through activities such as small group discussion, posing questions to the class, short written exercise and etc., but also to reinforce soft-skills (Keyser 2000). There are several models of active learning methods and one of them is Process Oriented Guided Inquiry Learning (POGIL) (Douglas *et al.* 2013]. In POGIL, the instructor does not give lecture in class but students develop their own understanding of the material through a set of guided questions while the instructors only probe them with questions to check their understanding. On the other hand, the use of active engagement tool, iClicker was introduced, which allows students to respond to polling questions during the class and instructors can quickly gauge the understanding of students (Shryock 2015). Class Debates were also introduced in engineering courses with less intense in mathematics (Hamouda and Tarlochan 2015) as an innovative pedagogy approached to enhance students' performance.

The above mentioned methods are considered as blended learning and flipped

classroom and they underpin the active learning. With the technology-based teaching methodologies, students are expected to do online exercises during class or have some knowledge prior to the class so that instructors have more time during the class for interacting and checking on students' progress (Baepler *et al.* 2014) or to support distant learners and reduce the seat time in class. The blended learning also prepares students for active face-to-face activities, provide integrated external information and interactive resources and permit incisive assessments (Pesavento *et al.* 2015). The online learning is well accepted by engineering students but they are not widely adopted (Mansor and Ismail 2012) due to several reasons. A review of the existing blended learning practices found several challenges in the design of effective blended learning environment (Boelens *et al.* 2017). It needs more attention in increasing learning control, stimulating social interaction and fostering an effective learning climate since technology is used in carrying out existing activities. Meanwhile, a Flipped Classroom, which is another form of blended learning where students are exposed to materials outside of classroom, requires student to be self-motivated (Rosiene and Rosiene 2015). The materials are usually available in the form of online presentation such as videos prepared by instructor or taking "quecture" (directed quiz-lecture). With these approaches, students may pause video lectures or repeat sections in order to have better understanding but they need high self-motivation to learn material and less motivated student may underperform.

Thus, in any classroom that implements active learning, students constantly engage with each other and with technology. They discuss ideas, take polls, and investigate for problem and solution online but sometimes they get astray from the topic and disregard the lecture when they are constantly engaged in active learning. Other risks of employing active learning are students may not participate, learn sufficient content and use higher order thinking skills. These risks can be overcome through well-planned activities as suggested in Project Design (PD) Courses developed by Kanazawa Institute of Technology (KIT) where they integrate blended learning and flipped classroom with other active learning activities.

Therefore, this paper describes how active engagement tools available in PD courses help students to become active learners, increase interaction with peers and instructors, understand the problem identifying and solving process and motivate further learning.

2. Project Design Education System

KIT has fully developed Project Design Education System (PDES) since 2012 and it becomes the backbone of KIT curricula (Sato 2012) similar to Engineering Design (ED) in the past. It consists of five courses, including Introduction to Project Design, Project Design I, Project Design II, Project Design Hands-on, and Project Design III. The objectives of these courses are to acquire problem solving skills and verification process skills. The Figure 1. shows steps or process in PD I and PD II that students can acquire those skills. All of the steps apply hybrid pedagogy which interweaves regular activities, such as lecture, group discussion, presentation, with online method such as online survey, interview and online self-assessment without reducing seat time.

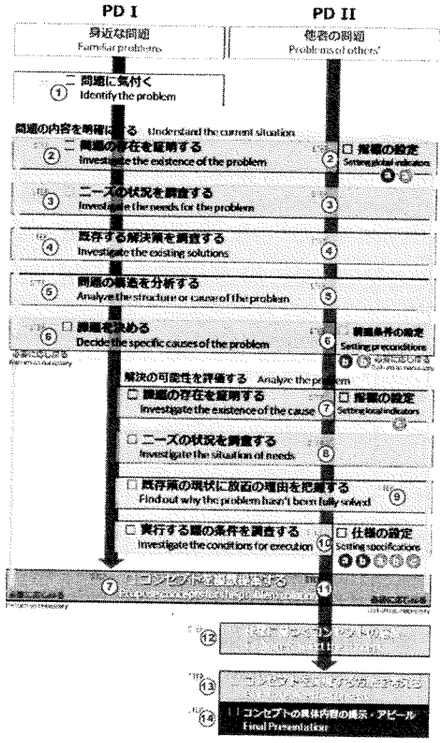


Figure 1 Steps in PD I and PD II

3. Active Learning in Project Design I

There are seven steps in the workflow of PD I, as shown in Figure 1, that guide students in the process of acquiring problem solving skills, from identifying the problem to proposing the solution concept. The Main Theme (MT) of the course is given and students have to identify their Project Theme (PJ Theme), which is related to the MT.

