

## Summer Studios – Lessons from a ‘small bet’ in student-led learning

### **Roger Hadgraft<sup>1</sup>**

Director, Educational Innovation and Research  
Faculty of Engineering and Information Technology  
University of Technology Sydney, Australia  
E-mail: roger.hadgraft@UTS.edu.au

### **Beata Francis**

Coordinator, Teaching & Learning Design  
Faculty of Engineering and Information Technology  
University of Technology Sydney, Australia  
E-mail: beata.francis@UTS.edu.au

### **Justine Lawson**

Manager, Teaching & Learning Design  
Faculty of Engineering and Information Technology  
University of Technology Sydney, Australia  
E-mail: justine.lawson@UTS.edu.au

### **Rob Jarman**

Associate Dean, Teaching and Learning  
Faculty of Engineering and Information Technology  
University of Technology Sydney, Australia  
E-mail: rob.jarman@UTS.edu.au

### **Jasmine Tekmen Araci**

Learning Designer  
Faculty of Engineering and Information Technology  
University of Technology Sydney, Australia  
E-mail: Yasemin.TekmenAraci@uts.edu.au

Conference Key Areas: Innovation as the context for EE; Engineering Skills

Keywords: curriculum change, studios, PBL, design thinking

## **1 INTRODUCTION**

Summer Studios developed out of our MIDAS strategy to create the next generation engineering and IT programs at UTS, using a sequence of studios in every program [REFs to be added after review]. MIDAS (More Innovative Design-Able Students) is a response to industry demands for graduates who are able to respond more innovatively to the challenges in our world. This builds on earlier studio implementations at UTS [1-3].

The 2016 national Quality Indicators for Learning and Teaching [4] also highlighted the need for summer offerings; it was decided to test our studio concept across a range of

---

<sup>1</sup> Corresponding Author

disciplines. Summer Studios were born. The Associate Dean for Teaching and Learning's vision was that: "students will be transformed by the summer studio experience and will want that learning to continue all year long". This intention came to fruition, as demonstrated by the data.

Much of the background to this studio experiment is published elsewhere [REFs]. The purpose of this paper is to map out what we think have been innovative approaches with quite a large group of students split across many topics. A key issue was taking the teaching staff through a mindset shift and this is an on-going process.

There are important lessons here for others who are rolling out project-based learning classes in response to industry demands for graduates who are ready for a rapidly changing working world.

## 2 LEARNING INTENT

Summer Studios were designed to be a generic framework for design-oriented activities as follows, drawing upon long experience in project-based learning [5-11]:

*Summer studios are designed to be high energy, high collaboration, project-based subjects where students can engage in real-world design challenges. The studios enable students to negotiate the ways in which they will demonstrate achievement of professional skills whilst working on real-world projects. Facilitated by a mixture of academic experts, industry and community partners, students work in teams to define problems and develop and implement projects.*

*Using a design thinking framework, students regularly engage in pitching and critiquing work amongst peers. Assessment is pass/fail and comprises a mixture of reflective writing and portfolio compilation and defence.*

The subject learning outcomes were modelled on FEIT's graduate attributes [12] – define the requirements, use a systematic design process, apply modelling skills, collaborate and communicate, and manage oneself:

1. *Engage with stakeholders to identify a problem*
2. *Apply design thinking to respond to a defined or newly identified problem*
3. *Apply technical skills to develop, model and/or evaluate a design*
4. *Demonstrate effective collaboration and communication skills*
5. *Conduct critical self and peer review and performance evaluation*

### 2.1 Student Response

18 teams of academics volunteered to conduct a studio in a range of topic areas (Figure 1). Four of the topics were proposed by students and three of them were ultimately led by students, with academic assistance.

168 students subsequently enrolled and completed (20% women and 16% international), across 13 final topic areas. (5 topics did not attract enough enrolments.)

