"I'm a designer, get me out of tech class!": closing the gap between design and technology education

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ABSTRACT: The following paper explores the use of collaborative pedagogical approaches to advance foundational architectural design education, by linking design process to sustainable technology principles. After a brief discussion on architectural design education, the mentioned collaborative approach is described. This approach facilitates students' exchange of knowledge between two courses, despite no explicit/assessable requirement to do so. The result for the students is deeper learning and a design process that is enriched through collaboration with sustainable technology. The success of this approach has been measured through questionnaires, evaluation surveys, and a comparative assessment of students common to both courses. The paper focuses on the challenges and innovations in connecting architectural design and technology education, where students are encouraged to implement lessons learnt, thereby closing the gap that these courses have traditionally represented.

Conference theme: Design Education
Keywords: Architectural design studio, Architectural science teaching, Collaborative teaching and learning, Deep learning

INTRODUCTION

This study provides a brief discussion on architectural design education and shares the experience of collaboration between two courses: design studio 'Architectural Design 3' (DAB310) and architectural science 'Integrated Technologies 1' (DAB330). Qualitative data reflecting the level of basic knowledge of 2nd year Architecture students in the School of Design at the Queensland University of Technology (QUT) has been analysed. The study gathered data from two questionnaires handed out in the two courses, at different times.

The aim of the collaboration was to enhance deeper learning in students and actively involve them in their own learning. In the literature, some of the features of deep learning are described as: connecting course content to real life; relating knowledge from different courses; and making connections between different courses (Ramsden 1988, Entwistle1988; and Biggs 1999). Various forms of integration of lecture-based knowledge courses, also called service units, to the design curricula in design studio has been discussed in previous works (Demirbilek and Demirbilek 2007; Hutchinson and Demirbilek 2005).

Rapoport (2000) strongly argues that design is a research based scientific discipline and criticizes the centrality of studio teaching. He argues for the reduction or elimination of its dominance in architectural education. On the other hand, citing Kruft, 1994, Beckley (2000) quotes Adolf Loos "…apart from a very small part of architecture … [e]veryhing else that serves a particular purpose must be excluded from the realms of art" and mentions Sullivan, Gropius and others, all advocating function in relation to form. He, himself, believes it is impossible to exclude the art of design from architecture and defines the relation of form and function as being the architectural problem. Reflecting on the work of Rapoport, Groat (2000) explains how her views on design education have evolved in time. Although having been intellectually challenged by Rapoport's drastic views on the studio system early on and defending architectural theory and the value of the studio, she admits that after twenty years of academic experience, she acknowledges Rapoport's *diagnosis* of architectural education problems, but does not agree with his *remedy* (Groat 2000:128). To this end, Groat (2000) presents an alternative model for architectural education, namely the *architect-as-cultivator*, in an attempt to find another descriptor to the definition of the architect as either an artist or a scientist.

In her summary on the approach to architectural education, Groat refers to a study that Ahrentzen and herself did in 1992 that challenged the model of *design-as-centerpoint*, pointing out that when design is classified as the core element, anything else becomes tangential (cited in Groat 2000:129). Therefore, what they proposed was the idea of weaving all design activities into the body of design education "as a tapestry", making sure to allow for the integration of any other schools of thought and approaches into the general architectural education model (Groat, 2000: 129).

Explaining why schools of architecture utilize and identify the studio culture as one of their valuable assets, Johnson (2001) defines face-to-face interaction types as *focused* and *unfocused* by referring to Goffman's book, Behavior in Public Places. He refers to Schön's argument about how critical the passive forms of communication are for the socialization process, which is a part of educating designers. He defines the individual desk-crit as a focused interaction, and adds that Schön and others find the unfocused interactions extremely valuable, as they involve learning by listening to what is said to others, interaction between students, and unprompted discussions (Johnson 2001).

Onat defines architectural education "as a systems effort that should be put into practice individually in order to obtain necessary behavioral development" as required by the architectural profession. This change in behavior "should be achieved through individual's own experiences; otherwise it could not be permanent". Onat then reinforces that this is the reason why practice is so essential in architectural education (cited in Kurt 2009:401).