Students work in a group which has five to six members and there are several groups in each class. There is also a structural organization in each group that consists of a leader, a secretary, a recorder, and presenters. These roles are rotated on weekly basis to ensure everyone can serve different roles during the course. This will also help give them a better understanding by experiencing work as a team. Furthermore, students are given individual and teamwork assignments during the course.

In this case study, the MT of the course was "How to improve the KIT's brand?" The following are the active learning activities, in which the students were involved while working on a solution to the problem. The results shown in this paper are from two classes of six teams in the PD I intensive course in English, summer 2017.

3.1. PD I Worksheets

The students are expected to complete a suite of worksheets, both individually and as a group. Since this paper is focusing on active learning and interaction with others, only group worksheets are mentioned as follows:

1) 1D-a – The vote result of brand ranking of KIT
2) 1D-b – Team organization form
3) 1D-c – Record of team activity
4) 2D-a – Present features of top-brand universities with KJ method
5) 3D-a – Present features of top-brand universities with KJ method [Slides of Mini-Presentation (1)]
6) 4D-a – Evaluate individual proposal for the improvement of brand-image of KIT by using an evaluation matrix
7) 5D-a – Present the favorite concept for the improvement of brand-image of KIT [Slides of Mini-Presentation (2)]
8) 6D-a – Investigate the favorite concept thoroughly
9) 6D-b – Expected numerical value for the improvement of brand-image of KIT
10) 6D-c – Explain concrete contents of the favorite concept for the improvement of brand-image of KIT [Slides of Mini-Presentation (3)]

11) 8D – Final presentation (Assessment for teamwork)
12) 8D-a – Slides of final presentation
13) 8D-b – Prototype regarding the improvement of brand-image of KIT

3.2. Communication of Own Opinions

A typical workflow of a worksheet completed individually is as follows:

1) Students submit the completed worksheets (individual and/ or group) in a project binder to the instructor by the given deadline for marking;
2) Instructor marks/ comments on the worksheets accordingly;
3) Students receive the marked copies back in the following lesson;
4) Each member shares his/ her work results to other members verbally.

The process of sharing individual work results allows each student to communicate his/ her ideas and gather feedback from others effectively as the example shown in Figure 2. This simulates a typical workplace environment in real world or OJT (On the-Job Training), which is one of the key characteristics of PD courses.

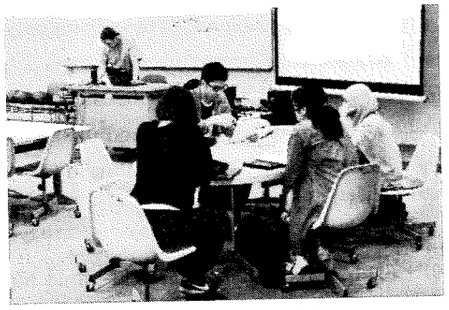


Figure 2 Student sharing his/her own work to other members

3.3. Group Activities

As mentioned in Section 3.1, students are required to complete thirteen (13) group worksheets. Table 1 shows some of the activities involved and the expected skillsets acquired in the course of working on these worksheets.

Table 1. Group Activities in PD I

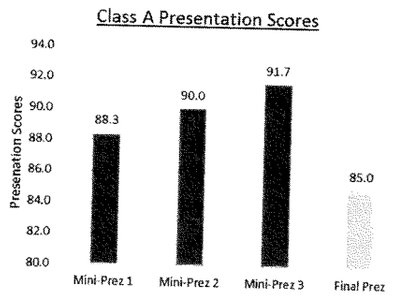
No	Group Activity	Skillsets Acquired
1.	Brainwriting Method • Write down 3 ideas about a topic given on a paper within 5 minutes • Pass on the paper to the next member • Process goes on till the paper is filled	• Quick-witted • Perform effectively in a deadline environment • Cooperative • Build confidence in producing ideas
2.	Kawakita Jiro (KJ) Method • Generate as many ideas as possible • Cluster similar ideas together • Give a category name to each cluster	• Collaborating • Organization • Management
3.	Campus Tour • Visit key locations • Observe/ Study these locations closely • Take note of good/bad points • Propose ways of improvement	• Planning • Critical Observer • Critical Thinker • Critical Analyzer
4.	Evaluation of Proposals • Combine all proposals into a matrix • Fix a set of evaluation criteria • Assess each proposal based on criteria • Select proposal with highest score	• Listening • Diversity Awareness • Collaboration • Decision making

