Building as a learning tool: a student-centred POE approach to the Swanston Academic Building (SAB)

Jin Woo
RMIT University, Melbourne, Australia
jin.woo@rmit.edu.au

Abstract: This paper describes the process of developing a student-centred POE project for the educational purpose of undergraduate students, using the experiential learning-by-doing approach to assess building performance. The case study building, the Swanston Academic Building (SAB) at RMIT University, is an exemplar of the Australian green educational buildings, creating a ‘vertical campus’ to support student learning. Four progressive assessment tasks were designed for the project based on time and resources availability: site visit, space analysis, energy audit and user satisfaction. The space analysis and energy audit enabled students to understand the functional, technical and environmental performance of the building, dealing with secondary data. The main focus of the project was building user satisfaction, assessing student users’ environmental comfort and satisfaction in respect of energy use and environmental impact in the case study building. A total of 193 participants responded and the respondents were satisfied with overall building performance including comfort at student portals. Although the respondents were less likely to report a significant change in health and work productivity they highly rated building facilities which support their work well. The student-centred POE project presented in this paper seems relevant to building education as it actively engages students in the learning process as a building assessor as well as a building user, reflecting on their experience of using the case study building.

Keywords: Post-occupancy evaluation (POE); green educational buildings; Swanston Academic Building (SAB); learning-by-doing approach.

1. Introduction

Post-occupancy evaluation (POE) is a systematic and rigorous process and provides insights into the consequences of past design decisions and the resulting building performance, by finding the difference between performance criteria and actual building performance of buildings-in-use. It should provide useable information about how buildings perform and how they interact with their users to help manage buildings and improve next building projects. Thus, POE does not seem to be a review of buildings it includes its process and clear performance criteria according to the scope of projects. With
this regard, in recent years, attention has been given to building performance and POE study within the architecture and building discipline, arguing that many building professionals have been trained and experienced to only create buildings, but they have not had an obligation to carry out the POE process to ensure building performance (Bordass and Leaman, 2005, Riley et al., 2010).

A student-centred POE project for undergraduate building discipline students at RMIT University was designed and conducted by using the experiential learning-by-doing approach to assess building performance. The core attributes of the experiential learning are action and reflection. Action can utilize actual experience with the phenomenon being studied to validate a theory or concept, and reflection as a planned activity, students need to relate it to their previous knowledge and test understanding of what took place (Beaudin and Quick, 1995). The 'learning-by-doing' approach based on experiential learning principles could allow students to develop a first-hand knowledge of understanding building user interaction with the building and the way it influences building performance (Gupta and Chandiwala, 2009).

This paper describes the process of developing and facilitating a student-centred POE project for the educational purpose of undergraduate students and explores its relevance to building education. The student-centred POE project in the present paper actively engages students in the learning process as a building assessor as well as a building user, reflecting on their experience of using the case study building. This allows them to identify elements which work well and those which do not work well to ensure the future building projects can learn from the outcomes of the case study building.

2. Overview of the POE project

The POE project ran over 12 weeks for undergraduate students in the school of property, construction and project management at RMIT University. This student-centred post-occupancy evaluation (POE) project focuses on assessing student users’ environmental comfort and satisfaction in respect of energy use and environmental impact in the Swanston Academic Building (SAB) at RMIT. By using the experiential learning-by-doing approach, students assess both hard and soft issues of building performance.

2.1. Case study

The case study building, the Swanston Academic Building (SAB), is an educational building at RMIT University in Melbourne, designed by Lyons Architects and completed in July 2012 (Figure 1 and 2, source: RMIT University, n.d.). With some 35,000 m² of floor space over 12 levels, SAB accommodates the college of business (850 academic and administration staff and 6000 students). Not just for the college of business, with being tied to the RMIT Timetable Services, it has 40% of RMIT teaching capacity in one building (McKee, 2013). With a range of sustainability/energy efficiency features such as innovative building façade, mixed-mode ventilation, rainwater and greywater systems and solar hot water panels, SAB is an exemplar of Australian design excellence achieving a Green Building Council of Australia (GBCA) 5-star Green Star Education Design rating. It provides an opportunity for students at RMIT to experience the latest sustainable building and further to use the building as a case study for their learning, in particular for the architecture and building students. Besides the sustainability features SAB provides a world-class educational facility with the latest technology. ‘Student Portals’ in the SAB support student learning experience, creating an environment of sharing and interaction between educators and students (RMIT University, n.d.), and ideally between student peers. It is more emphasized that having a sense of belonging and positive experience on campus for students, which has
changed the nature of space on campus, coupled with new ways of using technology in learning environment. In this context, the student portals could be an example of educational space that encourages socializing and peer learning.

