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Student Learning Journey Map: A Design Toolkit for Enriching Learning Experience

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Abstract. Engineering education has gradually moved away from knowledge-focused teacher-centered learning to competence-focused student-centered learning to exposing students to different learning activities as experience gained is critical to their knowledge internalization for competence development. Several teaching and learning methods have been introduced to the discipline as an effective alternative accelerator for student learning to intensive lectures and laboratory sessions and contributors supporting the outcome-based learning. However, some instructors may find it challenging to utilize the methods for enriching student learning journeys because specific implications are required for individual methods and the alignment to the content and other course design components. Consequently, this would lead to malfunctioned and unengaged journeys that impede achieving course learning outcomes. Therefore, this paper presents a course planning and preparation toolkit under the view of students to enrich their learning experience. The toolkit is developed based on the LOVE learning experience model and Kolb's learning cycle. It navigates the instructors through the process of transforming a course into an engaging and constructive learning journey, with a step-by-step visual representation of how to choose and arrange the methods and prepare other course components. An intensive graduate course on Product Design and Development is employed to exemplify the toolkit.

Keywords. Engineering education, knowledge internalization, student learning experience, learning journey map, design toolkit

Introduction

Competency-focused student-centered learning has attracted attention in engineering education due to the increasing demands from industry sectors for competent graduates. Competent graduates are expected to have not only new knowledge, but also skills in a variety of dimensions, including transdisciplinary skills. They must be able to work collaboratively with people from various disciplines in order to solve unseen and complex problems with effective and creative solutions.

According to that, several modern and technology-enhanced teaching and learning methods have been introduced and promoted in the discipline as effective alternative accelerators for student learning to intensive lectures and laboratory sessions and contributors supporting outcome-based learning. However, only a few – e.g., game-based learning, project-based learning [1], problem-based learning [2], peer-to-peer learning [3], flipped classroom [4], visual laboratory [5], virtual laboratory [6], Industry

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4.0 laboratory [7] – have gained popularity within specific communities. Aside from that, a recent study found that lecture is still the most commonly applied and has been dominating current teaching practices [8].

One of the main reasons is that some instructors find it challenging to utilize the methods for enriching student learning experience journeys because specific implications for individual methods and their alignment to the content and other course design components are required [9]. Therefore, according to a transdisciplinary engineering approach, this paper integrates knowledge from engineering education, neuroscience, customer-centric design, and experience design to engineer a step-by-step visual representation course planning and preparation toolkit to guide and support instructors in achieving better course delivery.

The toolkit is developed based on the LOVE learning experience model and Kolb's learning cycle. It navigates the instructors through the process of transforming a course into an engaging and constructive learning journey, with a step-by-step visual representation of how to choose and arrange the methods and prepare other course components. An intensive graduate course on Product Design and Development is employed to exemplify the toolkit.

The toolkit is presented in the following section, followed by an illustration of its application in an intensive graduate course in Product Design and Development. Following that, class ambiances and learner feedback are presented. The last section is conclusions and ongoing works.

1. Student learning journey map

1.1. Concept development

This section introduces the Student Learning Journey Map, a course planning and preparation toolkit designed to guide instructors through the process of transforming a course into an engaging and constructive learning journey.

The toolkit has been developed based on our belief that enriched learning experiences, which students acquire from their engagements with various types of learning activities, are essential sources of knowledge internalization leading to competence development.

In order to design and prepare the diversified learning activities, the toolkit unfolds all components of class activity that form learning experience and connects the design procedure to theories for strengthening the learning experience, the LOVE learning experience model [10, 11], and knowledge internalization, Kolb's learning cycle [12, 13].

With the visual representation in all design stages produced within the toolkit, instructors can easily and quickly predict the impacts of specific activities on student learning and identify the strengths and weaknesses of all components incorporated into a designed journey.

1.2. Design template

The digital design template (Figure 1) has been developed using a PowerPoint template for ease of accessibility and usage. The template is divided into three main sections: (1.) light blue areas – course learning outcomes and assessment tool, (2.) light grey areas – journey design, and (3.) a dark grey area – design component.

