The Promise of Project Based Learning for Surveying Educators

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SUMMARY

Surveying is a niche, practical profession. Surveying courses are few and surveying educators must somehow navigate a competitive world of universities chasing rankings and the practical demands of the profession they feed with graduates. Coupled with this, surveying technology is advancing at a rapid rate challenging educators to stay current.

Project Based Learning courses offer an opportunity to provide rich student learning and enable educators to keep up with advancing technology.

Project-based courses are generally structured as group work with no lectures and no exams. A large, complex project should be designed with many elements such as research, planning, field work/ data collection, processing, analysis and reporting.

The structure of a project-based course can be applied to many different sorts of surveying/ geospatial projects. Used strategically, this provides real-world education for students, an invigorating experience for educators and potentially valuable outreach for the university into the local industry and beyond.

This paper summarises the expertise gained after a decade of coordinating the final year capstone course offered in the Bachelor of Engineering (Honours) (Surveying) program at the University of New South Wales, Sydney, Australia. A recent project based on laser scanning Bare Island will be presented.

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1. BACKGROUND

Academic institutions feel pressure to ascend university rankings such as the Shanghai based Academic Ranking of World Universities (AWRU, 2025), the Times Higher Education World University Ranking (THE, 2025) and the QS World University Rankings (QS, 2025) for prestige, to attract better students and charge higher fees. Each of these ‘league tables’ relies on differing metrics. Whilst good teaching is rewarded, research performance carries a significantly higher weight.

Surveying education is closely related to its namesake regulated profession; therefore, practical skills are expected of surveying graduates by their local employers and professional organisations (Roberts & Harvey, 2019).

Surveying educators are therefore caught between their professions’ desire for work-ready, relevant graduates and their academic institutions’ desire for research performance and status.

Perhaps Project Based Learning can go some way to addressing both aspirations.

2. SURVEYING PROGRAM STRUCTURE

Most tertiary level surveying programs require 3-4 yrs of full-time study providing a base education that can be elevated to professional status based on some local industry-based qualification. An example of this is Registration in NSW, Australia (BOSSI, 2025) which certifies recipients to legally define property boundaries or authorise Mine Surveying operations subject to requisite work experience and successful completion of oral exams from a panel of industry experts.

By way of example, the Bachelor of Engineering (Honours) program at the University of New South Wales, Sydney, Australia is a program delivered over 4 yrs. It comprises 32 courses in all, 12 of which are core surveying courses plus 2 professional electives and a research thesis (equivalent of 2 courses) on offer (Figure 1). Roberts & Harvey (2019) list the breakdown of practical fieldwork offered across the program.

It should be noted that this program is accredited by Engineers Australia every 5 years and the Council of Reciprocating Surveyors Boards for Australia and New Zealand (CRSBANZ, 2025).

Bachelor of Engineering (Honours) (Surveying)

Year 1	Year 2	Year 3	Year 4
Term 1			
DESN1000 Engineering Design and Innovation	GMAT2500 Surveying Computations A	GMAT3100 Surveying Application & Design	Professional Elective, Recommend GMAT4400
MATH1131 Maths 1A or 1141 Higher Maths 1A	ENGG2500 Fluid Mechanics for Engineers	GMAT3150 Field Projects 1	CVEN3501 Water Resources Engineering
PHYS1121 Physics 1A or 1131 Higher Physics 1A	MATH2019 Engineering Mathematics 2E	GMAT3220 Geospatial Information Systems	CVEN4951 Research Thesis A (4Uoc) If Research stream
Term 2			
GMAT1110 Surveying and Geospatial Engineering	GMAT2700 Foundations of Geodesy & Geospatial Ref...	GMAT3700 Precise Positioning & Apps	CVEN4952 Research Thesis B (4Uoc) or GMAT4060 Thesis A (6UoC)
MATH1231 Maths 1B or 1241 Higher Maths 1B	CVEN2002 Engineering Computations	General Education elective	Professional Elective, Recommend GMAT4220
Elective	DESN2000 Engineering Design and Professional Practice		General Education elective
Term 3			
ENGG1811 Computing for Engineers	GMAT2120 Surveying and Geospatial Tech	GMAT3420 Cadastral Surveyi and Land Law	GMAT4150 Field Projects 2
Elective	GMAT2550 Surveying Computations B	GMAT3500 Remote Sensing & Photogram	Professional Elective
		CVEN3101 Engineering Operations and Control	CVEN4953 Research Thesis C (4Uoc) or GMAT4061 Thesis B (6UoC)