![Figure 1: RMIT Swanston Academic Building (SAB).](image1)

![Figure 2: Space planning.](image2)

### 2.2. Student portals

Student portals over ten levels support student learning, creating a ‘vertical campus’. The communal spaces linked to cafes and wireless technologies encourage students to have informal learning spaces where students can study and collaborate (Figure 3 and 4, source: RMIT University, 2013). One of the key sustainability features for the student portals is the spatial layout creating a ‘breathing building’ for ventilation and light. Also, a mixed-mode ventilation system used in the student portal can operate with weather conditions and student control. Using a mixture of automated systems such as opening windows, fans and water misters allows for student users to achieve their environmental comfort further through timed gas heaters and lighting fixtures. LCD screens in the portals provide information on the building performance and the way users can interact with their environment (RMIT University, n.d.).

![Figure 3: An example of student portals with LCD screen.](image3)

![Figure 4: Student portal – outdoor.](image4)
3. POE design

This POE project involved undergraduate students who participated in a course entitled Building Services. The course provides students a comprehensive understanding of complex building systems through face-to-face scheduled lectures for 12 weeks. Besides the lectures, a student-centred post-occupancy evaluation (POE) project ran over the semester, using the experiential learning-by-doing approach to assess building performance. As both building professionals and building users students are expected to be aware of how well buildings perform and how building users interact with the building. For this project, progressive assessment tasks were designed and number of techniques for POE were considered including site visits, measurement, analysis of construction documentation, analysis of project records and costs, analysis of utility data and running costs, user satisfaction and public opinion surveys, and video or photography. Generally, not all POE techniques are used at once, they can be selected and developed internally or some techniques are available commercially. The assessment tasks were narrowed down according to time and resources availability and the following were selected: site visit, space analysis, energy audit and user satisfaction.

3.1. Site visit

A site visit was conducted in week 2 just after a project brief was given to students in class. The class size was about 70 students and student groups of four were formed for the project. All students were expected to have the experience as a building user of the case study building since their pre-requisite course was run in the building in previous semester. The student groups were instructed to visit the case study building and to provide a site visit report. The following information was presented to students prior to the site visit.

- Project summary
- Space type and use
- Project design principles
- Sustainable/green features

3.2. Space analysis

After the site visit, each student group was asked to select a floor for building performance assessment. The space analysis was based on ‘RMIT Property Central (Figure 5)’, a web portal system that is an industry-standard, GIS application and a centralised, user-friendly repository of all onshore RMIT campus building plans and facilities information (RMIT University, 2009). The following tasks are given for students to learn how to use the portal system.

- Generate room classification map
- Tabulate the area of each room category
- Calculate the ratio of each room category to total floor area

An in-depth space analysis was required to develop a space-user-technology framework and discuss how well each space supports building users to perform their tasks and activities. An example of the space-user-technology framework is presented in Figure 6.
Building as a learning tool: a student-centred POE approach to the Swanston Academic Building (SAB)

3.3 Energy audit

An energy audit for the case study building was supported by quantitative data from ‘SAB interactive dashboard (Figure 7 and 8, source: Lucid’s Building Dashboard, n.d.)’. The hard, quantitative data includes electricity, water, natural gas, non-potable water consumptions, the student portals indoor conditions (ventilation mode and temperature) and Melbourne’s weather conditions. Using the interactive dashboard, the following tasks were given for students to analyse the utility consumption.