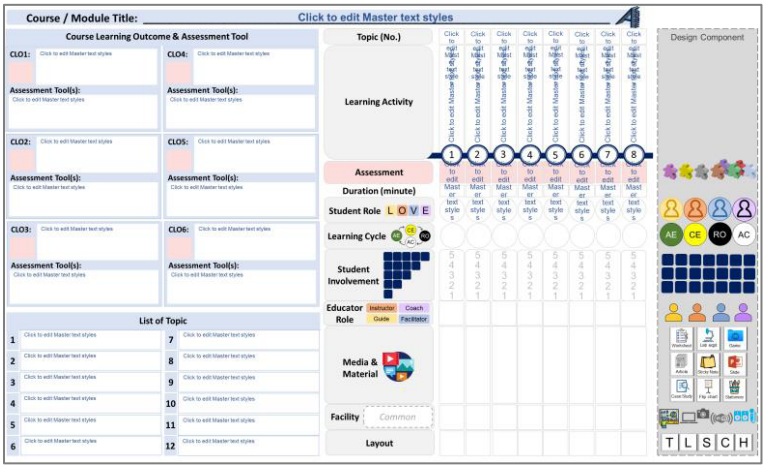

Figure 1. Digital design template.

1.3. User guide

The steps outlined below will assist instructors in visualizing the current learning journey of their course and enhancing the learning experiences of the journey.

1. Extract the data from a course syllabus (course title, course learning outcomes – CLOs, assessment tools, list of topics) and insert them into the light blue areas.
2. Provide a short description and determine the duration of all activities used to deliver the topics.
3. Place meeples in the assessment spaces where the assessment tools can be applied to evaluate the attainment of certain course learning outcomes (different colors for different CLOs).
4. Analyze the method used for each activity to identify the following components.
   - The student role (by consulting with Figure 2): Learner (L), Observer (O), Visitor (V), Experimenter (E)
     Figure 2 does not include all methods; however, through analysis, the student role in all of these methods can be identified.
   - The learning stage of Kolb's learning cycle [12]: Active Experiment (AE), Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualization (AC)
   - The level of student involvement: giving attention (1) – fully participate and have a direct impact on the result of the activity (5)
   - The educator role in order to deliver and manage the activity (adapted from [14]): instructor (specified learning activities controlled by teacher), coach (specified learning activities managed by learner), guide (open-ended/strategic learning activities controlled by teacher), facilitator (open-ended/strategic learning activities managed by learner)
5. Finish the rest of the design with the following design components. If necessary, additional components can be added.
   - Media and material: Worksheet, Lab equipment, Game, Article, Sticky Note, Slide, Case Study, Flip chart, Stationery
   - Facility: Digital whiteboard, Laptop, Camera, Wi-Fi, Sound system

- Layout: Theatre (T), Lecture (L), Stadium (S), Clusters (C), Horseshoe-shape (H)

6. Identify the current journey's strengths and weaknesses by consulting with the appropriate scenarios for the design components (Table 1).
7. Remove the unmatched and improper components that impede student learning to eliminate the weaknesses.
8. Incorporate more methods with the proper arrangement to enrich learning experiences and assist students in completing the learning cycle for all topics.
9. Adjust other components accordingly.

