Learning Outcomes Assessment using Worksheets Scaffolding for Project Design 2 at Kanazawa Institute of Technology

by Taufiq Ilham Maulana

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Azilah Saparon[1], Boon Chye Rudy Ang [2], Taufiq Ilham Maulana[3], Nguyen Xuan Hung[4], Shigeo Matsumoto[4]

[1]Faculty of Electrical Engineering, Universiti Teknologi Mara, 40450 Shah Alam, Selangor, Malaysia

[2]School of Architecture & the Built Environment, Singapore Polytechnic, 500 Dover Road Singapore, 139651, Singapore

[3]Department of Civil Engineering, Faculty of Engineering, Universitas Muhammadiyah Yogyakarta Lingkar Selatan Street, Bantul, Daerah Istimewa Yogyakarta 55184, Indonesia

[4]Project Education Center, Kanazawa Institute of Technology, Nonoichi, Ishikawa 921-8501, Japan

azilah574@salam.uitm.edu.my, rudy_ang@sp.edu.sg, taufiq.im@ft.umy.ac.id, hnguyen2@neptune.kanazawa-it.ac.jp, matumoto@neptune.kanazawa-it.ac.jp

***Abstract*— This paper describes the Project Design (PD) Education at Kanazawa Institute of Technology (KIT) and type of teaching and learning activities with their assessment method. This paper also illustrates several steps in the workflow of PD II and how the worksheets scaffolding can be used to assess the Learning Outcomes (LO) for each student or certain cohort. These outcomes were not measured and assessed before. With the mapping between worksheet and LO, certain LO performance can be improved and actions to be taken on certain worksheets can be identified.**

Keywords—Project Design Education System, Learning Outcomes, worksheet scaffolding, Assessment Method

I. INTRODUCTION

Learning outcomes of any courses normally represent the goals of an entire program. The achievement of a program can be measured and evaluated through the activities of the courses.[1,2,3] With the right mapping and tools, the attainment of program outcomes are easily interpreted from the scores contributed by the course/learning outcomes [4]. The assessment method for these outcomes can be obtained using direct or indirect methods. Direct measures enable reviewers to directly evaluate student work such as exams, lab reports, presentations and assignment that demonstrate the specific knowledge, skill or competency described in a student learning outcome. Meanwhile, indirect methods are based on perception obtained from survey, questionnaires and observation [5].

Kanazawa Institute of Technology (KIT) has fully developed Project Design Education System (PDES) since 2012 and it becomes the backbone of KIT curricula [6]. It consists of five courses, including Introduction to Project Design, Project Design I, Project Design II, Project Design Hands-On and Project Design III. These courses have their own objectives and learning outcomes, but the main objectives of these courses are to acquire problem solving skills and verification process skills. Even though KIT education system does not implement Outcome Based Education, which each part of an education system is based on goals, KIT still provides learning outcomes for its courses. However, there is no measurement on the attainment of the learning outcomes. So far, they only measured the performance of their students in soft skills such as presentation skills [7,8]. Their design skills in the courses are yet to be evaluated

Hence, this paper describes the use of scaffolding worksheets in PD II as their main activity and how the activities relate to the assessment of the learning outcomes.

II. PROJECT DESIGN EDUCATION SYSTEM

KIT curricula are strengthened by its Project Design Education System (PDES) which consists of five courses including Introduction to Project Design, Project Design I(PDI), Project Design II(PDII), Project Design Hands-On and lastly Project Design III.

The main objectives of PDES are to train students to be active learners and have independent thinking by learning the process and methods of problem identification and solving. PDES courses also allow students to improve their soft skills by presenting their results in a detailed manner and having regular interaction with peers and instructors. These objectives are clearly described in Learning Outcomes(LO) and for PD II, the LOs are tabulated in Table 1.

TABLE I. LEARNING OUTCOMES OF PD II

LO	Learning Outcomes
LO1	To be able to discover problems from main theme.
LO2	To be able to collect information for problem solving and combine it.
LO3	To be able to create multiple proposals (idea) which lead to the problem solution.
LO4	To be able to plan the validity verification of the proposal.
LO5	To be able to communicate about technical information using figures.
LO6	To be able to show posture of objective evaluation of own abilities.

As explained in [8], several steps of design and verification skills are introduced in PD I and PD II. The same steps in PD II are applied in PD Hands-on and PD III so that students are able to do research, design and evaluate their

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work as a group member or an individual. The steps used in PD II are illustrated in Fig. 1..