While discussing architectural education, Gross and Do (1997) talk about the way architectural design is learned through a project based approach in the design studio, where "designers express and explore ideas, generate and evaluate alternatives, and ultimately make decisions and take action" (Gross and Do, 1997: 1). Gross and Do also mention domain specific knowledge about buildings that is learned through theoretical class instructions where they learn to reason about the expected behavior of designers. They also claim that the studio is the most important part of architectural education: "it is where the knowledge about buildings is applied, and it is where the act of designing—generating, evaluating, and developing alternatives—is learned and practiced." (Gross and Do 1997:1). However, they also point out the ongoing challenge in integrating the discipline knowledge taught in lecture-based courses into the design studio learning experience. Gross and Do (1997) convey that only exceptional lecturers teach their students the ways to apply an integrated systematic method.

1. INTERWEAVING THE EXPERIENCE BETWEEN TWO STREAMS:

In response to the challenges mentioned above, a collaborative study has been carried out during the past few years. In the design studio, an approach that adopts design Logic, Spatial quality and Form is being implemented as a way of such a systematic method. This is an intentional development of Vitruvius' foundational theory of *Firmness*, *Commodity* and *Delight* in design. The students take the knowledge and experience to the technology course and with the knowledge and experience gained through the lectures, hands-on exercises apply to 2 projects. This design project based experience then feeds into the design studio for a final project that again takes Logic, Spatial quality and Form. Hence, this process of joining the forces and interweaving the experience between 2 streams reinforces that the whole of a system is greater than the sum of its parts.

In DE40 Bachelor of Design Architectural Studies at QUT, in addition to the project-based architectural design courses conducted in a studio setting, there is an additional "flavoured design studio" integrating technology (environmental, technical studies and documentation) and history/theory (culture and space) that is run alternately each semester.

1.1. Architectural Design 3 (DAB310)

During the first semester of the second year the design studio presents ideas in design methodology that address architecture as a process. In the introduction project, emphasis on building design as an *environmental filter*, a *container of human activities* and a *delightful experience*, manifests itself in the design of a small dwelling. In the final Architectural Design project, design process is further developed through the adoption of three divergent criteria: Logic, Space, and Form. This project presents an opportunity to consolidate the outcomes of the workshops from this course, and the previous lessons learnt in Integrated Technologies course; concluding with a final integrated design proposal. The outcome of the process is an acknowledgement that design Logic, Spatial quality and Form, all contribute to sound architectural design - each meriting consideration in the formulation and assessment of a design.
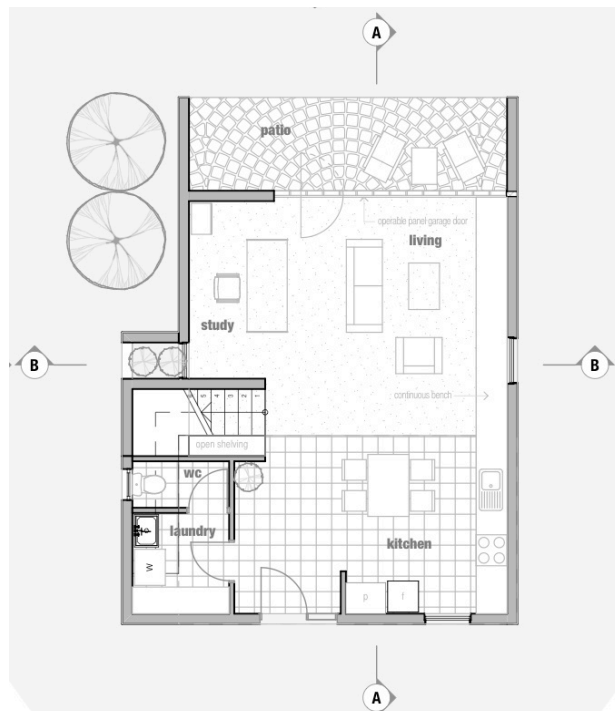
1.2. Integrated Technologies 1 (DAB330)

On the other hand, 'Integrated Technologies' (DAB330) focuses on environmental studies, and in particular climate responsive building design and daylighting. This course introduces basic technologies associated with architectural practice, and technical skills required for environmental design. The studio component of this course promotes an understanding of passive design principles, requiring an integrated re-design of a dwelling, within two alternative climatic regions.