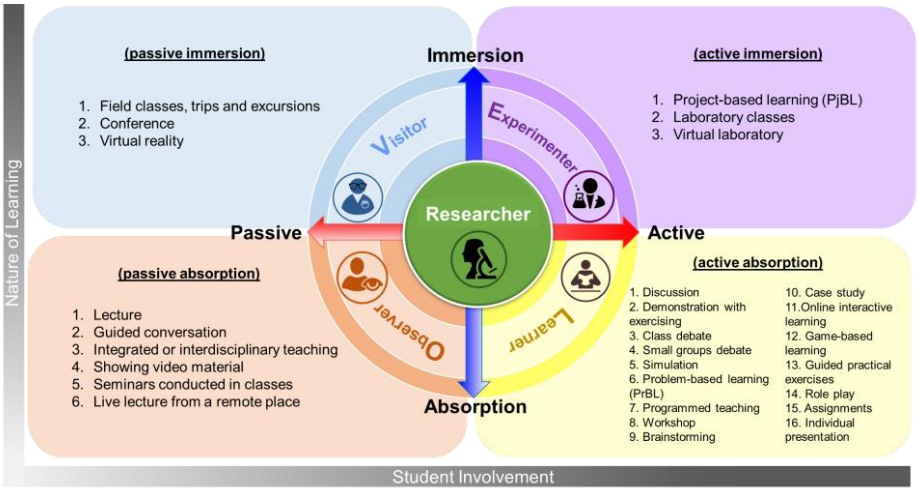

Figure 2. Classification of teaching and learning methods on the strong learning experience (LOVE) model (Adopted from [10,11]).

Table 1. Appropriate scenarios for the design components.

Component	Appropriate scenario
Assessment	There are enough activities to assess the achievements of CLO(s) for all individual topics.
Duration	The time allotted is adequate to complete the activities. A prolonged lecture is avoided.
Student role	Students play all four roles along a journey.
Learning cycle	The learning cycle is completed at least once for all individual topics.
Student involvement	The level of student involvement varies throughout a journey.
Educator role	An educator plays an appropriate role in supporting students' roles and guiding them through the learning cycle.
Media and material	Media and materials are expansive, of high quality, useful and appealing.
Facility	Facilities are of quality and always function as expected. They contribute to creating comfortable classroom environments and facilitating class interactions and engagements in all planned activities.
Layout	The layouts make it easier for students to interact and participate in all planned activities.

2. Illustration on Innovative Product Design and Development course (PDD)

2.1. PDD

PDD is a graduate course developed as part of the European Commission-funded joint capacity-building project 'Reinforcing Non-University Sector at Tertiary Level in Engineering and Technology to Support Thailand Sustainable Smart Industry (ReCap 4.0)'. PDD is one of ten modules in the project's training program to enhance the capacity for the effective delivery of engineering and technology knowledge and skills related to Industry 4.0.

The objectives of PDD are to develop two competences: (1) putting the product design and development process into systematic practice and (2) collaborating with others in the design and development of a product.

PDD, like the other modules, is divided into two sessions: fifteen hours of in-person training and ninety hours of self-practice and online coaching. Figure 3 depicts only the training session's module learning outcomes and assessment tools to exemplify the toolkit.