1. Activating the Smart City
2. Humanitarian Engineering
3. Challenges and Opportunities of Landfill Design and Reusing closed Landfills
4. Data Science
5. Deep neural networks learning for AI
6. Quantum Computing by Example
7. Brain Computer Interface
8. Control and Automation studio
9. IOT Project using Python
10. DIY medical diagnostic device
11. Robotics rehabilitation studio
12. Vivid 2018 – designing a light display for a festival
13. 3D Printing and Assistive Technology
14. Global Aerospace Challenge
15. Numerical solutions for problems in Structural Engineering
16. Innovation & Entrepreneurship
17. Genome sequencing
18. Natural Language Processing

Figure 1 - Studio topics

## 2.2 Facilitator Training

Thirteen studio leaders and 21 tutors attended four facilitator training workshops:

Workshop 1 – The focus was on transformative experience and how to facilitate beauty in subjects. Three powerful ideas: We learn better by experiencing things; We learn better when we connect new experiences to our past experiences; The experience of art can produce profound shifts in perspective; How might you notice or inject beauty in your studio? This workshop was run by Dave Goldberg as part of his on-going engagement with our team [13].

Workshop 2 – What does success look like in a summer studio? 3 big ideas: The importance of NLQ – Noticing, Listening, Questioning (and the power of ‘what’ questions); What is the ‘sticky story’ of your studio? (Why might a student give up their summer to do it?) Defining studios. What are they? What are they not?

Workshop 3 – Logistics of the Subject – Matters of Assessment. 3 big ideas: Being clear about subject learning objectives (SLOs); Understanding the portfolio assessment – how will the SLOs be expressed in your studio? Backward mapping – What will students be doing in Week 6...5...4...etc?

Workshop 4 – Timing & Mapping out sessions: Structure learning sessions around design thinking stages as inspiration; Facilitation from very structured to a large single project with guidance; Documenting the interplay between knowledge and skill acquisition and engagement through the project.

The common thread throughout the workshops was to offer practical language and steps to unleash a behaviour where it was safe for the studio leader not to know everything about the project. Students would need to be active learners.

Design thinking was the key concept uniting all the studios – empathise with the stakeholders, define the problem, explore solutions, prototype, and test. Other key ideas included continuous, constructive feedback using the language of conversations-in-action, NLQ (noticing, listening, questioning).

There’s a new language around design that academics need to acquire to complement the technical knowledge. This impacted the first 2 weeks in particular, where students felt a bit rudderless, not knowing quite what they needed to be doing to understand the problem they had been set.

## 3 KEY LEARNING ACTIVITIES

The summer studios were run intensively, from 22 January to 1 March, with 3-hour workshop sessions on Monday and Thursday afternoons, and informal, group-oriented work in the mornings of those days.

The first Monday was an all-day launch activity, including a design thinking workshop conducted by our University Innovation Fellows (UIFs).

### 3.1 Sprints, Mixes and Scrums

The 6-week period was divided into three, two-week sprints: (i) explore the problem, (ii) explore the solutions, and (iii) develop and test a prototype solution.

Each week, students also met for one hour in a Studio Mix. The entire cohort was mixed across studio boundaries and grouped into 6 classrooms where students had a



Figure 2 - Students engaged in design thinking on day 1

chance to reflect on their own performance with the assistance of students from other studios.

Students were initially apprehensive about working in the studios with a “*mixed bag*” of students of different ages, degree majors as well as overall background. Their only prior experience was working in ‘groups’ to complete an assignment in a traditional class. After the studio learning experience, students asked for more opportunities during the year, to integrate with others in pursuit of a common goal because they realised that the ‘differences within a group allowed us to bring more to our diverse skill sets to complete a project at a higher degree’.

The Design Thinking approach was a new concept for most students because they realised they had always tried (and been trained) to think of a single, perfect solution when completing coursework; however, they were challenged ‘to gather information and study the real causes of the problem [which] helps solve it in a more appropriate way’.

Bringing in this approach to class projects is overwhelmingly promoted by this cohort of students. ‘Small teams working together is very powerful and we can be inspired by other people’s creativity’. One student put it very neatly: “Being in a creative environment that promotes and nurtures [a] design thinking framework has led to an increase in creativity in other parts of my life: creativity breeds creativity.”