- Core surveying course
- Core GIS/ RS course
- Core geodesy course
- Research/ Project thesis

Figure 1 – Program structure of BE (Hons) (Surveying), UNSW Sydney, Australia. Note: GMAT4150 – Field Project 2 is the example course presented in this paper.

Like many similar surveying programs, the first year comprises foundational Maths, Physics and Computing courses and an introductory surveying course. The second and third year provide the lion's share of technical surveying, geodesy, GIS, remote sensing, photogrammetry and cadastral courses. These courses are structured to scaffold student learning and comprise many field and lab exercises designed to build confidence. This leaves the final year for a series of professional electives (some leading to registration in NSW) and an option for a research thesis.

GMAT4150 – Field Projects 2 is a project-based capstone course offered in the last term of studies and builds on all previous knowledge. Unlike the research thesis this project-based course incorporates peer learning and opportunities for improving team skills such as management and delegation. The project used within the course has altered each year, which was implemented to benefit student learning outcomes but has also brought some great benefits to the educators.

3. BENEFITS OF NOVEL PROJECTS

Selecting and preparing novel projects on an annual basis has a cost to the course coordinator, however experience gained by UNSW SAGE group has shown that there can be significant benefits to the faculty, the SAGE group and the educators themselves. The course educators have been able to explore emerging technologies, involve industry experts in meaningful ways, develop useful teaching materials for other courses, and increase the awareness of the course within the wider community. Various papers/magazine articles have been developed based on these student projects (Roberts 2021, 2022, 2023, 2024).

The students are aware that the projects are novel, and they are generally enthusiastically engaged in the challenge. They report high satisfaction with the course through the MyExperience survey (conducted each term in the weeks prior to the release of results).

4. DESIGN OF A PROJECT BASED COURSE

As an educator choosing a project is reliant on numerous considerations, the largest of which is the length of the term/ semester. The teaching year at UNSW (for example) now comprises 3 x 10-week terms. University rules will therefore restrict the scope of a proposed project.

A course coordinator should consider the number of students enrolling and the specific skills of their students. It is best to specify pre-requisite knowledge so that all students can cope with an ambitious project and to leverage those students who may have extended knowledge due to their concurrent work in a research thesis. This is why it is useful to schedule a project-based course at the end of a university program to benefit from all previous education.

Is the project scalable? For this course at UNSW, class sizes are rarely above 20. Project-based learning is more difficult for larger classes (Miao, G. et al (2024); Tse & di Bona (2019)). This is an important consideration for course coordinators.

Considerations of weather (season), travel (ie on-campus, off-campus day trip or off-campus multi-day camp style project) and therefore cost and logistics also feature highly in the design of a suitable project.

Student assessment is of course an important consideration. A combination of researching for a literature review, planning and logistics, project design, communication, leadership, fieldwork, processing, analysis, writing and presentation are all important metrics. However, one of the most important metrics is the use of self-assessment. This requires students to reflect on their performance at the end of the project. This is particularly valuable for final year students who are mature enough to provide insight to themselves and their colleagues. This feedback also helps assessors improve their project design for future offerings.

5. CHOOSING A SUITABLE PROJECT

Importantly a surveying educator should ask themselves what sort of project they want to do. Project-based courses can be used to not only educate students but also help educators get up to speed with a new technology by working together with students on a challenging project. The educator becomes a facilitator and guides the team towards an outcome.

This approach can be further leveraged by requiring students to write “cheat sheets” on new devices or software workflows that can be used by educators and students in future courses throughout the program. Presentation slides can also be used for this purpose. Empowering students to develop these materials as part of a project-based course of discovery is motivating, educative and valuable for time-poor educators.

