

“What an idiot!”

Building better working relationships between Architects and Engineers

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The typical process of engagement between architects and engineers have been sequential, the architects design the building and the engineers ensure the design can be safely built. However, the demand for environmental buildings has fostered a new level of collaboration, as more integrated design solutions are required. At the end of the 20th century, a number of reports highlighted the importance of professions and trades working together in the construction industry, as a result, interdisciplinary student projects were strongly recommended (Egan, 1998; RIBA, 1999).

In 2007, a pilot project was undertaken between the Schools of Architecture & Design and Engineering at the University of Tasmania. The aims of the project were to develop students' interdisciplinary communication and teamwork skills as well as applying their discipline specific knowledge. The joint project involved 85 students working in teams over a 6-week period. This included collaboration via face-to-face meetings, 'skype' and 'messenger'. One of the main challenges presented by this project was the physical distance (200 kilometres) between the Schools' campuses. This paper will highlight the opportunities and problems generated by the project through examining two different lenses, the self, and the student. The paper concludes by proposing future improvements for the project in 2008.

Introduction

Typically, the links between architects and engineers (whether professional or academic) are perfunctory and opportunities to develop creative solutions are often untapped. Historically, the roles and training of architects, engineers and surveyors were indistinguishable; there was no separation between these disciplines (Wilton-Ely, 1977, p. 192). Training was gained on the building site as apprentices of master craftsmen. During the 18th and 19th centuries, the roles of architect and the engineer became discretely defined and separate professional bodies were established (Crimson & Lubbock, 1994, p. 44). Universities were reluctant to contain professional schools, as some members of the universities thought that professional education involved instilling knowledge and habit (Schon, 1983, p. 36). For example, Harvard has only recently reinstated the School status to Engineering; Harvard dissolved the School of Engineering (1847-1906), "...out of the belief that the more practical aims of engineering were incompatible with the broader goals of a university" (Powell, 2007).

One of the driving demands for architects and engineers to work more closely is the design of innovative low-energy buildings (Johnson, as cited in Wallis, 2005). To date, this means that architects, engineers, and stakeholders are convened at the beginning of the project to brainstorm potential ideas (design charette). This ensures that technical expertise can inform the initial design and reduce the number of mistakes and expense. The collaborative design process has been used in the CH2 Building in Melbourne (internationally recognized with a seven star rating for Environmentally Sustainable Design) and the new School of Architecture

& Design building at the Inveresk campus of UTAS. Both these buildings have been awarded the National Architecture Award for Sustainable Architecture (RAIA, 2007).

This teaching development project was initiated by experiences gained in the design charette process for the School of Architecture & Design. In 2006, a Teaching Development Grant was submitted for a pilot collaborative learning project between the Schools of Architecture & Design and Engineering at UTAS. By no means was this idea revolutionary, but from personal accounts the association between the Schools had not been realised in the past 27 years (Clayton, 2007, personal communication). The two Schools are now based in different parts of the state. This exacerbates the separation but also adds another opportunity to explore digital technologies.

This paper describes the planning process and the strategies involved in this collaborative pilot. More importantly, this paper analyses the feedback gained from participating students (via questionnaires). The lecturers reflected on this feedback and the resulting recommendations are presented here. This paper illustrates both the students' views and opinions and the lecturers' reflections.

Review of the literature provides very few recent publications describing multi-disciplinary or interdisciplinary projects between students of architecture and engineering. Research into practice has indicated there is only limited material available discussing the process of integrated design for sustainable buildings (Wallis, 2005), as it is an emerging practice.

A recent international design conference brought together educators of architects, designers and engineers to exchange teaching ideas and discuss collaboration (ConnectEd 2007, UNSW, Australia). The proceedings of this conference seem to further indicate that this area provides future research opportunities as the presented papers had very limited references. Very few papers dealt with multi-disciplinary projects between architecture and engineering students (Longbottom, Bell, Vrcelj, Attard, & Hough, 2007; Vreclj, Attard, Bell, & Longbottom, 2007).

The literature supports the need for teaching and learning activities that bring together architect and engineering students, however there is little critical discussion beyond the initial idea. The UNSW (2005) have appointed a Professor of Multidisciplinary Design to promote collaboration between the Faculties of Engineering, Built Environment and College of Fine Arts. Further research is required in this area to locate exemplary projects, particularly from Australia and Europe where many Schools of Architecture and Engineering are combined, before undertaking this project in 2008. This will also confirm an initial theory that these projects seem to have a short lifespan (1-3 years).