3.4. Interview

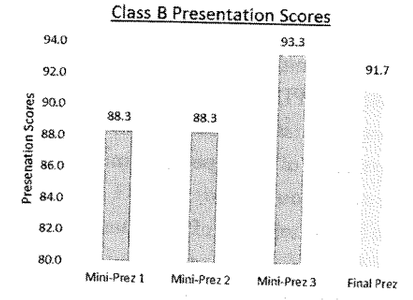
The students are required to explain the rationale of their proposals and seek opinions/ feedback from external parties, e.g. instructors, peers etc. through an interview. This process allows them to put their "selling" skills to the test as they need to pitch their idea to others in a convincing manner. In return, they will take note of the comments received and record them on the worksheets, which help further consolidate their proposals.

3.5. Group Presentations

Presentations at different junctures allow the students to highlight their findings of their work throughout the course of PD I. There are four (4) presentations; namely three (3) mini-presentations (3% each) by two (2) members rotating each time and a final presentation (10%) by all members. The values in brackets show the weightage of each presentation. Hence, the total weightage of the presentations component constitutes 19% of the final score. Figure 3 below shows the average scores of each presentation for both classes.



(a)



(b)

Figure 3 Average presentation scores of both classes for (a) Class A and (b) Class B

The plotted data above shows that there is an increasing trend of the scores for the three (3) mini-presentations. In addition, the quality of the presentation delivery exhibited by the students has seen improvement over the three (3) mini-presentation. One interesting phenomenon to note is the scores of the final presentation have dipped compared to those of the mini-presentations. This could be attributed to the fact that there are more contents to cover and more presenters involved, i.e. two (2) versus five (5). Nonetheless, the final presentation is a good platform for the students to share their journey of problem identifying and solution finding. Figure 4 depicts an example of a student making a presentation.

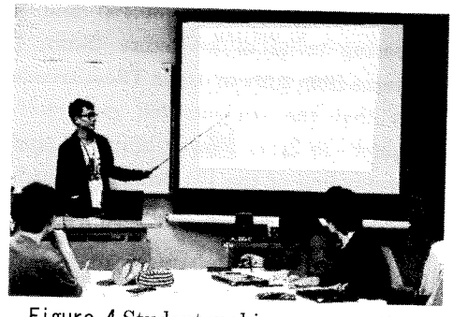


Figure 4 Student making presentation

3.6. Online Self-Checks

The students are required to complete three (3) online self-check questionnaires in the course of PD I. The purpose of these self-assessments is to record the level of achievement of their performance at every stage of the course.

The key categories of the questionnaires are as follows:

I. Ability that can play an active part in the real world
   - A. Oral presentation
   - B. Expression by the sentence (report)
   - C. Ability to act as a member of the teams
   - D. Action as an engineer
   - E. Collecting necessary information and utilizing

II. Understanding of the design process
   - F. Finding the project theme
   - G. Clarifying a project theme and making demand specifications
   - H. Idea creating

The students will evaluate the questions on a scale of 1 – 5; One (1) being "Cannot be" and Five (5) being "I can." Figure 5 below shows the distribution of results over the three (3) stages of self-checks.

The scores distribution shows that there is an increasing trend of high score (Score 5 increases from 11.4% to 30.4%) and a decreasing trend of low score (Score 1 decreases from 2.5% to 0.0%). These trends imply that the students felt more self-confident in their own abilities and understanding of the PD process through the engaging learning activities as the course progresses.

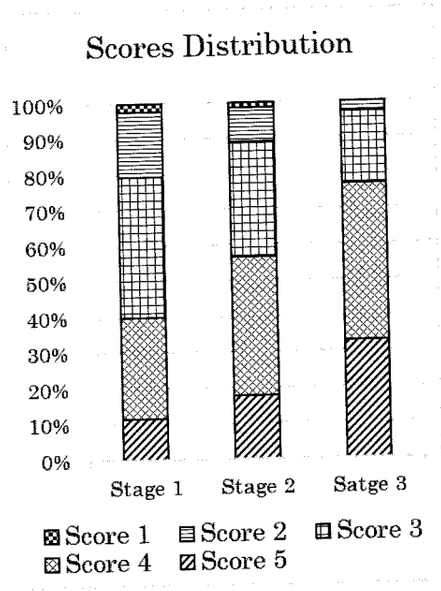


Figure 5 Scores distribution of self-check questionnaires

In addition, there are open-ended questions to gauge the students' response on the following areas:

a. Ambitions on the attendance of this course (strengths and weaknesses)
b. The current self-evaluation for the ambition of the beginning term and the future effort
c. Summary and future development

Below is an extract of some of the students' responses.