- Provide monthly utility consumption.
- Describe the monthly consumption pattern according to seasons and occupancy.
- Estimate annual utility consumption.
- Estimate annual carbon emissions.

---

**Figure 5:** RMIT Property Central (source: RMIT University, 2009).

**Figure 6:** Space-user-technology framework.
3.4. User satisfaction

A standardised occupant survey was developed for student building users focusing on the student portals in the SAB. The survey questionnaire was modified from BUS methodology which enables the building performance to be compared to other buildings using benchmarks (Arup, 2015). The modified version of occupant survey includes questions specific to student experience at the student portals. The student groups were allocated over ten student portals which would reduce inconvenience to building users and it was expected that each student in a group collected 2-3 questionnaires during a three week survey period in September 2014.

The survey was conducted as a face-to-face mode using a 2 page-hard copy questionnaire. The reason selecting a hard copy, face-to-face mode is to increase response rate and also it could be a learning experience for the student investigators to be in the location of the study. The student investigators were given a training session which included a summary of human research ethics before conducting the survey. On behalf of the student investigators, the human research ethics application was submitted by the course coordinator, as a chief investigator, and the ethics approval was granted on 20 August 2014 (Project number: CHEAN B 0000018826-07/14) with a low risk.

Survey participants were asked to complete a standardised survey provided by one of the student investigators. The survey took approximately 10-15 mins to complete and asked questions about building element such as heating and cooling, noise, lighting and the design of building and their perception/experience. The responses to the survey were collated and analysed by the investigators and all responses remained anonymous.

4. Results and discussion

4.1. Preliminary analysis from student survey

4.1.1. The building overall

A preliminary analysis was conducted from the student survey. A total of 193 participants responded and 87.6% (n=169) were RMIT students and the rest of them were staff and visitors. The age group of
under 30 was the largest accounting for 87.6% (n=169) of the respondents. The gender mix was 54.9% (n=106) for male and 45.1% (n=87) for female. ‘The building overall’ was evaluated by the respondents over eight items from the standardised BUS survey including ‘building design’, ‘needs’, ‘space’, ‘image’, ‘safety’, ‘cleaning’, ‘availability of meeting rooms’, and ‘suitability of storage arrangements’. Additional three items, ‘wayfinding’, ‘space at student portals’, and ‘furniture at student portals’ were developed for this student survey. All items were measured in a seven Likert-type scale (e.g. 1 unsatisfactory to 7 satisfactory). In general, the respondents were satisfied with building design meeting the building user needs. However, meeting rooms and storages were not as satisfying as others, reporting mean scores of 4.59 and 4.77 respectively. The respondents also showed some difficulty finding places using indoor signs. Figure 9 demonstrates the mean scores of the eleven items.

![Figure 9: Mean scores of the building overall.](image)

### 4.1.2. Comfort, health and productivity

This section outlines the analysis results of the student portals located over ten levels in the Swanston Academic Building. The student portals are a dedicated common space for informal study where students can study and collaborate. Using a standardised BUS survey, the student portals’ indoor environment was evaluated: ‘Thermal comfort’, ‘Noise’, ‘Lighting’ and ‘Comfort overall’. Also, building users’ work productivity, health, facilities support and their personal control over the indoor environment were assessed. All items questioned were measured in a seven Likert-type scale (e.g. 1 unsatisfactory to 7 satisfactory or e.g. 1 uncomfortable to 7 comfortable) except work productivity (measured in a nine Likert-type scale). Overall, the respondents felt thermally comfortable in both winter (4.93) and summer (5.14) and they also showed a level of satisfaction over lighting (5.63). Although they were concerned about internal noise, they seemed to be satisfied with noise overall (4.66). Regarding building users’ health and work productivity, the respondents were less likely to report a significant change, reporting a slight increase in both items: more healthy (4.65 out of 7) and about 10% more productive (6.15 out of 9). Interestingly, the building users’ overall evaluation over comfort and building facilities was highly rated than their evaluation over the individual items. They reported that they were satisfied with the overall comfort of the building environment (5.74) and that the building facilities meet their work requirements (5.66). It could be interpreted that although the
individual items did not seem to reach the building users’ expectations, the building users highly evaluated overall comfort and satisfaction due to the building design and image which they more highly evaluated than other functional items. It is evident that they provided extensive, positive comments about building design, mainly stating well-designed and innovative.