Methodology

A planning day was held in Ross (situated midway between the two, physically separate schools) over the Easter Break 2007 with CALT advisers from the Centre for the Advancement of Learning and Teaching (CALT) at UTAS. A subsequent meeting was held in the June break. The first meeting involved a familiarisation with the units and teaching and learning practices. Common learning outcomes, project type and program overview were identified from this meeting. The June meeting took place using 'skype' – free video

conferencing via the web and gave us an insight into possibilities and limitations of this software. ‘Skype’ was our main strategy to ‘reduce the distance’ between the Schools and assist teamwork communications. Software like ‘skype’ is currently used by some practices to communicate with consultants or colleagues remotely located.

Project overview

The main task of the project was to re-design/ re-use the School of Engineering building on the Hobart campus. The joint project involved students enrolled in second year architecture and final year civil (structural) engineering. These year groups were determined by the flexibility of certain core units (*KDA221 Design Studio 4* and *KNE 415 Civil Engineering Design 1*) to incorporate a joint six-week project.

We believed that students would engage better with this project if we used a combination of face-to-face meetings plus ‘skype’ meetings. We also thought that the face-to-face meetings needed to take place in both our Schools so that students could get a sense of how each other works and the places where they learn. Hobart provided access to the ‘project site’ and Launceston provided award winning exemplars of building re-use at the Inveresk campus . This resulted in the schedule documented in Table 1.

Table 1

Project Schedule, Semester 2, 2007

Wk/ date	Lecture content	Teaching and Learning Activities	Assessment tasks		
			AT1	AT2	AT3
1/ 17 Jul	Intro to unit Building typologies Analysis/ critique – diagram generation Learning	Workshop critiquing the building typology/ precedents Homework: prepare analysis of building precedents (6 per team) to discuss with engineering team members	LO1* LO3 LO4 LO5		
2/ 24 Jul	Intro to Arch/ Eng project Teamwork Favs/ Dislikes of Engineers	All day – Launceston with the Engineers (tba) Teamwork Tours – favourite and least favourite spaces – images Discuss with engineering group the precedents			
3/ 31 Jul	Robert + Jim Teamwork Favs/ Dislikes of Architects	All day – Hobart with the Engineers (tba) Site visit – client brief, favourite and least favourite spaces Brainstorming ideas in groups			
4/ 7 Aug	Learning environments and user relationships	Design tutorials – conveying problems and ideas in diagrams, check on team management etc...			
5/ 14 Aug	Giving Critical Feedback: “I” and “You” Language	Workshops: – practise critiquing with peers + students to discuss storyboard/ checklist with tutors (what is required)			
6/ 21 Aug		AT1 Critiques (presentations)			

* LO = Learning outcome

As the project progressed, the value of face-to-face meetings became apparent so a third trip was organised to allow the engineering students to participate in the interim presentations. At the end of the six-week project, the architecture students individually continued to develop

these schemes. Ideally the outcomes could be presented to engineering students (however, finding a common date at the end of year was difficult).

The task was undertaken in teams, comprising three architecture students and three engineering students. As there were double the number of architecture students, the engineering teams worked with two architecture teams. The team self-selected within the disciplines to counter the potential anxiety of working with another discipline team. The student roles varied because the engineering students were clients and engineering consultants, whereas the architecture students were designers. Their combined task was to work together in developing the brief, identifying opportunities and proposing design and structural solutions that were complementary and integrated.

To minimise the risk of working collaboratively, both disciplines worked on the re-design of the Engineering building but prepared discipline submissions from their teams. For example, the architecture team submitted an initial design scheme with reference to the engineering advice as client and consultant. The engineering students submitted a report, which outlined the implications of the design scheme and construction procedure as well as detailing one particular section and completing a structural analysis. The final engineering report was due after the architecture submission.

Teamwork and communication skills were key learning outcomes of the project (Figure 1). Teamwork resources were sourced from the HERDSA Guide: Managing Student Teams (Caspersz, Skene, & Wu, 2006) using the exercises, “What is my contribution?”, “Team Operating Guidelines” and “What roles do we need?” (pp. 48-49, 54). Students were also required to fill out and submit a meeting report proforma (Williams, 2007, pers. comm.), to illustrate their progress, discussion and the delegation of roles. The communication skills focused on “you and I” language and how to constructively contribute and critique ideas/work and not ‘attack’ the author. Students practiced and demonstrated these skills during the interim critiques (both verbally or in written comment).