### 1.3. Collaboration of 2 courses (DAB310 and DAB330)

For the last few years, the coordinators of these two design studios have collaborated to advance foundational architectural design education, by linking design process to sustainable technology principles in a 3-step-approach. In the first step, the introduction project of DAB310 emphasizes on building design as an *environmental filter*, a *container of human activities* and a *delightful experience* resulting in a modest design of a small dwelling within a temperate climate (Figure 1). During this 4 week long period, DAB330 introduces basic technologies associated with architectural practice, and simple technical skills required for environmental design supported by hands-on exercises and experiments, the details of which can be found elsewhere (Demirbilek and Demirbilek, 2007).

Then as the second step, the studio component of this course promotes an understanding of passive design principles, requiring an integrated re-design of the newly designed sub-tropical dwelling within two alternative climatic regions, such as hot-arid (Figure 2) and cold (Figure 3).
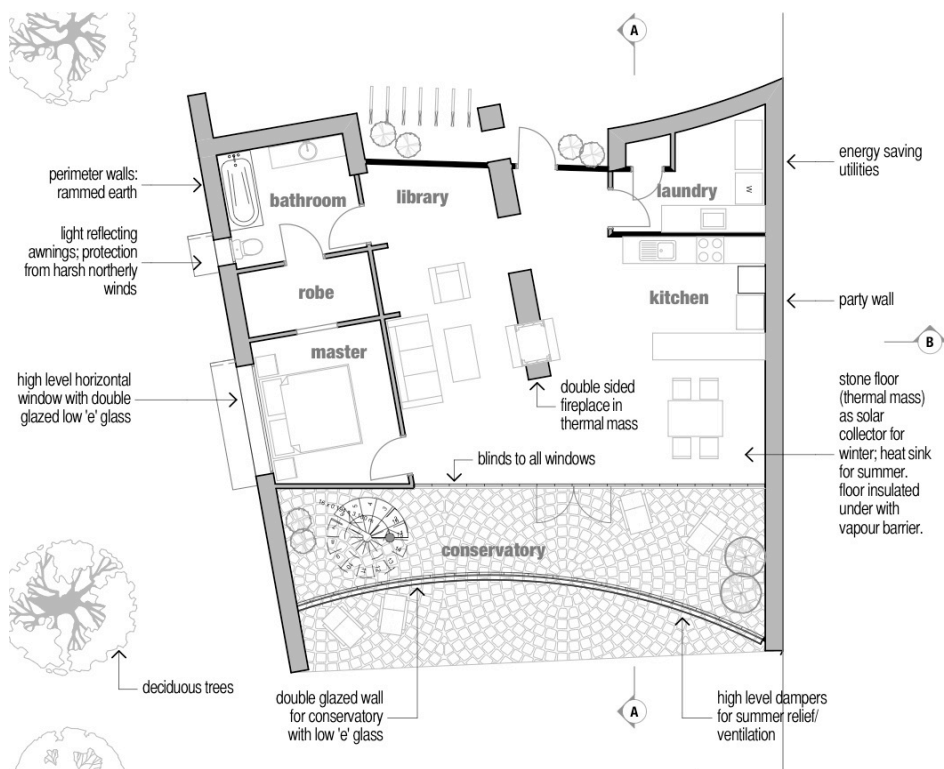
Figure 1: Floor plan of a small dwelling designed for a temperate climate

Figure 2: Floor plan of a small dwelling re-designed for a hot-arid climate
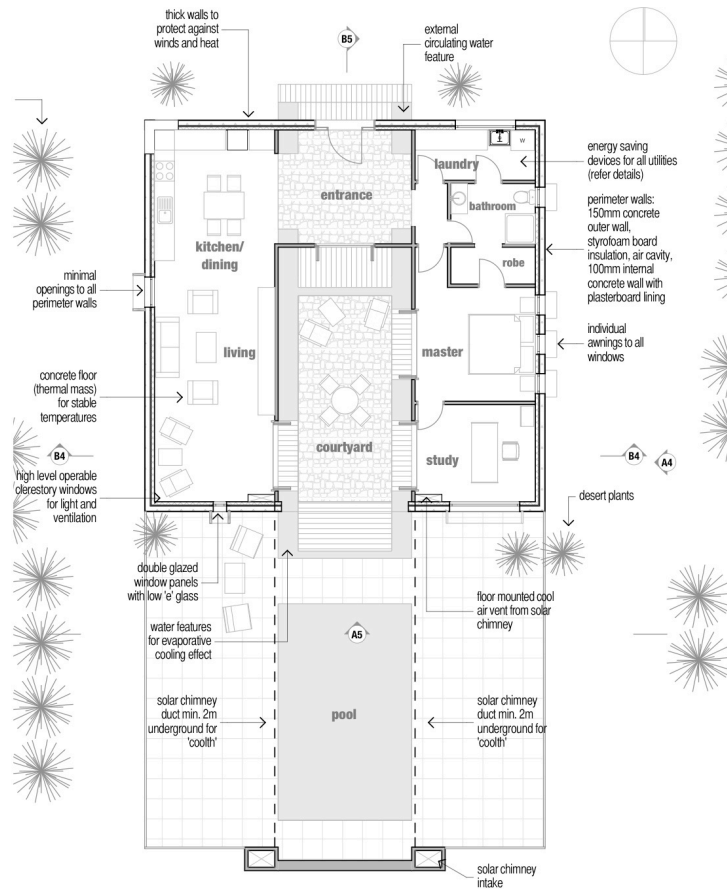
Source: (DAB330 Student work by D. Tammer, 2009)