![Figure 10: Mean scores of comfort and health.](image)

### 4.2. Discussion

Through the progressive tasks over the semester, students gradually understood a POE process and the assessment criteria. Although this project was designed as four progressive tasks including site visit, space analysis, energy audit and user satisfaction, the main focus was on the last part, building user satisfaction, assessing student users’ environmental comfort and satisfaction in respect of energy use and environmental impact in the case study building. Based on the site visit reports submitted by the student groups, it seems that the student groups showed two patterns: one focusing more on the technical performance of the case study building including the sustainable features presented in the project brief and the other focusing more on the functional performance of the building such as each space and their relationship, for example, the service spaces, circulations and the entrance of the student portal.

Hard data for the space analysis and energy audit were collected and analysed from the RMIT online resources, which enabled students to learn how to deal with quantitative secondary data for analysis. The hard data analysis is a desktop-based analysis of the secondary data, which made the students understand the functional performance of the case study building through the space analysis, and the technical and environmental performance of the building through the energy audit. The space analysis was designed as an individual task so that the individual students in the course can have the opportunity to demonstrate their understanding and analytical skill of the functional performance of the building. Almost all of the students demonstrated how to use the space information management system (RMIT Property Central) and accurately tabulated and calculated each space based on the room classification. However, for the space-user-technology framework some students seemed to struggle to categorise or sub-categorise each space. Through the energy audit the students could understand changes in utility
consumption according to seasons and occupancy. They analysed and interpreted the collected data, trying to understand how the local weather conditions, building systems, seasons and building occupancy affect the utility consumption. Based on their analysis, while the electricity and water consumptions tend to change according to building occupancy, i.e. semester and non-semester periods, the natural gas consumption does according to seasons, i.e. higher consumption in winter due to heating.

Soft data of the building performance were collected from the student building user survey using a standardised questionnaire. The students were asked to fill in the questionnaire as a building user and to conduct the survey at their chosen student portal as a building assessor. Through this process, the students were able to understand the role of building occupants in assessing building performance. They also reflect on practical difficulties they experienced in conducting survey. All questionnaires returned were coded and a preliminary analysis of overall building performance and comfort at student portals was conducted by the chief investigator (course coordinator) and presented to the students in class. Although BUS methodology enables the building performance to be compared to other buildings using benchmarks, this project designed for the educational purpose did not attempt the comparison which can be commercially made. Rather, it focused more on understanding the factors affecting overall building performance and dealing with building assessment criteria and variables and their measurement scale. Due to time constraints, a preliminary analysis of the student survey was only completed during the semester. It could be further explored, possibly in conjunction with a research project course.

5. Conclusion

This paper describes the process of developing and facilitating a student-centred POE project, using the experiential learning-by-doing approach to assess building performance. The case study building, the Swanston Academic Building (SAB) at RMIT University, as an exemplar of the Australian green educational buildings, provides an opportunity for students at RMIT to experience the latest sustainable building and to use the building as a case study for their learning. Four progressive assessment tasks were designed for the project based on number of POE techniques: site visit, space analysis, energy audit and user satisfaction. This POE project enabled the students to understand the functional, technical and environmental performance of the case study building, more specifically through the space analysis and energy audit they learned how to deal with quantitative secondary data for evaluating building performance, and through the building user occupant survey they learn how to assess building users’ environmental comfort and satisfaction. A preliminary analysis showed that the respondents were satisfied with overall building performance including comfort at student portals. Although the respondents were less likely to report a significant change in health and work productivity they highly rated building facilities which support their work well. The student-centred POE project seems relevant to building education as it actively engages students in the learning process as a building assessor as well as a building user, reflecting on their experience of using the case study building. Further analysis of the occupant survey and the utilization of the collected data would be recommended in conjunction with other courses.

References


