

FACILITATING INDEPENDENT LEARNING USING PROJECT-BASED METHOD

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ABSTRACT

Many engineering disciplines require practitioners to be conversant with codes or standards of practice that are relevant to their area of discipline. Introducing the content of these codes and standards in a class using traditional approach can be challenging as the topics are typically dry and uninteresting. There may also be a danger of the lesson being too theoretical. Students may not know how to apply this knowledge in real situations; which is the more important learning outcome of such topics. In this paper, we share how a project-based method can be used to enhance students' learning of such topics. Building Refurbishment, a module offered by the School of Engineering in Ngee Ann Polytechnic uses project-based method to deliver a topic on *Refurbishment for Barrier-Free Accessibility in Buildings*. The content of this topic is largely based on the document - **Code on Accessibility in Building Environment** published by the Building and Construction Authority of Singapore. Students work in teams to submit a proposal to refurbish a chosen type of building, for a class of user (elderly, visually impaired, disabled persons and etc) that would satisfy the requirements under the Code. In the process, students have to perform background research by studying sections of the Code that relates to the building type and user class they have selected. They then have to conduct an on site survey of a real building. In this exercise, students play the role of building auditors and make an assessment of the building's compliance and non-compliance in providing barrier-free accessibility based on the guidelines in the Code. Using the results of their survey, students work on their proposal by listing all findings and recommendations for areas that require refurbishments. They have to support their statements made in the proposal by quoting the relevant guidelines from the Code. The use of the project-based method to deliver this topic has resulted in many desirable outcomes. Firstly, students are given greater autonomy in their learning. They go through the Code on their own; formulate their own understanding through discussions with other teammates and consultation sessions with tutors. This facilitates independent learning, an important lifelong learning skill for students to acquire. The need to conduct an audit and submit a refurbishment proposal has encouraged students to go deeper into the topic. They now have to know how to use the Code, where to locate the relevant information, understand the guidelines and then apply them to their project. The entire process has helped to deepen students' learning. Finally, the fact that real buildings are involved has helped students relate what they have learnt to real life, thus making a potentially dry topic interesting, meaningful and relevant.

KEYWORDS

Project-based learning, experiential learning, learning design.

INTRODUCTION

'Building Refurbishment', a 3rd year module offered by Ngee Ann Polytechnic's School of Engineering, sits within the curriculum for the diploma in Real Estate Business as well as other cognate diploma programmes in built environment. The aim of this module is to equip emerging professionals in built environment with the fundamentals of building adaptation to enable them to manage both the maintenance of buildings as well as changes in the context of buildings. The practice of building refurbishment, also referred to as building adaptation, covers a wide range of works to buildings beyond maintenance. These include alterations, extensions, improvements, as well as partial to full conversions of use and renovations.

Given that this is a single module carrying 3 credit units, it has to complement the other modules on building construction and maintenance to ensure that students develop an appreciation of the critical issues involved in building adaptation such as barrier free accessibility and sustainable adaptation as well as the basic know-how involved in deciding on and planning for refurbishment activities. Basic know-how included the ability to conduct an analysis and evaluation of a building's compliance with building codes and make recommendation for building adaptation activities.

In deciding on the nature of the learning experience for students in this module, the module design took into consideration that given the wide scope of building refurbishment possibilities, a single module carrying 3 credit units would not be able to 'cover' all building situations and contingencies. The module would therefore have to complement and draw on the skills and knowledge acquired in other modules on building maintenance and construction and provide students with a learning experience that was more applied than what they would likely experience if the module adopted a more teacher- and content-centered approach (which would typically see students listening to and learning from lectures given on the various topics and instructions on how to carry out various building adaptation processes). Key features of the learning experiences designed for this module therefore include active and experiential elements that involve students in crafting, monitoring, and critiquing their learning.

This paper discusses a project-based learning experience adopted in this module for the topic 'Refurbishment for Barrier-Free Accessibility in Buildings' and outlines the benefits to learning and some of the key challenges faced.