5.1 Research based topic

A proposed topic could be used to assist researchers undertaking a project in their area of expertise who lack the Surveying and Geospatial skills to realise this project. A well-resourced surveying school can use their students as consultants to these researchers and develop a useful project that satisfies their “client” whilst accommodating all the assessable tasks set out in the project-based course curriculum. Roberts, (2021) provides an excellent example of a such a project (A densified vertical control network to support groundwater studies at Thirlmere Lakes) working with groundwater engineering researchers within a separate department of the same School of Civil and Environmental Engineering, UNSW. The students were motivated to provide a useful deliverable and the researchers benefited from high quality work that could be used to further their research – at no cost!

5.2 Industry based topic

Course coordinators at less well-resourced schools may feel unable to offer ambitious projects due to lack of access to equipment or software. This is an opportunity for industry engagement. The topic of a project-based course could be proposed in partnership with an industry partner who is looking to investigate a new technique or test a new device. Educators should reach out to their local industry or instrument provider well before a proposed project to determine what equipment might be available to borrow for the student project.

Partnerships with a local university are very attractive to companies and gives them access to students and who they can get to know and potentially offer work to the very best students. Equipment suppliers have the opportunity to expose students to their brand of equipment.

Educators should never hire equipment. Educators should demand the use of top-end equipment for free and for up to a month if necessary. The currency of surveying educators is relationships. Take attractive pictures which tell a story of students using equipment in exotic locations with the instrument suppliers’ equipment and give them the picture. Or post a short story on LinkedIn or similar and tag the company. This is much more valuable than a simple hire fee and gives the instrument supplier a good news story about university engagement and terrific free advertising. Surveying educators should use every tool at their disposal to realise an ambitious project-based course.

5.3 Community based topic

Sometimes securing a suitable site for a project can be complicated. By partnering with a community-based organisation such as a scout group, church group or sporting club, a project could be located on the grounds of said organisation and perhaps a project that will benefit them can be devised. An example of this is at the Cataract Scout Park south of Sydney, where a student project led to the creation of a digital map now used for visiting scouts and others as well as special mapping layers designed for facility managers at the property (House, 2015). Such community-based projects are also very motivating for students who see that their work is more than just an assessable course to complete their degree. They develop an understanding of their value as surveyors, and it is also educative for the organisation they service to learn more about the skills of modern surveyors and advocate to their community on our behalf. A win-win.

6. DELIVERING A PROJECT BASED COURSE

Delivering a project-based course can be less onerous than a traditional course which require lecture materials, workshops, practicals and assessments. The structure is looser, but it takes preparation. A few months before the start of a project, issues such as access to equipment, industry support, field sites and software should be confirmed to avoid delays during the short-scheduled time that the project will run. University timetables are very strict, and course coordinators should be very assertive to ensure that there will be no external delays or frustrations once the project is underway.

Project-based courses have no scheduled lectures and no exams. For such courses, final project reports can usually be submitted up to week after the timetabled term period (eg UNSW final project reports can be submitted in week 11 even though terms are only 10 weeks in length. This takes some pressure off the students). But a proposed project must fit within this structure.

It is easiest to timetable one long class per week (4hrs is recommended).

The first class requires an introductory lecture (no more than 1 hr) from the course coordinator to explain the structure and philosophy of the course, but also to introduce the project (its motivations and its challenges), present a draft timetable, the assessment, work/health/safety and to assert that this project is to be driven by the students. Creating a group environment where all are involved is best for student engagement.

Shortly after this introductory lecture, the whole group is instructed to elect a Managing Director[1] (MD) to coordinate all the activities of the project. Depending on the size of the student group, it is good to also nominate a Deputy (2IC) to assist.

Directly thereafter, the MD and 2IC takeover and run a meeting with the class. The course coordinator can provide a meeting template and guidance to teach students how to run a semi-formal meeting structure with an agenda, minutes and action items. Project plans and timelines can be developed and evolved collectively with all students contributing their combined skills. The lecturer/ course coordinator must facilitate and guide these weekly meetings if they start to waver. The Chair and Secretary should be rotated at the end of every meeting, so all students experience this role.