Figure 1. First group meeting of architecture and engineering students, 2007.

To further demonstrate the role of teamwork in the creation of architecture, a short documentary was produced locally investigating the relationship and practices between distinguished architect, Robert Morris-Nunn and engineer, Jim Gandy. Their work has received international publication and received many National Architecture and Engineering awards. Students were shown this film before visiting the 'site' to inspire and encourage team partnerships. Both Robert and Jim attended the screening and answered students' questions after viewing the documentary (Figure 2).



Figure 2. Students meeting with Jim Gandy and Robert Morris-Nunn, August 2007.

In this paper only the assessment process used for the architecture students has been described. The learning outcomes, assessment criteria and activities were constructively aligned (Biggs, 2003). Students were given an assessment rubric at the beginning of the project, which described outcome expectations. The assessment criteria were used to assess both the individual and the team. Students were assessed individually on their teamwork skills (25%) and critiquing skills (25%), and as a team member on their strategic thinking (25%) and design proposal (25%). Teamwork skills were determined by the meeting reports and peer assessment (Williams, 2007, pers. comm.). Critique skills were evaluated in the interim critique. The team's digital submission was appraised for strategic thinking and the design solution.

The framework of this teaching development project was based on previous experience working with advisers from academic developers in the Centre for Advancement Learning and Teaching (CALT) at UTAS. Assessment of this collaborative project drew on Brookfield's (1995, cited in Moss, Thomas, & Wallis, 2007) "...claim that teachers should critically reflect on their practice through four 'lenses' [self, students, peers and literature]". This increases the opportunity to unearth false assumptions and evaluate a number of different sources on the same topic. The primary sources for collecting evidence were:

self – at the end of the project, both lecturers reflected on their experiences through writing, then later discussed these thoughts by 'skype' and telephone. It should be noted that during the project both lecturers were in regular contact via 'skype' and email;

students – questionnaires were conducted at the beginning and after the completion of the project. The questionnaires comprised two parts: questions using a *Likert* scale (1 to 5 where 1 is strongly disagree and 5 is strongly agree) and open-ended questions.

Further, valuable information was collected from meeting logs and emails. Focus-group interviews were planned after the questionnaire data was analysed, however it was thought that not much more depth would be gained, as the questionnaire data was rich;

peers – to be sought from the presentation of this paper from Teaching Matters conference, CALT advisers and unit tutors; and

literature – evolving with the development of the project and the identification of resources.

As stated earlier this paper will focus on the *student* and *self* lenses in the results and discussion section (Brookfield, 1995).

Results and Discussion

In this paper, the results and discussion section are focused on the questionnaire feedback and the lecturers' reflection on these results. Overall, 85 students were involved in this project and most filled in the questionnaires. The first questionnaire (week 2) had 93% participation and the second questionnaire (week 8) had a 71% participation rate.

The key issues/themes identified from the analysis relate to:

- students' expectations;
- program/ timing;
- exchange process between architecture and engineering students;
- communication/ 'skype';
- lecturers' and students' perception of the year level difference; and
- lectures' and students' overall reflections on the project.

It is noteworthy that very little student feedback expressed concern about team members or the team selection process.

Students' Expectations

The students were enthusiastic towards the collaborative project in week 2 and forecast many positive benefits from this opportunity. A lot of the quotes indicated students' interest in learning how the other discipline thinks or approaches their work and why they do so.

I hope to learn what ideas architects have for structural design and that will give me a better indication of using creative thinking.

Hope to see how engineer students operate (work) and how we can assist each other.

How do we find a balance between the knowledge of engineer and architecture students? Eng[ineers] have done limited creative design and how much structural do arch[itecture] students really know?

There was a lot of goodwill expressed by the students towards the objectives of this project.

I don't think I have any expectations from what I can learn from the engineering students. But at the same time I am open to learning about those things which they find important or crucial to the project.

The results from the Likert scale questions further supported the qualitative data, by showing students' "level of enthusiasm and interest towards the project..." aims. Students indicated that their "level of enthusiasm and interest" ranged between somewhat interested to very interested.