PROJECT-BASED EXPERIENCE

All new buildings in Singapore have to meet the requirements for barrier-free accessibility for the physically challenged, visually impaired and elderly users. Owners of existing buildings are encouraged to incorporate new features to satisfy the *Code on Accessibility in Building Environment* when refurbishment works are carried out to their properties.

In this project, which runs over 2 weeks (See Appendix A for the Project Schedule), students must plan an audit of a real building with respect to the Code on Accessibility in Building Environment, conduct the audit, construct the report of audit and make recommendations, present the findings and propose the changes, review the findings and proposals from other audits, and reflect on their competency level in the practice of building refurbishment.

The design of the project-based learning experience puts students in the driving seat and requires their active involvement from the start where they select their building and their teammates till the end of the project where they reflect on what they have learned. Tutors

take more of a coach-consultant approach guiding students through as they navigate the various phases of the experience.

Outline of Project Expectations:

Prior to the audit, students are expected to:

- Choose a building to be audited and the class of users to work on.
- Select their audit teammates.
- Conduct the necessary research and gather the necessary information to carry out the audit. This includes getting the necessary approval to conduct the audit on the premises.
- Design the audit exercise including the necessary methods and instruments needed in the conduct of the audit.

One the day of the audit, students are expected to

- Carry out the audit in their teams

On completion of the audit, students are expected to

- Develop a proposal for refurbishment to comply with the Barrier-Free Accessibility Code.
- Put together a report of the audit findings and their recommendations
- Present their findings to their classmates for critique and feedback.
- Reflect on what they have learned

THE PROJECT IN CDIO TERMS

Described as a CDIO experience, this project-based learning experience appears to have distinct elements of the conceive, design and implement stages.

Conceive

Students have to decide on the teammates for this project. They have to discuss and select the class of user that is of interest to them. They have to decide on a suitable building for audit by researching on the history of the building. The students have to think of ways to convince the building management in getting permission to audit the building of interest. Relevant auditing strategies have to be conceptualized for development.

Design

The students will be required to do on-line search for the relevant code, and study the relevant section in the code pertaining to their selected class of user. They are then required to plan out the audit strategy.

At the post-audit stage, they need to determine how to present their findings to their classmates and design a user-friendly viewing interface for the various potential readers of the project report.

Implement

Students will go to the selected building to do the audit. It will be carried out through visual assessment and, if possible, interviews with the building users. The audit report will be put together using the various e-tools and platforms.

KEY LEARNING BENEFITS OF THIS EXPERIENCE

Beyond developing an awareness and a basic understanding of the contents of the Code on Accessibility in Building Environment, this learning experience has multi-faceted learning benefits as outlined below.

Develops discipline specific knowledge and thinking & project-handling skills

Through working on their own project, students not only learnt about the Code on Accessibility in Building Environment, but also sharpened their project-handling know-how which requires them to identify and clarify the nature of the problem/situation to be addressed, find the relevant information that would inform their work and decision-making activities, formulate their plan of action, carry out the plan and make the necessary recommendations.

The following snapshots of student working documents of their audit findings and proposals show evidence of the students' understanding and application of the Code they were working with as well as their ability to analyse and make recommendations.



The image shows a student audit finding document. At the top, it says "BUILDING REFURBISHMENT Wiki > 2008 April, Deep Water". The main content is divided into three sections:

- Problem:** There are two parts of the stairs found on level one that have no detectable guardrail at all. This will cause danger to those visual impairment as they might knocked into the stairs without noticing it at all as there are nothing to warn them about the stairs.
- Code:** Clause 3.7.5.2. Overhead hazard states that a detectable guardrail or other barrier having its leading edge at or below 580 mm from the floor level shall be provided where the headroom of an area adjoining an accessible route is reduced to less than 2000 mm as illustrated in Figure 20(b).
- Propose:** These 2 areas of the stairs will be fitted with detectable guardrail in accordance with the Code, with the diagram as illustration.