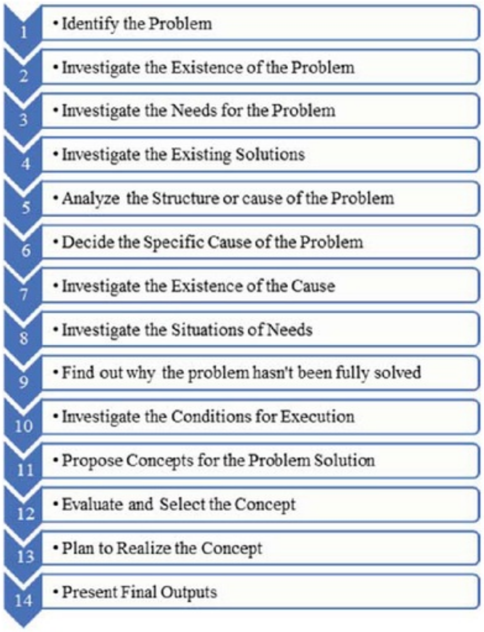


Fig. 1. Workflow of PD II

III. Activities and Assessment of PD II

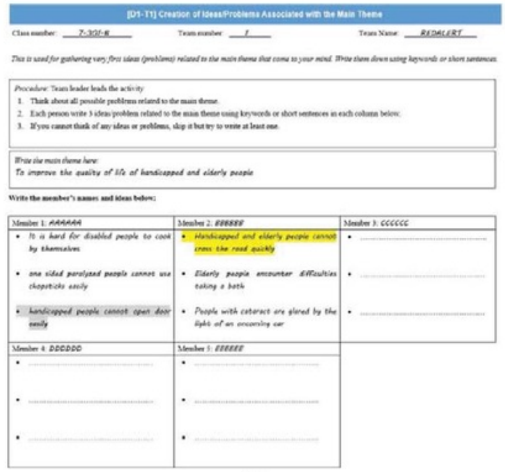
PD II implements hybrid pedagogy which interweaves regular activities such as lecture, group discussion, presentation, online survey and interview related parties.

A. PD II Worksheets

Besides having instructors with relevant knowledge and class dynamics, worksheets scaffolding, is one of the main tools in learning Project Design. Students are given worksheets for each design process and the worksheets are aimed to guide the students towards ideas to consider during the process of analyzing and approaching the task for the day. They are also given a sample of solution for the worksheet so that they have some hints or information of what they are required to do.

Choo and et.al [9] claimed that worksheets may not have a significant influence on student's learning because students who are generally passive learners could be relying more on the worksheet for guidance and reduce students' feeling of choice and autonomy. This is not true since the intention of having worksheets scaffolding is to boost students' confidence, help lower frustration levels and ensure that students remain motivated to advance to the next step. With the help of facilitative tools such as breaking the task into manageable parts, think aloud and dialogue among peers, these can deliver efficiency in learning design process. This technique is provided to novices until they begin to master the material and develop independent skills [10]. In K.I.T, students will have confidence in those skills and able to do research by their own for their final year project.

Sample of team and individual worksheets used in PD II in English Spring 2018 are shown in Fig.2a and Fig.2b. respectively.



[D1-T1] Creation of Ideas/Problems Associated with the Main Theme

Class number: 7-301-E Team number: 1 Team Name: REDALERT

This is used for gathering very first ideas (problems) related to the main theme that come to your mind. Write them down using keywords or short sentences.

Procedure: Team leader leads the activity

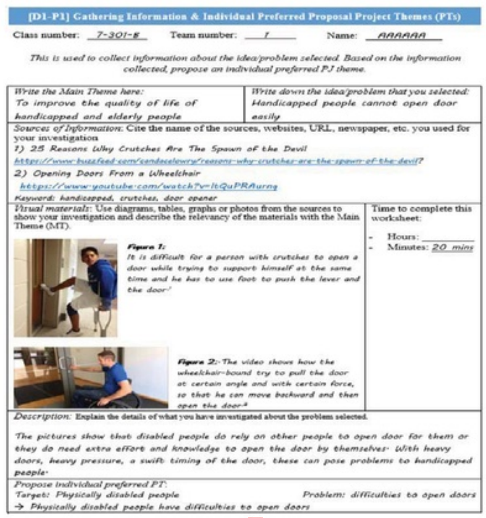
1. Think about all possible problems related to the main theme.
2. Each person write 3 ideas/problem related to the main theme using keywords or short sentences in each column below.
3. If you cannot think of any ideas or problems, skip it but try to write at least one.