Students also want the delivery mode of ‘traditional’ subjects to include the *narrative* of how the technical knowledge will help in future engineering subjects as well as future jobs. Students said ‘being able to get a good contextual background of the capabilities and higher level structure of the topic enabled them to find a wide range of resources to investigate and thus find their own path to become proficient at an otherwise very technical and difficult-to-understand area’. They want lecturers to invite industry speakers as guests into the teaching space because ‘that helps to improve thinking and change strategies to get a solution.’

Each week, staff also met in a Studio Scrum, to debrief what was working and not working and what needed to improve. Data were collected every week from staff and students at the Mixes and Scrums and used as feedback in the next classes through iterative conversations.

The final day included both formal presentations within each studio as well as an Expo of all student work on the final afternoon.

#### 4 STUDENT FEEDBACK

The following statements from the Student Feedback Survey summarise some of the key student reactions:

*The subject provided whole new unique perspective to **collaborate** and come up with a solution, which really helped me a lot to step outside my comfort zone and just have a go at it. The range of tutorials and the work everyone has put out was outstanding. I would really encourage students to undertake this subject.*

*Open ended scope, **freedom and creativity**. I liked how I had freedom to learn using my own practical experiences instead of a regimented assessment schedule.*

*[Specific studio leaders] should both be commended on their teaching and mentoring styles. They were very **approachable and always eager** to steer us in the right direction whenever we encountered difficulty.*

*This is the **standard** that should be set for all the engineering faculty’s teaching staff. ... we [will] have ... better learners and ultimately top-class engineers.*

*I really enjoyed the opportunity to work as a **multidisciplinary** team on a large problem.*

*[Specific studio leaders] made the processes of learning really **fun and effective**. Both offered really inspiring ways to enhance my learning. I found the subject rewarding as it enabled me to work with a stakeholder in Nepal and to help communities to improve crop production on their farms.*

*The humanitarian studio gave me a lot of opportunities to develop my **innovation and human centred design** thinking as well as expand my network.*

## **5 STAFF REFLECTIONS**

For most of the academics involved in summer studios, this was the first time that they had conducted a project-oriented class where there were no prerequisites and where there was a mixture of students from different disciplines and different years, which meant quite a range of background knowledge in each studio cohort.

### **5.1 About students**

There were mostly positive comments about the students' engagement in the projects:

- The students were seen to be highly motivated and open to new ways of thinking
- They were interested in the learning materials and transformed their knowledge
- They mastered practical problems and enjoyed the hands-on experiences.
- They asked many questions (most of the time) though some students became quite frustrated in a couple of studios where they felt they were overwhelmed by new concepts. We hypothesised that many students are not used to asking questions in class.
- Students grew in confidence, excitement and courage.

### **5.2 The teaching and learning process**

Many aspects of project-based learning were identified:

- There was a steep learning curve in most studios at the beginning
- Design thinking was key in most of the studios, but this needs greater emphasis. A basic introduction to systems engineering [14] could be helpful.
- Many student groups developed genuine collaboration and group identity through solving the complex problems. They became supportive of each other and made decisions for the benefit of the group.
- Some students were reluctant to explore alternative solutions, tending to fixate on their first idea.

There were some negative aspects:

- In some studios there was a big learning step to get started. However, proper scaffolding of the early stages of the design process is also essential.
- Need a shift in mindset so that students don't see that the first and last weeks as a waste of time.
- The student Mix sessions were not well liked by all students.

### **5.3 Assessment**

The portfolio form of assessment was not well understood by students and some studio leaders. The intention was that students would add to their portfolio each week, including evidence of attainment of each of the learning outcomes as they emerged through the design thinking process.

Next time, we will require a formal technical report as part of the portfolio, to address LO3. This would ensure that the students would properly document the technical issues.

Portfolios are a measure of progress. Most academics need training in understanding assessment as a measure of growth as opposed to evaluation. Assessment should be formative using constructive feedback and not just summative with grading.

#### 5.4 Facilitators

The workshop sessions run in the months prior to the commencement of the summer studios were described earlier. Despite the workshops, some studio leaders seemed unprepared for some of the challenges, particularly the need to help students get started from their existing knowledge base.