Each subsequent class commences with a meeting to drive the progress of the project much like what is undertaken in many surveying/ engineering consultancies. Meetings should not take longer than 1 hr and all students should be in attendance and contribute. As the project progresses, students gain confidence in running and facilitating meetings and hopefully see the value of a paper trail – like surveying field notes! These are important communication soft skills for their future careers.

The remaining 3 hrs of the 4-hour timetabled class can then be used as determined by either the initial draft schedule provided by the course coordinator, or increasingly as developed by the group as a result of the project progress and their agreed timelines as specified in their weekly meetings.

The group decides the best form of communication such as shared files on Google drive, Facebook messenger, WhatsApp or their class Learning Management System. It is best if the students decide, and the course coordinator follows.

All students should keep a log of their hours worked on the project (usually on a shared spreadsheet that the course coordinator can see). This is seen as training for future work as a graduate surveyor and is also used for final assessment.

7. ASSESSING A PROJECT BASED COURSE

Assessment for a project-based course will generally be qualitative. Assessment timelines can promote timely progress of the project but should be generous to allow for contingencies (Kruszelnicki, 1999). Assessment can also guide the utility of the deliverables to be produced by the students (ie write reports for future industry use).

[1] The Managing Director (and to a lesser extent the 2IC) will have extra coordination roles for the group as well as direct communications with the course coordinator. They should therefore be allocated a lighter technical role as part of the project, similar to how a surveying consultancy would run.

A **literature review** to underpin the technical aspects of a proposed project is a good first task. This is an exercise in revision from previous course materials taught throughout the program, with a likely extension of knowledge to accommodate any challenging requirements of the project. For class cohesion and morale, it is recommended to make this a group report, with a 4-week timeline. Individual students should be allocated a section of the literature review which can be discussed in the first group meeting. This report could cover background, technical requirements, compare and contrast suitable techniques and recommend a project plan with timing, equipment and logistics. If possible, it is useful to undertake a reconnaissance of the project site before the report submission to inform the project plan. All students should indicate to which part of the group report they contributed.

For such a large group report, it is advisable that one or two students be allocated as the editors. To reduce their workload, a class template can be developed by the students of how the report should be presented and all contributing students should adhere to this template. Therefore, the job of the editors is greatly reduced. The workload allocation can be discussed in the weekly group meetings. By assigning templates and editors, the look and feel of the literature review and the final report will be much more professional. This is another example of how communication soft skills are embedded into this project-based course.

This group report can be assessed on written presentation, depth and technical merit of the literature review. Also, the breadth, quality of referencing and insight for the comparison/discussion of techniques should carry some weight. The proposed project plan, logistics, equipment, techniques, workflow, site evaluation and WHS (work, health and safety) documentation should also be assessed.

This first literature review report will receive a group mark. The assessor should try to provide feedback to the group within a week or two. This feedback is an opportunity to help improve the student reporting to ensure the final report is of the highest standard – an example of scaffolding.

The **final report** is the main deliverable. Depending on the class size and the breadth of the project, not all students will be involved with all aspects of the project. This cannot be avoided for a large project. Students will allocate themselves various specialist roles based on their interest, skills or desire to learn a new skill. This can be organised during the weekly meetings with assistance from the course coordinator. Similar to the literature review, assessment should be based on the written presentation, design and quality of project work, results, interpretation, insight and conclusions.

Depending on the project, this final report can also become a valuable document for the wider industry. Rather than just writing a student report for assessment, students should be instructed to write their report with a view to their industry. They should write as if instructing a time-poor surveyor about the utility of the new equipment or technique they are learning as part of the project. Assessment of cheat sheets and troubleshooting documents therefore becomes a valuable addition to this report.