- *"My strength is that I like English. I like to* ***talk with people*** *with using English. But when I talk, I think the full-sentences and then start speaking. So it takes lots of time. I want to eliminate the weak point."*
- *"I improved a* ***communicate skills*** *before. For example, I didn't tell my mind to others before but now through explaining method and joining various activity I'm* ***not afraid*** *to speaking English and* ***not worry*** *to telling my mind in English. Looking back, I didn't talk deeply about other member's suggestion. It was as hard as to understand what everyone saying."*
- *"Because I like English when I was a child so I want to improve my English skill. And I'd like to* ***communicate with other department's people*** *in PD and share opinions in English. At first there are few ideas and I didn't know how to continue to discussion. But our team member helped me we could overcome to make a good idea and prototype. I thought that it is* ***important to communicate people*** *and* ***don't be afraid.*** *I thought my English is better than before and I got mind that don't be afraid to talk in English. I want to use English after PDI class and my future job. I noticed that it is* ***important to plan*** *how to investigate the* ***solving-problem*** *method. Until now, I didn't think deeply like PD when I make action. It is so different that* ***think various angles.*** *From now on, I want to use the method that I learned from PDI to act. I think it is different before I attend PDI class. For example, I learned* ***"communication-skill" presentation-skills*** *from this class. They are very* ***important things*** *now and/or in the companies. I want to improve my English and my* ***presentation*** *and* ***communication-skills*** *with the aggressiveness in possession."*

There are many other similar responses showing the enthusiasm and positive attitudes of the students studying the PD I course.

4. Conclusion

Various active learning strategies are infused in Project Design (PD) Education developed by Kanazawa Institute of Technology. In this paper, the results of PD I course was presented as a case study of KIT's PD Education System. It is more effective compared to other traditional methods of teaching because a number of soft-skills are acquired through individual and team activities. Through this method, it is proven that students stay engaged during lesson time with their technical and soft-skills competencies improved at the same time.

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ディベート学習による汎用的技能向上の効果の検討

Effects of Debate Education on Generic Skills

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＜あらまし＞　本研究では，初年次教育においてディベート学習を取り入れた授業実践を行い，汎用的技能向上の効果を検討するために，受講者 67 名に対して，自己評価方式のプレポスト調査を実施した．因子分析の結果，「課題解決力」「自己制御力」「対人関係力」「思考力」が見出された．pre,post のそれぞれの下位尺度得点を算出し，対応のある t 検定をおこなった結果，「思考力」「自己制御力」因子において有意差が見られた．

＜キーワード＞ ディベート学習　汎用的技能　初年次教育

1. はじめに

1.1. 汎用的技能

近年，経済のグローバル化や IT 技術の革新などの社会情勢の変化を受けて，変化が激しい社会を生きぬく力として「汎用的技能（ジェネリック・スキル）」が注目されている．汎用的技能とは特定の専門分野や職種，業種に関わりなく，大学卒業者レベルに汎用的に求められる能力，態度，行動特性のことである（濱名 2010）．

2008 年の中央教育審議会答申「学士課程教育の構築に向けて」において，大学が授与する学士課程で保証する能力として，汎用的技能が提示されており，我が国の大学教育で育成することが求められている．また，答申では「当該大学の教育理念や学生の実態 に即して，各項目の具体的な達成水準などを主体的に考えていく必要があろう」（中央教育審議会 2008:11）と示されてあり，育成を目指す能力の定義は，各大学の教育理念や学生の実態を考慮しながら設定することが求められている．

このような背景を受け，汎用的技能の要素を自大学の特性と照らして教育目標として検討した上で，それを学生に身につけさせるカリキュラムを実施する大学が見られるようになってきている（久保田 2013）．本学においても，AP（大学教育再生加速プログラム）の助成を受けて，本学のディプロマポリシー（学位授与のための基本的な方針，以下ＤＰ）に基づき，13 項目で汎用的技能を定義している（横山・土川 2017）．

汎用的技能は，議論への参加や教員への質問といった能動的学習が重要（小方 2008）とされているが，汎用的技能を養成するための具体的な方法の検討はこれまでほとんどされてこなかった．山田・森（2010）が「汎用的技能を高める具体的な教育活動・教授法（初年次教育や少人数教育，アクティブ・ラーニングや講義等）に関する詳細な検討も必要であろう」と述べているように，その方法の知見の蓄積が必要とされている．

1.2. アクティブ・ラーニングとしてのディベート学習

近年多くの大学で，アクティブ・ラーニング法