The diagram, labeled "Figure 20(b) Overhead Hazard", shows a cross-section of a staircase. A person is walking on the stairs. A vertical dimension line indicates a height of 2000 mm from the floor level to the top of the stairs. A horizontal dimension line indicates a distance of 580 mm from the floor level to the leading edge of the stairs. The text "No detectable guardrail found at stairs" is written below the photograph of the stairs.

Figure 1. Student audit finding, application of the code and proposal

BUILDING REFURBISHMENT Wiki > Mokah

Toilet Flooring

Even though our main focus is on accessibility for the elderly, we would like to touch on hazard areas too as it would relate.




Dangerous step leading into the toilet + slippery tiles

From the pictures above, we can tell that the floors are made of homogeneous tiles and are slippery when wet. This in return causes a huge obstacle for the elderly woman that may want to use the toilet on the 1st floor. If you were to look more closely, you may notice that throughout the wash basin and the walls surrounding, its all tiled using homogeneous tiles. These provide neither grip nor support, so in actual fact it is very dangerous and therefore considered a hazard.

Figure 2. Audit finding and analysis

BUILDING REFURBISHMENT Wiki > 2008 April, Y4

Our proposal



The red box in figure 8 and 9 shows the exact location of our proposed ramp (figure 10 below). This is to meet the requirements of the accessibility code 2007 in providing a barrier free access for wheelchair users.

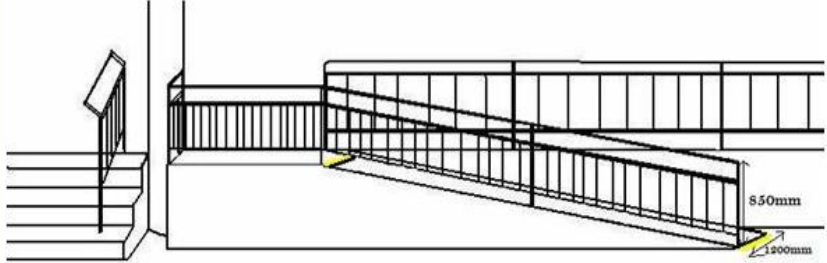


Figure 3. Student audit finding and proposal

Additionally, through reviewing and critiquing the findings and recommendations of other project groups, students gain valuable exposure to a broader range of building types, adaptation issues, and recommendations, as well as deeper insights into alternative ways to report and present their findings and proposals as can be seen from the different styles above.

Develops interest through active and experiential learning environment

That students are given some control to decide on what they learn, how they learn, with whom they learn tends to increase their involvement in and awareness of their own learning.

Reflections on their own learning have tended to display more accountability for as well as a deeper awareness of the outcomes of their own development as a building professional. This can be seen from a sampling of student reflection extracts below.

“In addition, I had also learnt to be more attentive and sensitive to the various features that are provided in the mall through the site assessment audit. This is because the audit would require me to be observing every single part of the mall carefully, and not to miss out any feature as that feature might be a possible problem faced by the elderly users.”
– Student A

“Since my class of users was for the blind, the project has pointed out much differences that a few changes can make in the lives of the blind and how their life can be made easier and letting them be more independent. Brainstorming and looking out for other risks were also a part of the project in which the learning process was very fun.”
– Student B

“The LCL learning has done just that – make us understand the importance of constantly having to keep up with the vast paradigm shift and adjust accordingly. Buildings cannot stay the same forever. The facilities provided are especially important for a functionally friendly building to the users. A good example is the project handed to us during LCL learning which is to understand and apply the newly revised barrier free act and incorporate it to shopping centers.” - Student C

(NB: Names of students have been anonymised.)

Develops collaborative and team-based work skills

Students developed and sharpened their team-based work skills as the project required them to establish project team goals, a work plan, member roles and responsibilities, a team communication plan indicating the channels of communication (including e-platforms and tools) to be used by the team and a plan to monitor the progress of the project.

Sharpens professional communication skills

The project required them to plan for and establish communication with Building Management in order to seek and gain permission to conduct an on-site building audit. They also had to plan for and conduct information gathering exercises such as interviews and surveys.