Another important aspect of the project assessment is culture. Group work can be challenging and those students who show commitment to the project should be rewarded. Therefore, course coordinators should, at their discretion, allocate some assessment to attributes such as chair/secretary roles in weekly meetings, leadership (MD, 2IC, Team leaders), report editing, template design, specialist technical skills, coding, coordinating, general team support or just a willingness to help. This is a discretionary assessment and should not be overused but gives the opportunity to reward (or otherwise) individual effort.

Because there are no exams, the deadline for the final report can be extended by one week, which provides great relief to students.

All students should prepare a **class presentation** (PPT or similar) to be scheduled in the last week of the timetabled term. This will be an individual presentation based on their particular specialist role in the project. Collectively all students should present their parts of the project in a logical narrative that they can be curated as part of their weekly meetings. Students should be instructed to present to their colleagues as well as the course coordinator. This then becomes like a large conference presentation where all students present a combined report to each other. This gives an opportunity to reflect on how all the parts fit together to realise the larger project outcomes. Assessors can then individually assess the student presentations. Also, the course coordinator could choose to invite colleagues from their school, university or external profession to attend this presentation. A great opportunity for outreach and to hone the communication skills of students. The assessment for this presentation should only comprise around 10% of the course.

Self-assessment is the final assessable task and gives students an opportunity to reflect on their performance. As part of the project, students should be asked to 'cost' the job by keeping track of their hours worked. This is intended to better prepare students for work as future graduate surveyors. They are also asked to assess themselves and their performance during the project and give themselves a mark out of 100. This task is designed to force students to reflect on their own performance and rate themselves according to any criteria they choose. It is surprising to read the honesty in student reflections and realise that the marks they nominate for themselves are often very similar to that of the assessor. Assessors should be closely associated with the project so that they provide a well-informed score.

For students, self-assessment is an unusual task, however after completing such capstone courses, students are mature enough to provide useful insights and usually award themselves a mark very close to that of the lecturer. As future professional surveyors, this task can be sobering but this reflection offers deep learning and important skills for a future professional career.

8. EXAMPLE PROJECT – GMAT4150 – LASER SCAN BARE ISLAND

Project based courses have been offered for many years as part of the surveying curriculum at UNSW. GMAT4150 – Field Projects 2 (figure 1) is the subject of this paper and in recent times has been leveraged to not only provide great education, but also to address some industry challenges. In 2018, surveying students were used as “consultants” to ground water engineering staff/students to upgrade the datum, vertical control and GIS mapping products used at their annual camp by educators within their own school. The Thirlmere Lakes project assisted researchers for their groundwater engineering studies (Roberts, 2021). A comparison of low-cost multi-GNSS RTK vs survey grade RTK receivers provided useful industry insight and a report accessed by a several surveyors (Roberts, 2022). More recently students tested the government supported Satellite Based Augmentation Service SouthPAN vs current GNSS positioning[2] services (excluding RTK) and provided a report and some presentations detailing the performance of this fledgling new positioning service (Roberts, (2023), Roberts, (2024)).

