Project-based approaches to foster learning research among undergraduate landscape students

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Abstract—With the growing trend of applying Evidence-based Design in the field of landscape architecture, it has become necessary to equip undergraduate landscape architectural students with systematic and scientific research competence. This article shares the author's experience in delivering a Research and Design module in an undergraduate landscape programme for three years. In the module, Project-based Learning approaches have been employed to tackle challenges as an action research. Effectiveness and lessons learnt are discussed. It is important to keep close observation on students' performance and listen to their feedback, so as to adjust teaching and learning strategies timely for education improvement.

Keywords—Project-based learning, research, landscape architecture, undergraduate students

I. Background

Core competences of Landscape Architecture are usually emphasized in "actions" of landscape planning, design and management [1]. Research, especially systematic and scientific research is commonly not emphasized in this discipline unless to prepare students for an academic career at graduate levels. However, with the fast growing research outputs and arising trend of Evidence-Based Design in recent years, landscape architecture is moving towards a more scholarly profession [2]. It has become necessary and even critical to equip undergraduate landscape architectural students with systematic and scientific research competence.

In Technological and Higher Education Institute of Hong Kong (THEi), one module entitled "Theory: Research & Design" is allocated in the third year of its four-year Bachelor programme of Landscape Architecture. This 14-week module mainly aims at introducing research concepts and methods for landscape architectural inquiries, potential application in landscape planning and design, and academic writing skills. It also equips students with basic design-related investigations skills for their final year project. While approaching end of their study, students are hoped to be prepared for entering the real world as practitioner or academia. No matter which career path they are going to take after graduation, it is good for them to have some idea about serious research as well as how research findings and practice could mutually benefit each other. This article shares my experiences of delivering this module in three consecutive years.

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II. The Challenges

Although the intention is good, quite a number of challenges were encountered soon when the module was delivered for the first time. The biggest challenge is that students are typically not well-motivated to learn systematic research, as they consider it unnecessary and difficult according to their learning experiences in landscape architecture. In their existing experience, they are usually allowed to simplify complexed problems or issues and generate relatively ideal proposals, as long as they have impressive big concepts or innovative planning/design proposals. In addition, research requires solid evidence to support each step and statement, which requires a lot of efforts on logic and rationale development and examination. These actually reflect different ways of thinking and valued qualities [3]. In exercise and assignments, I found many of them work mechanically, and lacked active or holistic digest, as well as higher order thinking. As a result, a lot of extra tutorials had to be arranged.

Secondly, soon after the first delivery was started, it was realized that typical approaches that research is conveyed to graduate research students in related fields, was not suitable for undergraduate students of landscape architecture. This refers to the content coverage, depth of knowledge delivered, tasks in the module, etc. For graduate research students, they choose to take the academic path thus are generally psychologically ready to meet and face challenges and problems need to be solved. Whereas our undergraduate landscape students are typically more sensitive to information that can directly lead to tangible spatial configurations or big ideas, rather than abstract information that requires deep thinking and a lot of analyses. They usually struggle in adjusting their way of thinking, sometimes like fitting a cube with a sphere. The new knowledge in this module appears floating in the air and lacks of anchoring. And students usually got confused or mixed things up. Under such circumstance, even though contents were much simplified, exercises and projects were involved with the hope to increase relevance of research in students' minds, it turned out as ineffective in the first round.

The third challenge we encountered is unbalanced knowledge bases of students. They have learnt some investigating methods in other modules that related to land analysis, ecological evaluations, etc. Therefore they can do relatively good job on environment-related or physical/tangible affairs in general. While regarding social or

intangible factors, they hardly know how to investigate systematically, not to mention integrating these sectors. This also reflects that students are not well motivated to learn new knowledge related to research.

III. Objectives

With careful reflection after the first round delivery, it was found critical to motivate students to engage actively in teaching and learning activities. The teacher need to facilitate students to establish personal connections with research.

IV. Theoretical Framework and Related Literature

Project-Based Learning (PBL) has been fully adopted since the second delivery of this module. PBL involves authentic problems that closely related to real-world situation [4, 5]. It allows students to carry out investigations on their own ways and paces, thus highly effective in improving students' engagement, and critical thinking [6]. The end products are essential to demonstrate students' learning outcomes [7]. As most projects are conducted in group settings, students can also improve their social collaboration, reflection and peer-learning skills [8]. During the process, teachers are scaffolding students mainly in preparing them with necessary cognitive tools for the projects, and facilitate their project development through motivating, discussing and guiding them [9]. In such way, students could achieve cognitive growth initially beyond their reach via small successful steps [10].