Figure 3: Floor plan of a small dwelling re-designed for a cold climate

In the final DAB310 project, starting during the DAB330 project presentation week and forming the third step, the design process is further developed through the adoption of three divergent criteria: Logic, Space, and Form. This project presents an opportunity to consolidate the outcomes of the 3 workshops from this course, and the previous lessons learnt in DAB330; concluding with a final integrated design proposal. The outcome of the process is an acknowledgement that design Logic, Spatial quality and Form, all contribute to sound architectural design - each meriting consideration in the formulation and assessment of a design.

2. STUDENT FEEDBACK – QUESTIONAIRES

166 DAB330 students answered the first questionnaire one week after the completion of their two dwelling design projects. This was followed by the second questionnaire that was answered by 108 DAB310 students a week before the submission of their final project.

The DAB330 questionnaire results and the feedback from the second year Architecture students showed that almost all participants were pleased with their overall experience of the collaboration of the two courses. A majority of them found this integration helpful and useful. Students used words like: "real world" approach; "it was really worth while"; "makes things easier"; and "incredibly valuable".

The DAB310 questionnaire, which was given 4 weeks after the DAB330 questionnaire, showed that the integration of technology to the design studio was found to be very good and valuable. Students expressed this with the following comments: "perfect balance"; "Good connection to 310 and 330, makes things easier."; "Very well linked units."; and "I found the integration and approach to climatic design incredibly valuable". "This unit got us looking at more then [sic] just the use of space and aesthetics and focused more on looking at natural earth impacts and how [it] can be used to improve or change a design".

To describe what the technology course gave them in terms of design learning, students used words such as:

> "It helped me with being more aware of the design environment"; "you could see the positive/negative aspects of your design approach, how to develop it, and better understand it"; "… we could get a full understanding"; "In my opinion climatic factors play a really important role in the design process before we think about how interesting our design (shape, form) we have to think how it is going to work in the specific climate."; and "Without considerations for climatic factors the building can fail as a design."

There were some comments on the large amount of work involved but still accepting the value of the knowledge and experience gained such as "… a lot of work but a critical part of learning how to design". Of a total of 74 written comments for DAB330, there was only one negative feedback, saying "No comment, too much effort."

The DAB330 questionnaire asked the students to rate the importance of 5 climatic factors relative to the design approach of their DAB330 small dwelling design projects. The collated scores of the answers to that question are

shown in Table 1 with highest scores highlighted. The ranking from most important factor (1) to least important factor (5) can be summarized as:

- Cold: Orientation, choice of materials, ventilation, shading, evaporative cooling
- Hot Arid: Orientation, shading, shading, evaporative cooling, ventilation (problem with choice of material)
- Hot Humid: Ventilation, shading, shading and orientation, choice of materials, evaporative cooling
- Temperate: Orientation, orientation and evaporative cooling, shading, evaporative cooling.