Students also had to construct a report of their audit findings and recommendations to be presented to and critiqued by their classmates.

Sharpens Professionalism

The project enables 2 key professional and ethical practices to be honed:

- Respect for the rights of property owners and users of the property where students must first seek permission from building owners to conduct the audit, and then seek permission from users to gather information and use it for their purposes.
- Respect of intellectual property and the use of information and original works. Students must ensure that their work is their own and that they have acknowledged and cited all sources referenced appropriately.

Develops e-competencies

The nature of the project made it necessary and natural for students to make use of e-tools and platforms to enable the collaboration, productivity, and professional presentation.

For example, to decide on a building to audit and to plan for such an audit, students need to find out information about the particular building and about the Code. To do so, they had to hone their information search skills using the various internet search engines and the appropriate library databases.

Another point at which e-tools and platforms were the natural work partner for the students was for working collaboratively across time and space in between in-class times to collect, document and log information and data on-site during the audit. Tools used by students for these purposes included the wiki, blog, discussion forums and Flickr.

CONCLUDING REMARKS

As a conclusion this paper reviews 3 common arguments against the use of experiential and active learning approaches such as what has been adopted in the module 'Building Refurbishment'.

The approach is time and resource ineffective

Students need more time and effort to learn about a small aspect of what can be covered in a one or two hour lecture on the topic. Tutors have to expend more time and effort tracking and coaching different groups of students who may be at different points of development at any one time.

The experience with Building Refurbishment.

Project-based learning in the Building Refurbishment module has indeed required an investment of student and tutor time and effort. However, as can be seen from the outline of benefits gained (as described in the section above), content coverage by the lecturer has been exchanged for a multi-faceted, more holistic learning and development of the students.

Such approaches work if students are interested, motivated, and mature

Students need a certain level of motivation and maturity to self-direct. Students at Polytechnic level may therefore not be able to benefit from such a learning experience.

The experience with Building Refurbishment

As can be seen from the examples of student reflections in the section above and in Appendix B, despite the fact that such active and experiential learning experiences require more effort, energy, time, and self-direction, student satisfaction with their learning and development is positive (See Appendix B for student feedback on the whole module).

The assessment of student knowledge is more subjective than in a more content-centered, examination-based approach

It is difficult to ensure fairness in the assessment of students' performance in projects of this nature.

The experience with Building Refurbishment

This is an area for further work and enhancement for this module. While there are currently points at which the tutor assesses the work, points at which students give peer reviews, and points at which students self-evaluate through their reflections, a clearer outline of the assessment points and their respective objectives and rubrics would help to pace and guide both the students and their tutors through the process.

Biographical Information

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APPENDIX A: PROJECT SCHEDULE

The students are briefed on the project during 5th week of the term. Two consecutive weeks of lectures and tutorials hours (6 hours) were allocated for this project. Presentation of the project will be done during the first week of term two.

Table 1
 Project Schedule

Tasks/Activities	Timeline
1. Preliminary discussions among team members - Decide on the building to audit. Research on the historical background of the building. Read up the Code on Accessibility in Building Environment.	Week 06 (Term 1)
2. Site assessment – Site survey and audit existing conditions. Take video/photos and conduct interviews if permissible. Begin working	Week 07 (Term 1)

on the report and submit the report by end of the week	
3. Presentation and give comments on other groups' proposals.	Week 13 (Term 2)
4. Write their reflection on discussion board in MeL.	Week 14 (Term 2)

APPENDIX B: MODULE EXPERIENCE SURVEY

Summary of Oct 2008 Module Experience Survey on the module 'Building Refurbishment'

- 93% of students agreed that the module helped them to develop useful skills and knowledge
- 91% of students agreed that the module stretches their thinking
- 98% of students agreed that the teaching and learning approaches are appropriate for this module/project.
- 93% of students agreed that the module activities enhanced their overall learning.
- 86% of students agreed that the module provided a good learning experience.