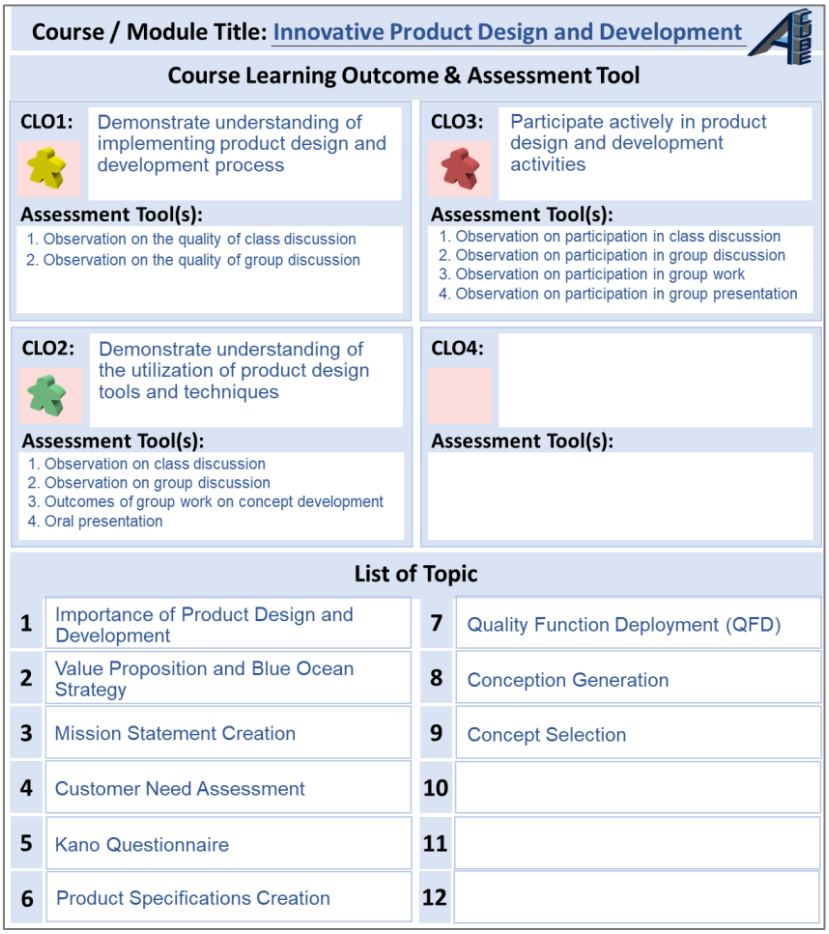

Figure 3. Inputs from the course syllabus.

2.2. Design comparison

The initial (Figure 4) and new (Figure 5) designs of PDD's student learning journey are shown below. There are differences in every aspect of the journey. The additional learning activities – group work on a case study, group work on a design, gallery walk, game-based learning – add variety and assist in transforming the lecture-dominated into an engaging and constructive learning journey.

The new design journey provides more places for assessments. All topics are connected to the CLOs. The lecture hours were reduced. Students can play all the four roles in this journey. They are directed to close the learning cycle for all topics at least once, assisting them in developing their own understanding of all topics.

Their overall involvement is increased and alternated. Instead of instructing, coaching plays a major role in delivering and managing the journey. Guiding and facilitating roles are also applied at the beginning of the journey, providing spaces for students to express their interests and share their own knowledge in classes. Media and materials are in variety. The list of facility and planned layouts are supportive for individual designed activities

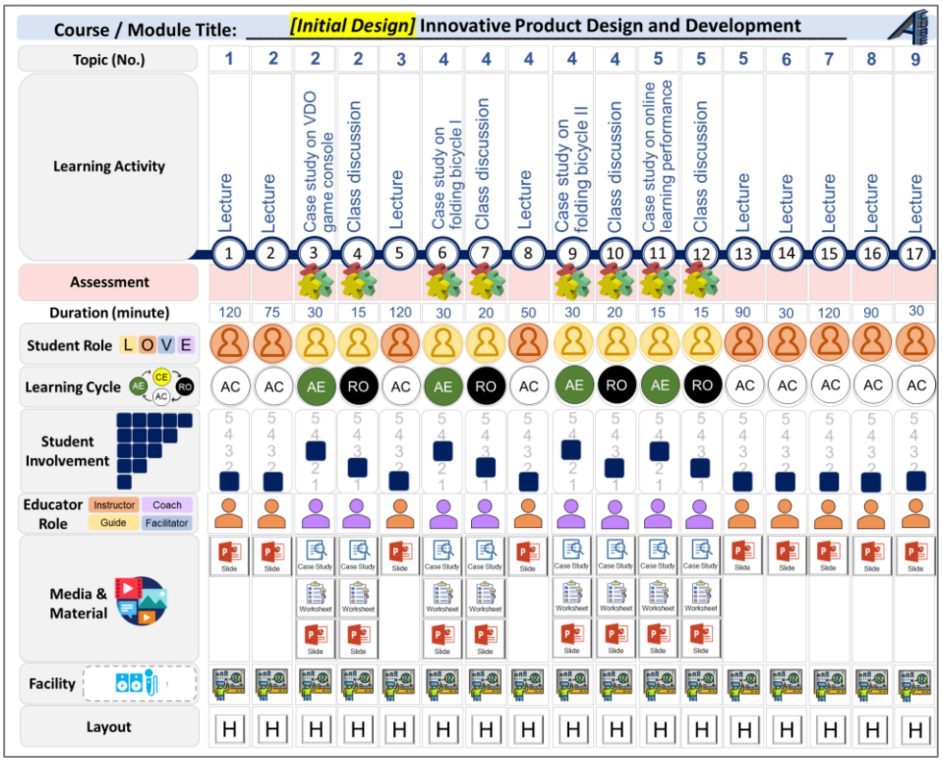

Figure 4. Initial design of PDD's student learning journey.