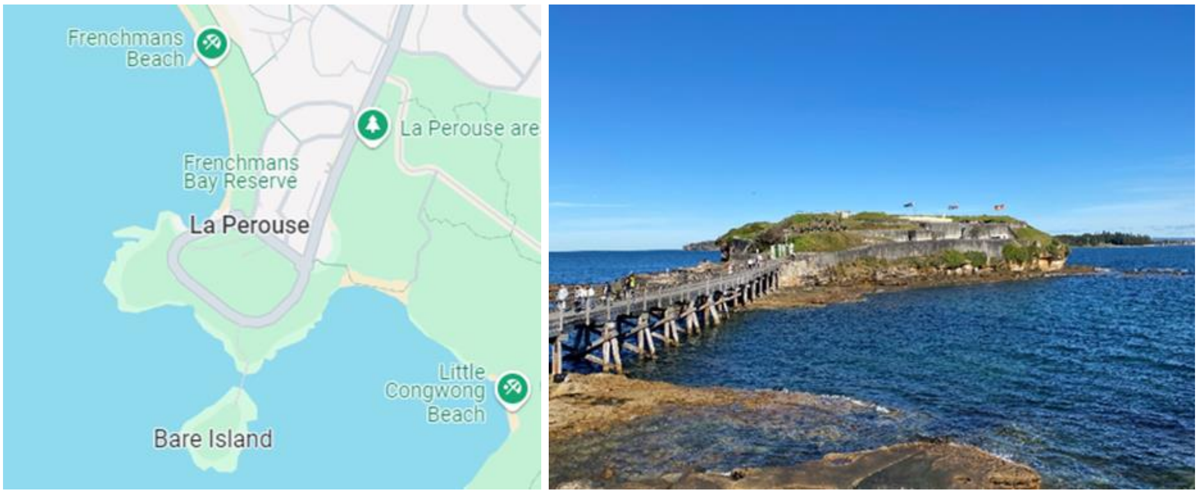

Figure 2 – a) Map of Bare Island; b) Photo of Bare Island looking south

Most recently in 2024, students were tasked with laser scanning a whole island inside and out to better than a centimetre accuracy and georeferencing the point cloud to MGA/ AHD. Bare Island is about 10km south of UNSW campus at La Perouse. It was fortified (much like Fort Scratchley) in 1885 to defend against a possible Russian invasion during the Crimean War. It was also used as the “bad guy’s lair” in the movie Mission Impossible 2. Bare Island is geometrically complicated, with complex tunnels and side rooms, a mix of regular concrete walls, vegetation and cliffs around the outside. A big challenge! However, with 15 students

[2] Students did such a good job that they were awarded a Highly Commended in the Extra Dimension and Innovation category at the Institution of Surveyors ESSI Awards in 2024.

and the productivity of modern scanners, the aim was to produce a registered and georeferenced point cloud of the whole island in 10 weeks.

Prior to the start of term, industry support with UNSW industry partner MNG Land Partners (MNG, 2025), local Leica instrument supplier CRKennedy (CRKennedy, 2025) and the Australian Riegl instrument supplier (Riegl, 2025) from Brisbane was arranged. These experts could work with the students and showcase the cutting edge of laser scanners – a generous offer and great opportunity for all.

Eight laser scanners: Leica RTC360, BLK360, BLK2GO and the school's Leica C5, Riegl VZ-600i, Zeb Revo (handheld), Navis and the Green Valley mobile scanner were used and compared.

Students spent the first few weeks of term preparing a group literature review (120 pages by week 4), testing equipment, reconnoitring the island and preparing a plan for control and scanning. They identified a courtyard as a testing area to compare all scanners against for some analysis later in the project.

Week	Activity
1	Meet, explain project, allocate tasks, choose MD, commence lit rev.
2	Site visit (1.5hr max), develop project plan, detail discussion of scanning/ logistics.
3	Amend project plan, test equipment, lit rev, control design.
4	Collate and complete project plan, control survey on island, initial scans.
5	Field work
6	Flexibility week – processing scan data and control data
7	Field work, processing, registration
8	Georeferencing, data analysis, Cloud Compare (?), write up group report
9	Compile group report, tidy up loose ends
10	Project presentations, self-assessment

Figure 3 – a) Draft project timeline; b) Curious old survey mark showing 46 feet above sea level; c) Simultaneous reciprocal trig heighting

Two full field days were required. All tasks were planned and allocated in the student meetings prior. The control team utilised static GNSS, total station traversing (Leica TS60) and even simultaneous reciprocal trig heighting to transfer height and position control onto the island. They needed to coordinate the numerous scanning targets and devise a clear numbering system. Logistics and communication to work in unison with the scanning teams was challenging.

Curious old survey marks showing height in feet above sea level were measured. Historically, these were needed for ballistics calculations for the range of the various cannons. How good were these heights? Students were required to check this but interestingly the dimensions were in feet and assumed to be referenced to the old “standard datum” from 1885. What was the relationship to AHD? Turns out these heights were related to neither and most likely to a local datum established at the time of this historical fortress. Students computed a consistent offset between standard datum, AHD and the presumed local datum. And interesting historical research outcome.