Write the main theme here:
To improve the quality of life of handicapped and elderly people

Write the member's names and ideas below:

Member 1: AAAAAA	Member 2: BBBBBB	Member 3: CCCCCC
• It is hard for disabled people to cook by themselves	• Handicapped and elderly people cannot cross the road quickly	•
• one sided paralyzed people cannot use chopsticks easily	• Elderly people encounter difficulties taking a bath	•
• handicapped people cannot open door easily	• People with cataract are glared by the light of an oncoming car	•
Member 4: DDDDDD	Member 5: EEEEEE	
•	•	
•	•	
•	•	

(a)



[D1-P1] Gathering Information & Individual Preferred Proposal Project Themes (PTs)

Class number: 7-301-E Team number: 1 Name: AAAAAA

This is used to collect information about the idea/problem selected. Based on the information collected, propose an individual preferred PJ theme.

Write the Main Theme here: To improve the quality of life of handicapped and elderly people

Write down the idea/problem that you selected: Handicapped people cannot open door easily

Sources of Information: Cite the name of the sources, websites, URL, newspaper, etc. you used for your investigation
1) 25 Reasons Why Crutches Are The Spawn of the Devil
https://www.buzzfeed.com/candacelowry/reasons-why-crutches-are-the-spawn-of-the-devil?
2) Opening Doors From a Wheelchair
https://www.youtube.com/watch?v=ltQuPRAurng
Keyword: handicapped, crutches, door opener

Visual materials: Use diagrams, tables, graphs or photos from the sources to show your investigation and describe the relevancy of the materials with the Main Theme (MT).

Figure 1: It is difficult for a person with crutches to open a door while trying to support himself at the same time and he has to use foot to push the lever and the door[1]

Figure 2: The video shows how the wheelchair-bound try to pull the door at certain angle and with certain force, so that he can move backward and then open the door[2]

Time to complete this worksheet:
- Hours: ______
- Minutes: 20 mins

Description: Explain the details of what you have investigated about the problem selected.

The pictures show that disabled people do rely on other people to open door for them or they do need extra effort and knowledge to open the door by themselves. With heavy doors, heavy pressure, a swift timing of the door, these can pose problems to handicapped people.

Propose individual preferred PT:
Target: Physically disabled people Problem: difficulties to open doors
→ Physically disabled people have difficulties to open doors

(b)

Fig. 2 Sample of (a) team and (b) individual worksheet used in PD II:

B. LO- Worksheets Mapping

To know the achievement of students in LOs, all worksheets can be mapped to appropriate LOs. The marks obtained individually or by team effort are used to assess their LO performance. The mapping enables instructors to evaluate the course and identify number of worksheets required to achieve certain outcomes. Table II and Table III show the mapping of PD II's team and individual worksheets and their outcomes.

TABLE II. Team Worksheets Associated with LOs

Sheet Code	Name of Team Assignment Worksheets	LO1	LO2	LO3	LO4	LO5	LO6
[D1-T1]	Creation of Ideas/ Problems associated with the Main Theme	√	-	-	-	-	-
[D1-T2]	Evaluation of Individual Preferred PTs: A tentative PT selected	-	-	-	-	-	√
[D2 T1. 1]	Survey on Existing Similar Problems: Comparative investigation	-	√	-	-	-	-

[D2-T1]	Survey on Stakeholders' Opinions and Needs of the Tentative PT Problem	-	√	-	-	-	-
[D2-T2]	Re-evaluation of Tentative PT: Revised PT	-	-	-	-	-	√
[D3-T1]	Mini-Presentation (1)	-	-	-	-	√	-
[D3-T2]	Structure/ Cause Analysis of Tentative/ Revised PT Problem	-	√	-	-	-	-
[D3-T3]	Selection of Specific Point (SP) Problem.	-	-	-	-	-	√
[D4 - T1.1]	Survey on Existing Conditions of the SP Problem	-	√	-	-	-	-
[D4 - T1.2]	Survey on Stakeholders' Opinions and Needs of the SP Problem	-	√	-	-	-	-
[D5-T1]	Mini-Presentation (2)	-	-	-	-	√	-
[D5-T2]	Survey on Specification Indicators of the SP Problem	-	√	-	-	-	-
[D5-T3]	Evaluation of the SP Project Theme	-	-	-	-	-	√
[D6-T1]	Creation of a Symbolic Scene of the SP Problem	-	-	-	√	-	-
[D6-T2]	Evaluation of Individual Concept Proposals: Final concept selection	-	-	-	-	-	√
[D7-T1]	Mini-Presentation (3)	-	√	-	-	√	-
[D7-T2]	List of Final Concept Specifications	-	-	-	√	-	-
[D7-T3]	Action Plan to Realize Selected Concept Proposal	-	-	-	√	-	-
[D8-T1]	Final Presentation	-	-	-	-	√	-
	Total Worksheets	1	7	0	3	4	5