Four of the 13 studios had significant involvement by students as facilitators. The space, humanitarian and Vivid studios were effectively led by senior students, with academics providing overall coordination. The smart cities studio was initiated by a senior student who then provided the industry partner for the project as well as some student facilitation in the sessions. The student-led studios had very high levels of engagement and satisfaction.

#### 5.5 Outcomes

At the end of the 6-week session, we asked our studio leaders what they should stop and start with their normal teaching, based on their summer studio experience. They said they wanted to “stop strictly following the topics in a syllabus while putting more effort into integration with other subjects and other disciplines; stop giving too much structure; stop lecturing and start facilitating.”

Other things leaders wanted to ‘start’ were “more curiosity; multidisciplinary learning opportunities; collaborate with peers more; give students more independent work such as projects; start giving students more structure around design thinking and systems engineering; start getting engineers to communicate better; start co-designing studios with students and academics.”

Overall, it was clear that the studio leaders favour providing students with a *transformative learning experience*. They realised that not every subject must teach students to master the fundamentals before they have the chance to solve real problems in that area. Why wait? They observed that students have the ‘capability to master a practical problem from their perspective in terms of the fundamental, the hands-on, the research and development, while contributing as an individual member to a collective project’: “Observing this capability and the pleasant feelings from the students in their acquisition of knowledge through studio learning remains the best and unique reward for me as an educator.”

Academics want their peers to know there is power in motivating students to learn by engaging industry and together make the *compelling why* of the subject *more obvious*. Studios enable students to “think differently” and all students should be given the time to grapple with a real-world problem in diverse teams.

Therefore, Studio leaders want the same things for students as the students want for each other. That is, to engage students in assessment tasks where students can work in small teams and develop skills in innovation, entrepreneurship and creativity. They believe in promoting both technical rational **and** design thinking skills. They want more emphasis on providing students with real world problems that are industry connected into their daily studies. Studio leaders want students to work within a multidisciplinary environment where they can appreciate other points of view.

## **6 DISCUSSION**

### **6.1 Highlights**

The Expo on the last afternoon demonstrated student delight at what they had achieved. Many students made more progress than they expected.

Consider the story of Nisha, a second-year student who enrolled into the Robotics Rehabilitation Studio. During the Final Presentation, Nisha presented her artefact, a physiotherapy application where the rehabilitation patient moves their fingers in the air to play a virtual piano keyboard projected on a screen. Nisha enrolled with Word as her only computing skill. Her leaders almost turned her away, but her enthusiasm won them over. She learnt programming skills to create her healing device and is so thrilled by her efforts that she entered her work into a competition and won! She is now going to the Virginia Tech Global Challenge in August 2018.

Facilitators now realise how important it is to know where students are at in terms of their existing understanding and to lead the discussion from there. The structural engineering studio was a good example of helping students to progress quickly from a basic understanding of structures to perform complex vibration analysis of a building under wind load.

The four studios initiated and led by senior students were among the most successful studios with high degrees of energy, purpose and outcomes.

### **6.2 Insights**

Better scaffolding was required in several studios where there was a significant amount of learning of new concepts, e.g. in data science and in machine learning. Students need a more structured approach to new ideas.

Similarly, students needed support in understanding the design process, particularly in the first two weeks. This will be supported by additional workshop training next time for facilitators and also for students.

We also need other summer subjects, where a subject can be learned, and taught, in a less constrained way than our normal teaching. The Structural Engineering Studio took this approach, adapting to students' prior knowledge rather than being fixated on a particular set of content.

Students discovered real teamwork and collaboration – not the divide-and-conquer teamwork that often occurs in some projects. Students reported genuinely working together to understand difficult concepts.

### **6.3 Pleasing outcomes**

Several studio participants, both students and staff, wanted to continue the studio activity into the Autumn semester. We are now planning to enable that and also to have a fresh round of studios in Spring and Summer 2019. This feeds nicely into the MIDAS project, where the vision is cross-disciplinary studios in all programs.