V. Methodology

As most of our students have similar education background, with no or little experience in serious research before enrolling this module, the baseline of cognition level on research are considered same and very low. Action research has been conducted during module deliveries to examine how effective are PBL approaches in fostering learning research among our undergraduate landscape students.

A. General module setting

Originally, the module was quite lecture intensive, covering 10 out of 14 classes. Besides, there was only one class for field study, two classes for assignment presentations, and one class for tutorial before their final presentation. There were three assignments in total: literature review, methodology, and evidence-based design proposal. Latter assignments need to be developed base on previous ones accumulatively to a research report and design proposal at the end.

After careful reflection and consideration, features of PBL has been much more enhanced by re-composing the module with seven lectures, four tutorials, and three presentations (one for each assignment), while the requirements of assignments are not changed much. Meanwhile, in order to

nurture sense of control among students, "theoretical" contents are delivered in a more relevant way to the students.

At an early point of the introduction part, a general topic is set up for students' further initiations. This topic is generic enough with research potentials but at the same time closely related to design issues in real life, therefore should be able to foster PBL [11]. From this general topic, students form groups of three to four, further select a focus which interests them to develop their own research and design project step by step. Each step is kind of implementation of knowledge and techniques just delivered to them. By semester end, they will complete the project with design or planning proposals based on literature review or evidence generated from their own investigations. Learning is hopefully maximized in this way as the project is closely related to real-life and allows autonomy [12]. The updated flow and rhythm of knowledge delivery and student project progress is shown in Figure 1.

Week	Content		Assignments
1	Overview		
2	Literature Review	Lectures	Assignment 1 Literature review
3			
4		Presentation	
5	Methodology	Lectures	Assignment 2 Methodology
6			
7			
8		Tutorials	
9			
10		Presentation	
11	Evidence-based Design	Lecture	Assignment 3 Evidence-based design proposal
12		Tutorials	
13			
14		Presentation	

Figure 1.   Updated flow of delivery and project progress in the module

It is clear that the content delivery and students' project development evolve simultaneously. Scaffolding is mainly to ensure students acquire relevant knowledge as their projects progress, ensure they are on the right track to avoid failure in later stages, and provide feedback timely. These are done step by step, and leading responsibility is released to students gradually [13]. Besides, group work can foster collaborative learning, as it is found more effective and would lead to better critical thinking performance and deep learning, which is essential to this module [14, 15].

B. Effectiveness of PBL Approaches

Specifically, PBL approaches of in-class exercise and discussion, tutorial, assignment presentation and discussion, together with field study and reflection have been employed. Effectiveness of these approaches is observed from students' in class engagement and quality of their outputs. These are achieved through certain approaches employed during module delivery. Reasons behind can be revealed by in-depth observing in class engagement and conversations with students through different kinds of interactions.

VI. Outcomes

According to my experience, several approaches are found effective: in-class exercise and discussion, tutorial, together with assignment presentation and discussion. Field study is effective under certain condition.

A. *In-Class Exercise and Discussion*

In-class exercises are commonly applied in different kinds of teaching and learning activities [16]. When educating landscape students research, it is essential to keep in-class exercises informal and allow creative answers. Pop quiz or serious exercise that testing their memory or with single correct answers would easily push them away from engagement. The most important point of in-class exercise is to keep students' minds active and reveal any misunderstanding or problem they have for further clarification or elaboration. For instance, when introducing the concepts of variables, there was an exercise asking students to think about a social problem that ought to be solved, and identify the variables of it. One student said "housing problems in Hong Kong". This was rather vague with unclear variables. Therefore, I encouraged him to further specify the problem, what lead to the housing problem and who are affected by such problem. He said that limited land supply resulted in insufficient housing supply, and residents, especially residents with low income in Hong Kong were affected seriously. Thus he could specify the problem as "due to limited land supply, there are insufficient housing supply for low-income residents in Hong Kong". And students were able to identify independent and dependent variables accordingly.