TABLE III. INDIVIDUAL WORKSHEETS ASSOCIATED WITH LOS

Sheet Code	Name of Individual Assignment Worksheets	LO1	LO2	LO3	LO4	LO5	LO6
[D1-P1]	Gathering of Information and Proposal of Individual Preferred Project Themes (PTs)	-	-	√	-	-	-
[D1-P2]	Mock Experience (Simulation) Reflections	√	-	-	-	-	-
[D3-P1]	Assessment of Available Solutions	-	-	-	-	-	√
[D4-P1]	Assessment of Available Solutions of SP Problem	-	-	-	-	-	√
[D5-P1]	Survey on Current Status of Specification Indicators of the SP Problem	-	√	-	-	-	-
[D6-P1]	Elaboration of Individual Concept Proposal	-	-	√	-	-	-
[D7-P1]	Illustration of Final Concept	-	-	√	-	-	-
D3/D5/ D7	Mini-Presentation (1), (2), (3)/ Poster Presentation (Individual Assessment)	-	-	-	-	√	-
D8	Final Presentation (Individual Assessment)	-	-	-	-	√	-
	Total Worksheets	1	1	3	0	2	2

Each worksheet will be graded by instructors and for the presentation, the marks will be given by instructors and students' peers.

IV. RESULT AND ANALYSIS

For this study, marks given to seventeen (17) students in PD II Intensive English Spring 2018 class are analyzed. For each student, the marks for worksheets that are associated with certain LO are added together with marks from other worksheets. Then the sum is divided by the number of sheets and the average value is considered as the achievement of the LO for the student.

TABLE IV. INDIVIDUAL MARKS ASSOCIATED WITH LOS

STUDENT	*LO1*	*LO2*	*LO3*	*LO4*	*LO5*	*LO6*
A	100	75	98.3	93.3	63.75	93.57
B	100	91	98.3	93.3	68.125	93.57
C	100	95	98.3	93.3	66.25	93.57
D	100	91	100	93.3	65	93.57
E	100	91.7	100	93.3	66.25	93.57
F	97.5	95	98.3	93.3	65.625	93.57
G	97.5	94	100	100	66.875	98.57
H	92.5	94	98.3	100	66.25	97.85
I	97.5	95	98.3	100	66.875	97.85
J	92.5	94	93.3	100	66.875	99.28
K	92.5	95	93.3	100	65	98.57
L	97.5	94	98.3	100	66.25	97.85
M	95	94	95	93.3	66.25	95.71
N	95	94	91.67	93.3	65	94.28
O	95	94	95	93.3	66.25	95.71
P	95	94	96.67	93.3	65	97.14
Q	95	94	95	93.3	63.75	95.71

Table IV show the achievement of LO for each student. These marks are averaged, and the overall performance of the class are shown in Fig. 3.

Fig. 3 Achievement of LO for PD II

From the results, we can see that students had slightly low achievement in LO5 which is communicate about technical information using figures. The marks represented this LO are taken from the mini and final presentation. Knowing which worksheets are connected, instructors know which part should be improved in next class. Another observation from this method, instructor may increase or reduce number of worksheets or assignments. For example, LO1 can be assessed just by two worksheets and their performance is better that LO5.

V. CONCLUSION

The Project Design Education System is well established in Kanazawa Institute of Technology (KIT) but the achievement of Learning Outcome for PD courses was not measured. Since worksheets scaffolding are main method in PD pedagogy, the worksheets can be mapped to appropriate LO and measurement can be based on the marks given for the worksheets. Hence, the performance of LO for this course can be obtained and analyzed for the betterment of the program.

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