### **6.4 Final comments**

Our first aspiration for Summer Studios was to create a community of practice. We believe we are entering the very first stages of cultural change to achieve curriculum renewal. We all know that it takes much longer than one long hot Aussie summer to change teaching and learning practices. Nonetheless, in a small way, we have introduced new *language* into the Faculty through the Summer Studio experience.

Moreover, we know the quickest way to change a system or build a new system is to use this new language. The new language encourages academics to embrace this

idea of active learning, turning up authentically, and working together to try to improve something. Once we use *sticky* language to tell a new story and be prepared to change the story as people react to it, we teach people that it is okay to bring about change.

People will have their own stories. In every case, the new language will be rehearsed and communicated repeatedly. This process creates transparency, that we are working on things together to make things better, and that we are listening to students. There is a partnership.

Our second aspiration is to create a Studio where academics can enrol and get the 'experience of the experience' while training how to be an effective studio facilitator. Our focus for next time will be in developing strong facilitation skills around the design process.

Summer Studio was a little bet and a significant undertaking. There were upsides and downsides to report. Each studio was an opportunity for innovation and a source of lessons learned.

The biggest learning outcome is that Studio Leaders need to be better trained and certified. Once they themselves qualify as a Studio Leader, they earn the opportunity to run a studio in Summer 2019. We might frame the chosen as an elite team of advanced facilitators of the future. They will design and facilitate the learning experiences of the future.

We have experienced enough good outcomes to know that MIDAS is on the right track.

## 7 REFERENCES

- [1] Prior, J.R., C. Arjpru, and J.R. Leaney, Towards an industry-collaborative, reflective software learning and development environment, in Proceedings of the 23rd Australasian Software Engineering Conference (ASWEC 2014). 2014: Sydney, Australia.
- [2] Prior, J.R., A.L. Connor, and J.R. Leaney, Things Coming Together: Learning Experiences in a Software Studio, in Proceedings of the 19th Annual SIGCSE Conference on Innovation and Technology in Computer Science Education 2014 (ITiCSE'14). 2014: Uppsala, Sweden.
- [3] Prior, J.R., S. Ferguson, and J.R. Leaney, Reflection is Hard: Teaching And Learning Reflective Practice in a Software Studio, in Proceedings of Australasian Computer Science Week (ACSW'16) Multi-conference. 2016: Canberra, Australia.
- [4] QILT. Quality Indicators for Learning and Teaching. 2018 4 May 2018]; Available from: <https://www.qilt.edu.au>.
- [5] UTS. 41150 Summer Studio A. 2018 6 Aug 2018]; Available from: <http://handbook.uts.edu.au/subjects/41150.html>.
- [6] Hadgraft, R., et al., Redesigning Engineering Curricula around Studios, in AAEE2016 CONFERENCE, S.T. Smith, et al., Editors. 2016, Southern Cross University: Coffs Harbour, Australia.
- [7] Hadgraft, R., et al., Curriculum Transformation with Students as Partners, in Proceedings of the 28th Annual Conference of the Australasian Association for Engineering Education (AAEE 2017), D.I. Nazmul Huda, Nicholas Tse, Graham Town, Editor. 2017, Macquarie University: Sydney. p. 800-808.



- [8] Hadgraft, R.G. and N.S. Paget, A problem-oriented approach to engineering education, in 2nd Annual Conference of the Australasian Association for Engineering Education. 1990: Monash University, Melbourne.
- [9] Hadgraft, R., A problem-based approach to a civil engineering education, in PBL Conference 92. 1993: Sydney.
- [10] Hadgraft, R.G. and J.K. Prpic, Introducing problem based learning : shifting the paradigm. 1997.
- [11] Hadgraft, R.G. and J.K. Prpic, The key dimensions of problem based learning. 1999.
- [12] UTS. FEIT Graduate Attributes. 2018 4 May 2018]; Available from: <https://www.uts.edu.au/about/faculty-engineering-and-information-technology/who-we-are/engineering-and-it-uts/graduate>.
- [13] Goldberg, D.E., M. Somerville, and C. Whitney, A Whole New Engineer. 2014, Douglas, Michigan: ThreeJoy Associates.
- [14] Shamieh, C., Systems Engineering for Dummies. 2011, Hoboken, NJ: Wiley.