Table 2

Students' Level of Enthusiasm and Interest

		N/A	Not interested	Not very interested	Somewhat interested	Very interested	Extremely interested	Av mean
			1	2	3	4	5	
Q9.	Your level of enthusiasm and or interest towards this project, to collaboratively re-design the School of Engineering (in Hobart)	1	1	4	19	43	11	3.71

Students were also asked specifically about how important it was to their education "to work in a group project with Architecture and Engineering students" and "to learn teamworks skills and approaches from lectures and workshops". Respondents indicated for both questions that it was very important.

Table 3

Students' Valuation of the Group Project and Teamwork Skills

How important is it for your education:		N/A	Not important	Not very important	Somewhat important	Very important	Extremely important	Av mean
			1	2	3	4	5	
Q7.	to work in a group project with Architecture and Engineering students?	0	0	1	18	40	20	4
Q8.	to learn teamwork skills and approaches from lectures and workshops	0	0	0	8	49	22	4.18

Program/ timing

The data showed that students found that the collaborative project required more time than allocated. They also felt that the short period designated for this project and the sequence of

activities did not support collaborative approaches between the interdisciplinary teams. In particular, many students thought that the 'site' visit took place too late into the program and the project really needed to begin with the 'site' visit.

We should have visited the engineering school in the first week then the project would have been more beneficial. As there was no way near enough time for the collaboration idea to work very well

On reflection it was easy to recognise that the placement of the 'site' visit in the program was too late and compromised the students' face-to-face contact. The site visit took place in week 3 of 6/7 week program to re-design the School of Engineering building. This resulted from the deliberate approach to allow students' time to meet each other and to stop teams from generating instant solutions. The Launceston venue facilitated this approach and allowed students to explore 're-use' precedents on the Inveresk campus. This took place in week 2, because week 1 was taken up with introducing the units and travel logistics. Despite these problems, some students thought that the 'site' visit to both campuses were well organized and valuable to their learning.

I liked the site visits and freedom of the project

...the visits between schools was [sic] quite good, and were organised well, it was great having Morris and Gandy and seeing the dome.

Both lecturers resolved that "...too much was trying to be achieved" in a short period of time. The project scale and its requirements would need to be reduced or the project time extended. As the project progressed and evolved, many problems and opportunities were observed during the collaboration.

Exchange process between architecture and engineering students

One of the key objectives of this project was for students to work collaboratively and to create an environment where positive learning experiences occurred, to challenge the traditional pattern of the architect designing followed by the engineer resolving the structure. This objective was not met.

*...not very much **parallel** design process more like here are the plans here is the engineering*

It was a good project - but perhaps the end result with the engineers wasn't as effective as I was hoping...

The data showed that students thought the concept was good, but required further development and additional time in the project to encourage exchange.

Good idea - needs a bit of tweaking to become a real collaborative exercise

Giving more time to work on the project. Engineers couldn't really do much until archi[itecture] designs were finished. Maybe give an initial small project so everything wasn't left for the last week.

This last quote suggest students found it difficult to reconcile and work collaboratively in the framework. Their discipline tasks relied on each other, but evidently not enough.

I found we didn't communicate so often with the engineers because most our problems could be solved ourselves. The ones that weren't structural.

The strategy to minimise the teamwork risk by generating two separate submissions that 'piggy backed' each other did not support sufficient collective ownership. The hand-in dates were staggered, allowing the engineers more time to analyse the architects' schemes.

The miscommunications we had with the engineers revolved around them having a different final dates for work, which meant they didn't do anything for us.

Try [sic] to have a final panel worked by both engineers and architects rather than separated

In the reflective discussion it was apparent that the submissions needed to be more tailored together. The lecturers had unconsciously set up the traditional pattern. A discussion began on how we could get the different student groups to empathise with each other roles and perspectives. The possibility of beginning the project with architects and engineers swapping roles to gain an appreciation of the concerns and processes required and then return to their typical roles was also considered. Alternatively, it was proposed that initial face-to-face contact could be an intensive two-day design – so there was no separation in the initial development. The lecturers could facilitate and model some of the exchanges.

After the completion of the project, architecture students sent an email that indicated their enjoyment of the process and how satisfied they felt about the collaborative design process within their architecture team. It was the first experience for the architecture students to work collaboratively on design, let alone work collaboratively with engineers.