Table 1: Scores of the importance of 5 climatic factors relative to the design approach of the DAB330 small dwelling designs (rated from 1 to 5, 1 being the most important)

COLD	1	2	3	4	5
Choice of Material	23	76	16	9	9
Evaporative Cooling	4	2	5	13	101
Orientation	96	23	3	4	4
Shading	5	6	42	59	15
Ventilation	2	17	58	47	4

HOT HUMID	1	2	3	4	5
Choice of Material	2	5	8	21	14
Evaporative Cooling	1	7	1	11	30
Orientation	18	5	14	10	3
Shading	3	21	14	8	4
Ventilation	24	11	12	1	1

HOT ARID	1	2	3	4	5
Choice of Material	17	13	25	22	27
Evaporative Cooling	22	18	21	30	23
Orientation	43	24	19	17	11
Shading	27	32	30	17	10
Ventilation	8	16	18	20	54

TEMPERATE	1	2	3	4	5
Choice of Material	2	7	4	9	1
Evaporative Cooling	3	3	15	2	7
Orientation	22	12	6	1	2
Shading	5	6	4	10	6
Ventilation	3	7	9	3	1

These results show that, while there have been some discrepancies; students have generally learnt the basic design factors to be implemented in their designs. Some results of temperate region are statistically insignificant due to a reduced response. An even distribution of choice of material in hot arid region is interesting and shows that there is no clear cut consensus about material use for this region. However, the least important factor, which can also mean as the factor to be protected from, for each region is the highest scored factor for cold, hot arid, and hot humid climatic regions.

The DAB310 class results and the student feedback also showed that the students were pleased with their overall experience of the integration of the two courses, and appreciated the design factors learnt. This has been expressed by the following comments:

"Really they are the components that make up design. It's also been really good to find out and progress further with using spatial planning"; "all (design factors) are equally important. Any building won't be perfect unless considering all these factors"; "The design should be inspired by its natural surroundings"; "All of these design factors are as important as each, its very hard to scale them all. "They [the 10 design factors] all work together"; and "Extremely important".

DAB310 students were asked to rate the importance of 10 design factors relative to the approach of their design project. The collated scores are provided in Table 2 with highest scores highlighted. The summary of the ranking, from the most important factor to the least important one given in the first column of Table 3, shows that two of the architectural design factors (client brief and spatial planning) are seen as the most and second important factors. This is immediately followed by orientation and daylighting, for this specific site. However, there are quite a number of respondents who had chosen orientation as the most important and second most important as given in the second column of Table 3. The comparison of the cumulative results for each factor can be seen in Figure 4.

Some DAB310 students stated that climatic design factors were more important than the form of the building. This has been expressed by comments such as:

"Design for climate is most important. Natural cooling, ventilation, lighting systems are 1st priority. Form comes after. The brief can change"; "I would prefer a technologies subject to be taught in first year. This is vital aspect of architecture"; and "The importance of daylighting, shading, orientation, choice of materials and evaporative cooling are all key in the design as they are all elements of sustainability".

Table 2: Scores of the importance of 10 design factors relative to the approach of the DAB310 final design projects

	Choice of Material	Client brief	Daylighting	Evaporative cooling	Form	Orientation	Shading	Spatial Planning	Structure	Ventilation
Most important factor	8	60	8	4	11	19	2	17	6	4
2nd important factor	7	11	12	5	10	24	9	36	11	7
3rd important factor	7	11	16	4	10	24	10	15	10	13
4th important factor	11	6	16	3	14	11	5	8	9	12
5th important factor	12	3	18	6	10	7	17	5	15	15
6th important factor	9	1	13	10	9	9	12	4	10	12
7th important factor	15	2	11	8	12	2	16	7	13	15
8th important factor	22	3	12	8	7	2	11	10	13	16
9th important factor	15	7	1	9	13	7	18	5	14	12
Least important factor	2	4	1	51	12	3	8	1	7	2
TOTAL	108	108	108	108	108	108	108	108	108	108

Table 3: The ranking of the importance of 10 design factors relative to the approach of the DAB310 final design projects