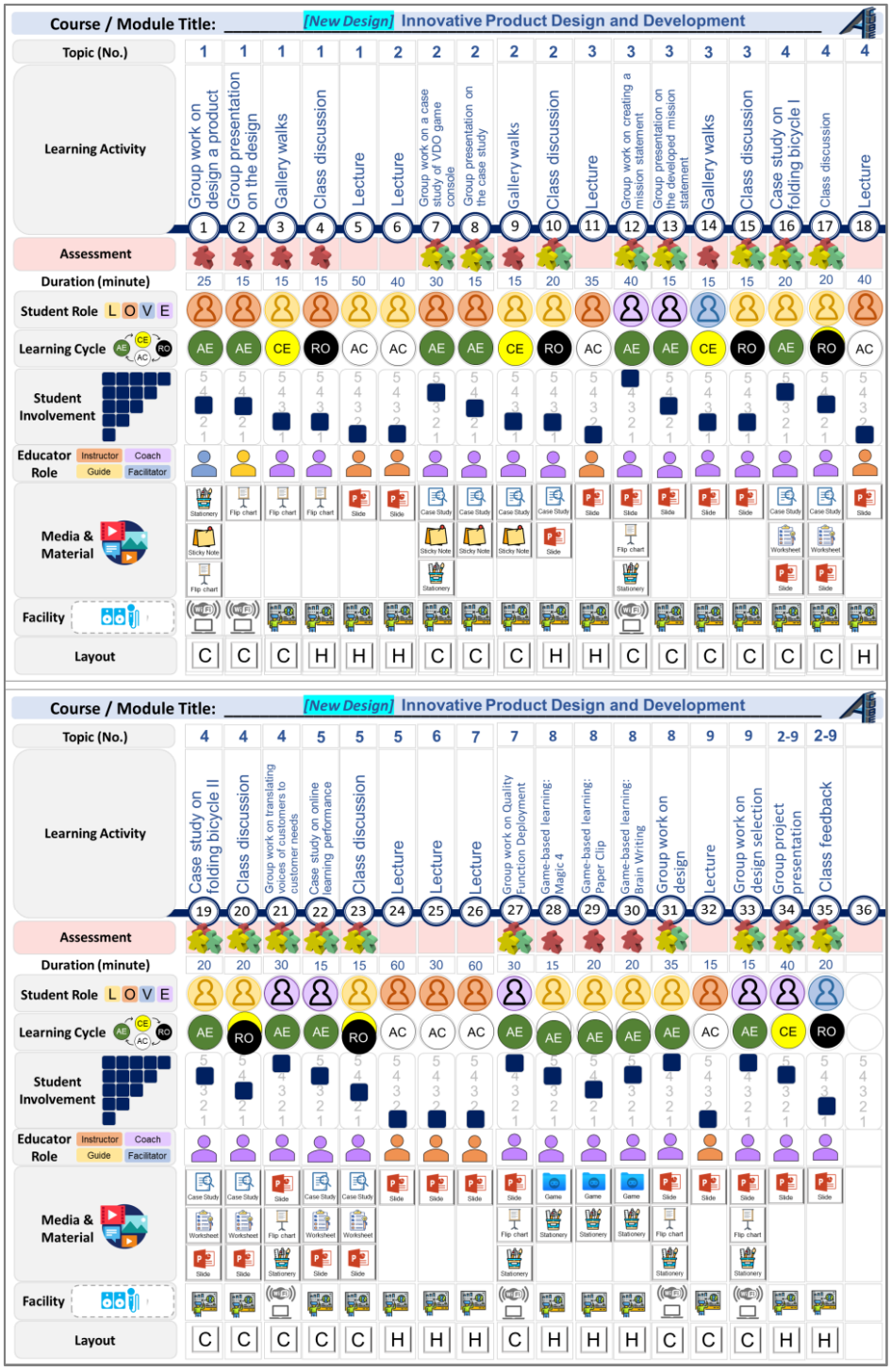

Figure 5. New design of PDD's student learning journey.