Communication/ 'skype'

The lecturers found the installation process and operability of 'skype' easy. It took 10 minutes to set-up and did not require additional assistance. Planning meetings were held successfully over the mid year break using 'skype'. Unfortunately, the ease of our personal experiences distorted our expectations of setting up 'skype' for our students on the schools' computers. Currently, the university's IT section provides limited conditional support. We both feel that

this hurdle with 'skype' can be resolved next year, even if it means having a dedicated 'skype' computer in Architecture and Engineering. Future investigations are planned in designing a 'wiki' to allow the entire group to exchange materials, and assist collective learning.

Students' frustrations to 'hooking' up with each other via 'skype' was reflected in their questionnaire responses. The most negative response was fielded by question 11, "Would you suggest that your team did not have too many problems with hooking up between Launceston and Hobart". The rating was 2.38, on a Likert scale where 1 was strongly disagree and where 5 was strongly agree.

Table 4

Students' Experience Using Skype

	N/A	Strongly disagree	disagree	neutral	agree	Strongly agree	Av mean (total)	Av mean (eng)	Av mean (arch)
		1	2	3	4	5			
Q11. your team did not have too many problems with hooking up between Launceston and Hobart	2	12	15	20	9	0	2.38	2.06	2.5

These difficulties were disappointing for both students and lecturers, especially since 'Skype' had been demonstrated in a lecture theatre and had worked well. Despite these problems, a number of students showed initiative in maintaining communication.

Had lots of "meetings" through messenger due to ichat/SKYPE not having been setup in time. Apart from communication difficulties it was a fantastic experience

On reflection, we also realised that the lecturers took the main responsibility to organise the meetings, which allowed some students to take a passive stance. It was envisioned that students would communicate mid-week using 'skype', email and/ or 'messenger'. However, at least one team had only four meetings, which were the ones that we had supported: two face-to-face meetings, a 'skype' session using the lecturers' machines and the interim critique. It was agreed that, in 2008, students would be encouraged to take more ownership of the meeting logistics.

Perception of the year level difference

The data showed that a few architecture students were nervous about their ability to work with more experienced and senior engineering students. No comments were recorded in either questionnaire suggesting that the engineers thought there was a level or experience concern. Engineering students were impressed by the second year Architects' confidence to present and express their design ideas. As a result of the interim presentations, engineering students will be encouraged to develop their presentation skills and feedback skills (in a non-

combative way). It was resolved that the lecturers had “more ageism” concerns than the students, and the difference in year level did not appear to negatively affect the project.

Overall reflections on the project

The final questionnaire inquired whether students thought that this project experience was valuable and should be continued to be developed; they agreed it should (see Table 5). This does not alter significantly from their earlier responses in the week 2 questionnaire which rated the level of importance at a similar level (4.22), despite the key issues discussed above.

Table 5

Students’ Opinions on Future Collaborations

	Strongly disagree	disagree	neutral	agree	Strongly agree	Av mean (total)	Av mean (eng)	Av mean (arch)	
	N/A	1	2	3	4	5			
the experience was valuable and they should continue developing a joint project between the Schools?	0	0	2	14	31	13	3.92	4.06	3.86

Conclusions

In reviewing the data it appears that in some places our diligence to forecast problems and our ‘anxiety’ to ensure things worked out or at least to minimise risk inhibited the project outcomes. This was particularly true with our objective to assist collaboration. Despite these teething problems it was an enjoyable process, setting the project in motion and observing what happened along the way. The reflection on our experiences is ongoing.

In 2008, the teamwork building process will be a part of the project task – giving students a common focus and allowing the project proper to commence. Regardless of the time dedicated to this joint project there needs to be a scaling down of the project and its requirements – this in turn will allow more opportunities for collaboration. The project will be tailored more closely together so that students need to collaborate to fulfil their discipline tasks. The possibilities of a two-day intensive program will be investigated – coordinated between the two schools. The questionnaire indicated that most students had a part-time job or parenting responsibilities, so this may be difficult to achieve without sufficient warning. It also has timetable complications. We anticipate that the implementation of ‘skype’ or compatible software program will be resolved early in 2008. The review of the student feedback and reflective discussions has re-energised and confirmed our enthusiasm to undertake this joint project again. In this project students realised and appreciated each other’s skills, the next step is to nurture the collaborative process.

I enjoyed working in group work with eng. students. ... and hope to do so more in the future. Thank you

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