Ranking of the factors	Highest Score	Second Highest Score
Most important factor	Client brief	Orientation
2nd important factor	Spatial planning	Orientation
3rd important factor	Orientation	Daylighting
4th important factor	Daylighting	Form
5th important factor	Daylighting	Structure
6th important factor	Daylighting	Shading, Ventilation
7th important factor	Shading	Choice of Material, Ventilation
8th important factor	Choice of material	Ventilation
9th important factor	Shading	Choice of Material
Least important factor	Evaporative cooling	Form
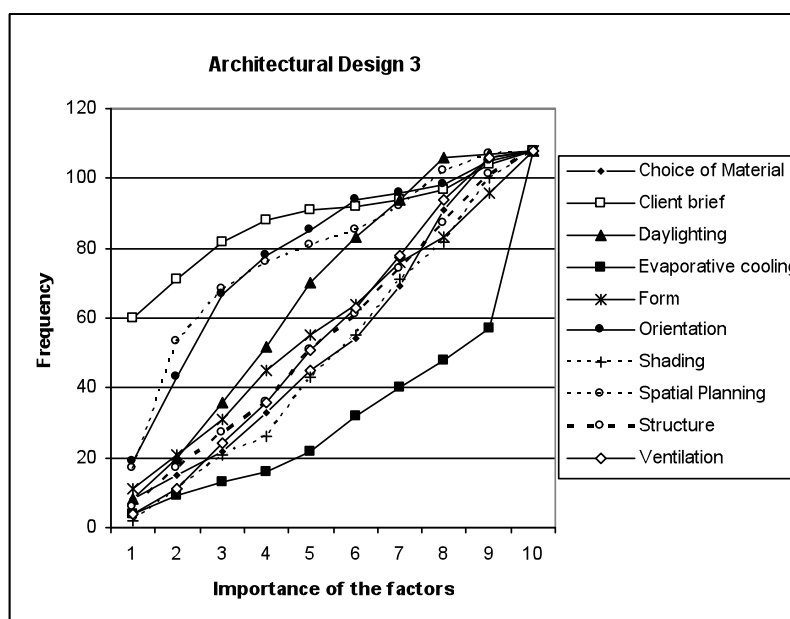
Figure 4: The comparison of the cumulative results for each factor

Students' feedback for the open-ended question was similar between the two courses. The second questionnaire for DAB310 took place four weeks later than the first survey, and in the feedback, students made it clear that they still remembered what they had learnt previously in DAB330. Students used the following words to express their deep learning experience:

> "I enjoyed it and will continue to use it"; "… would be really useful in the workforce"; "…interesting and helpful and [I] actually learnt things I can take with me through my studies"; "After completing DAB330 I feel like I am a stronger designer and a more adequate architect"; and "I … will take many things that I learned into each project that I complete".

These comments demonstrate the deep learning that occurred as a result of the teaching in both courses.

3. STUDENT FEEDBACK – COURSE EVALUATION SURVEYS

Student comments in the broader course evaluation surveys, carried out by the University through web, were consistent with those provided in the earlier research specific paper based questionnaires. In response to the generic question "What were the best aspects of this unit and why?", many students chose to focus on the successful collaborative nature between the two courses.

DAB310 students provided feedback including:

> "The underlying themes of logical, spatial and formal design thinking were an interesting way to approach the projects"; "This unit was wonderful because it made us design outside what we are used to, which lends itself to adaptability and provides a different view of how design works"; and "The best aspects where the idea of providing new perspectives and ideas for developing design ideas and carrying them through to a finished product." One student noted that they enjoyed "[b]reaking the architecture process into firmness commodity and delight and analysing each individually." Another student appreciated "[c]ontinuing to learn interesting and new design techniques and how they can be applied. This subject… works well with integrated technology."

Similarly, the DAB330 students noted that:

> "[t]his unit really helped [them] with DAB310" and that it "also integrates with other units." Further course evaluation comments regarding the best aspects of the course included: "The relevance to the subject and clear understandable lectures. It is an interesting subject and can be implemented in many other subjects"; "The main assignment was really useful in forcing us to put what we've learnt into practice and i [sic] think it was the perfect copmliment [sic] to the course" and "From this unit I have probably learnt the most important information for archietctural [sic] design." One student observed that "[l]earning about how light, heat, cold, and air affect[s] how we design. Climate, orientation and site are also important factors…". Another student referred to the dwelling design project as "a very beneficial assignment and [he/she] took these things onboard for other subjects."

CONCLUSION

The collaborative pedagogical approach to the teaching of these two courses facilitates students in applying knowledge across them systematically, despite no explicit/assessable requirement to do this. The result is deeper learning and a design process that is enriched through collaboration with sustainable technology. The success of this approach was measured through student questionnaires, student evaluation surveys, and comparative assessment of students common to both courses.

The paper discussed some of the challenges and innovations to integrate architectural design and technology education. The students have been encouraged to implement lessons learnt, thereby helping to close the gap that these courses have traditionally presented. Of the 74 written comments in the DAB330 questionnaire, there was only one negative comment. The high percentage of positive written and verbal feedback encourages the authors to maintain this collaboration into the future, with some further improvements including consistency and alignment of tutors between the two units.

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