2.3. Implementation

The designed journey was implemented. Figure 6 and 7 present some examples of class ambiances offered in two different venues.

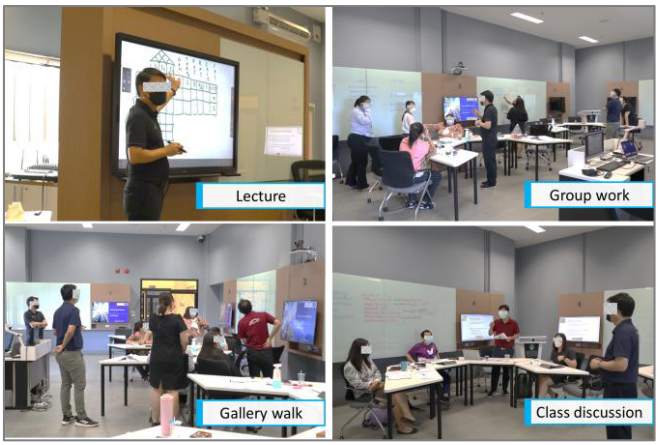

Figure 6. Examples of class A's ambiances.

Figure 7. Examples of class B's ambiances.

2.4. Learner feedbaclk

At the end of the training sessions, learners were asked to fill out a training evaluation form. According to the findings (Table 2), PDD received high scores in all dimensions. The trainer's effective approach is the statement that received the most agreement from the two classes. The dimensions of module relevance to their teaching practice and understanding received relatively low scores, indicating areas for improvement. According to their comments, PDD introduced completely new tools and techniques to them that required time to understand. Therefore, additional activities should be

implemented to guide them to complete another learning cycle for some topics, especially QFD.

Table 2. Results of training evaluation.

	Class A *December 2021*		**Class B** *March 2022*	
Total Number of Class Participants	8		11	
Forms Received	7		11	
1. Demographic Profile				
	Male	**Female**	**Male**	**Female**
1.1) Gender	28%	72%	37%	63%
	Mean	**SD**	**Mean**	**SD**
1.2) Age	37.0	4.8	45.5	4.9
1.3) Years of Teaching Experience	8.7	3.8	14.6	6.8
2. Overall Feedback *(1: Totally Disagree, 3: I am not sure, 5: Totally Agree)*				
2.1) The themes / topics developed in the training were relevant for my teaching practice.	4.43	0.53	3.91	0.94
2.2) I understood the concepts presented in the training activities.	4.43	0.53	4.36	0.67
2.3) I had an active participation during the training activities.	4.57	0.53	4.45	0.52
2.4) The trainer(s) had an effective approach during the activities developed.	4.86	0.38	4.73	0.47
2.5) The training materials used were useful for the activities.	4.71	0.49	4.54	0.69
2.6) The training was valuable experience for professional growth.	4.71	0.49	4.64	0.50
2.7) I will recommend this training to somebody else.	4.86	0.38	4.54	0.69

3. Conclusions and ongoing works

A toolkit for enriching student learning experiences has been developed. The power of the toolkit has been demonstrated by the illustration and the learners' positive feedback. It has been demonstrated that learning experiences are enhanced when all aspects of learning activities are consciously designed and aligned.

We believe that this toolkit will be useful not only for Engineering courses, but also for courses across disciplines. Our ongoing works include implementing the designed journey to other PDD classes and applying the toolkit to other ReCap 4.0 training

program modules for further analysis and development. In addition, we believe that the toolkit has the potential to aid in progressing courses towards student-centeredness.

Acknowledgment

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