Another possibly effective way of in class exercise and discussion is role play. This has been applied during introducing interview method. After introducing basic concepts and tips of conducting interview, I played the role as interviewee, while students as interviewers. Based on a given topic related to urban landscape in Hong Kong, they asked me questions and probe for further elaborations. During the process, I also debriefed them about whether they were asking close-ended or open-ended questions, leading or non-leading questions, how to keep interview focused and how to move on when encounter "frozen" moment, etc. As all my responses were based on their questions, my debriefs were specifically for our conservation on the given topic, these provided students direct personal experience. Such interactive experience is much more impressive and contributive to their learning compared to direct theoretical explanations or examples from the teacher and appear irrelevant to them.

In many cases, especially large classes, the majority tend to keep silent even they are encouraged to express. In such cases, some stimulating mechanism is needed. What I have found effective are group discussions and assigning a small portion of marks to in-class exercises. It is also important to disclose the results to student from time to time, better compare their overall result with and without adding this portion of evaluation. Once they found that lacking in-class engagement really dragged their marks down, most of them would take action and became active. This may be different across different cultures. But unless they don't care about the results at all, it is always beneficial to encourage in-class exercise and discussion, not only for timely clarification, but also for keeping their brains active.

B. *Tutorial*

Tutorials are employed mainly in the latter half of module delivery, when students need to start Assignments 2 and 3. The assignment 2, methodology, is quite critical in between defining research questions and objectives by Assignment 1 and developing evidence-based design in Assignment 3. In many cases, students have certain problem in identifying valid research question from literature review, although they have general ideas about the focus. For instance, there was one group wanted to study how to design natural playscape in Hong Kong to promote connection between children and nature, thus contribute to children's development. However, the students simply listed out literature summaries one by one without integration according to their focus and lack of discussion. Following such summary they directly jump into research question and objectives. As a result, they got a rather low mark for this assignment. Afterwards, they came for a tutorial, and we discussed about their problems. I found that they did not fully understand the proper way of conducting literature review and techniques for identifying research gap or question from it. Even we went through sample papers in class to explain this process, the papers are good to show the end products, but not enough to demonstrate how selection and organization was done. So students feel lost and frustrated when facing the ocean of literature. They must go through the process with certain guidance so as to acquire the techniques. After the tutorial, they were able to revise their work towards the right direction before designing methodology. If there was no tutorial after Assignment 1, I will only know the low quality of their output, but never know the problems behind.

Since the students got onto the right track after Assignment 1, more tutorials were provided during their work on the following assignments. Gradually, they can move much smoothly. Then, I gradually reduce scaffolding and only need to identify their significant problem or provide suggestions when they approach me. Compare to Assignment 1, they received more positive feedback and encouragements on their action plans. This helps establish their confidence and encourage active engagement. Correspondingly, they start to have sense of ownership towards their projects and progress spontaneously. Some groups even carried out data collection and analysis very fast and effectively, which was totally out of my expectation. When they started doing Assignment 3, as design is not anything new to them, the learning emphasizes making good use of evidence generated by others and themselves to ensure a defensible design proposal. When such proposal is visualized into typical deliverables in design such as diagrams, plans, sections, and perspectives, some groups can do very good job.

In addition, as tutorials provide certain privacy to each group, it makes them more relaxed to express their thoughts and ask questions. Therefore, I am able to understand each group's difficulties and problems closely. Thus our discussions can be much deeper than in other occasions.

C. *Assignment Presentation and Discussion*

Compared to tutorials with each individual group, presentation and comments in front of the entire class is more effective in identifying and solving problems that are common among different groups. In addition, such presentation also allows students to compare their work with others', and critique others' work, therefore facilitate their reflection, critical thinking and learning [17, 18].

In the first round, there was no such arrangement. When students received my comments on their submitted assignments, the next session of classes had already half gone (mainly due to the large class size of 70+ students). This means if they had misunderstood anything in the previous part, it was carried forward and probably affected their learning in later sessions. Besides, my feedback in this way are mainly in written form. Lacking face-to-face clarification and communication as no tutorial could be added according to the tight module plan. It is possible that they may even misunderstood my comments! Under such circumstance, teaching and learning becomes rather mysterious. The consequence was not good learning outcomes in general. The most important lesson learnt from such problems is do not rush to cover new concepts or knowledge before clearing out obstacles on students' learning paths, effectively, before submissions.

That is why one session for presentation and discussion has been added before each of the three submission deadlines since the second round delivery. The presentation and discussion sessions are found especially helpful. The most encouraging moments during presentation and discussion sessions are when peer audience critique sharply and contributively while presenting students respond to peers' and teacher's queries logically. After such interactive sessions, most groups were able to revise effectively and meet assignment objectives. Through such process, students also learn and practice high order and rational thinking on top of intuitive and aesthetic thinking. When either the presenting groups or querying audience receive positive feedback, they earn more confidence and eager to continue their study.

The shortcoming of such presentation and discussion is time consuming. When the class size is large, the module delivery schedule does not allow every group to present each time. Therefore, there would be still some hidden problems not been revealed. In such case, it is more critical to have tutorials with each group.

D. *Field Study and Reflection*

In the first two rounds, there was a field study towards the end of methodology session for the students to exercise on-site investigations with given methodology and reflect afterwards.

The task was to study use pattern in a public park in groups. Students could select a section of the park for their study. I walked around to provide suggestions at the same time. One week later, students presented their data analyses, findings and reflections on their field study, and responded to

queries from the rest of the class and me. The purpose of this exercise was to allow personal experience on studying user-space interaction, and encourage peer-learning base on comparable outputs, which is contributive to students personal and professional development [19, 20].

Effectiveness of such approach varies according to class size and style of module delivery in general. For the smaller class around 30 students than the first class with over 70, it is more feasible for site selection, on-site guidance and in class presentation and discussion. Interestingly, students of the first year gave more positive feedback on field study than the second. The major reason would be that in the first round, the entire module was mainly theoretical and general lack of practical elements. Under such circumstance, the field trip became not only a chance of application, but also a release. In contrast, the second round was more project-oriented. Students would like to focus on building up their own projects therefore found such given and extra project irrelevant or disturbing.

VII. Discussion and Conclusion

During the three rounds delivery of this theoretical module on research and design for undergraduate landscape architectural students, several PBL approaches have been implemented. Group works promote discussions among students; sequential tasks urge continuous efforts, deep levels of thinking and problem-solving skills; in class exercises, tutorials, discussions and presentations foster learning of research concepts, methods and techniques, as well as implementing these into students' projects and lead to well supported design proposals. These also encourage students to be critical and reflective, which, as specified by Julianne [11], are critical components of effective PBL. While working on later phases, students often find that they need to revise previous work, as mentioned above. Through such back and forth efforts, they start to acknowledge and accept non-linear process of research and design development, and gradually be able to integrate research and design together. These, according to Newbury [3], demonstrate the effectiveness of the applied PBL approach. Meanwhile, our experience also reminds that field study need to be carefully involved in such module.

During the education process, as pointed out before, it is essential to encourage students and motivate them to actively engage in the learning process and project. Therefore, the teacher should be generous in affirming what students have done well and praise their achievements and progress. When doing so, the reason behind must be provided as well to encourage students' reflection and improvement. In most cases it is even more effective to do these publicly. In such way, the power of appraisal would be exaggerated in the students' minds, but at the same time with certain power to push them to progress further so as to maintain their reputation among their peers. While on the other hand, the class get some idea about what does a tangible and achievable good performance look like, and understand how this could be achieved. In fact, these would nurture benign competition among students effectively. However, if students are found not doing well on certain tasks, I found it would be more

effective to work in a positive way, i.e., provide suggestions for improvement after pointing out the problem and explain why it is problematic. So the students understand why they are not doing well this time while encouraged to try an alternative approach for improvement.

It should be noted that for undergraduate students of landscape architecture, or other design-related disciplines, it is critical to set realistic targets according to their learning experience before, and characteristics in way of thinking. For instance, most of our students lack of necessary mathematic knowledge to conduct high level quantitative analyses; many of them appear to be weak in deep thinking or dealing with problems that involve multiple factors. In such situations, the teacher may consider whether it is really necessary and helpful to include significant challenges on these aspects. If so, enough scaffolding should be provided to help students overcome the difficulties. According to my experience, it is more critical to let the students go through and entire process and establish connection between research and design in their mind. So that during their career development, they would make use of research findings to support their design proposal or decision making.

Teachers need to well understand the strength and weakness of each teaching and learning approach, so as to organize them in an integral way and make them support each other mutually and contribute to the ultimate goals from different aspects and at various levels. Generally speaking, through establishing personal connections with module contents, PBL approaches would also prompt retaining and application of learnt knowledge and techniques in future [21, 22]. These could also be useful for students in other non-scientific disciplines.

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