The team are grateful to NSW National Parks and Wildlife Service staff who were very accommodating and the industry supporters who also assisted with processing the laser scan data. The island was a wonderful canvas this was for student and staff learning. Collectively the team learnt about the operation of all 8 scanners plus data extraction and processing of the data. Then registering point clouds from different scanners and combining into one large point cloud – 2.6 billion points – at 4mm[3] (well let’s say cm-level).

All point clouds were compared against a “control” point cloud using Cloud Compare software giving the students some insight into research methodology. Various point clouds included combined, static and registered scans, others from mobile scans using SLAM techniques and the Riegl used RTK GNSS, mobile scanning and SLAM to resolve a georeferenced point cloud. Amazing work by the students.

Figure 4 – a) Chasing the mms as part of the control survey; b) Control survey (top) and mobile laser scanning (below) showcasing the 3D nature of the survey; c) Control traverse around the tunnels for georeferencing targets.

[3] Output from software

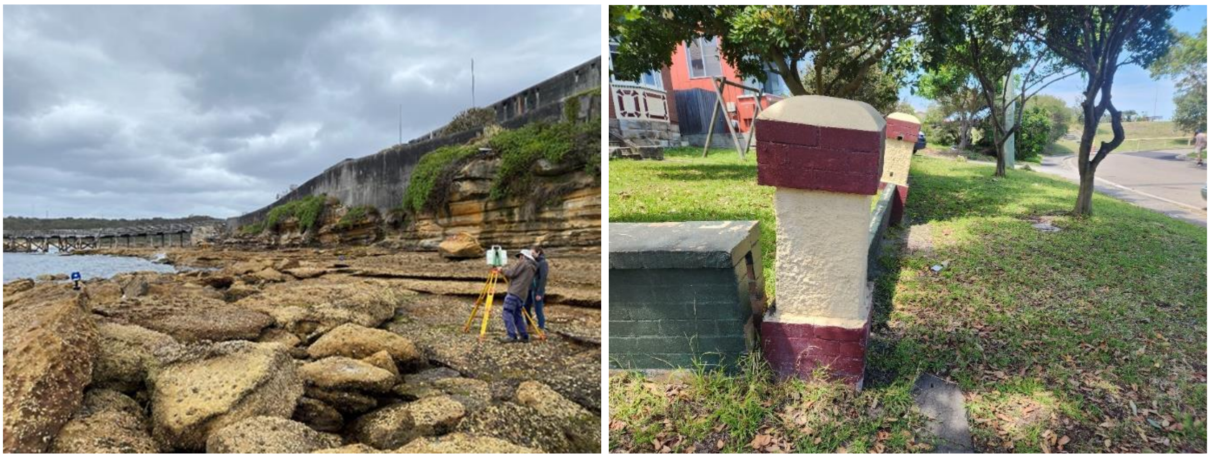

Figure 5 – a) Scanning the outside of the island; b) Cadastral survey of leaning fence.

Some students personalised their learning experience by undertaking a small cadastral exercise in La Perouse. They performed the search, field survey, investigation and analysis on a small boundary determination and found some interesting old reference marks but had to resort to some old fences (one leaning) for a boundary fix. A more interesting survey than first anticipated, which may develop into a project for this course in a future year.

Students presented their work in one large narrative – again they allocated tasks amongst themselves – and prepared an associated report (230+ pages) which has been accessed by several surveyors. The course coordinator invited school colleagues and external industry to attend this presentation. A summary of the project, along with a photo featuring the student managing director and technical manager, was featured on the front cover of the Institute of Surveyors NSW magazine Azimuth. The project was also shared on LinkedIn attracting over 12,000 views and reshared 5 times. This is a great example of outreach with benefits for the university and the wider industry. Three of the students will present their project at the ISNSW Annual conference in Feb 2025. This project will be entered into the Excellence in Surveying and Spatial Awards (ESSI) in 2025. In-so-doing, course coordinators can teach their students valuable communication skills and outreach – something the surveying profession needs to improve.

9. CONCLUDING REMARKS

Project-based learning gives surveying educators the freedom to explore ambitious projects. These could be to further their own research, to work closely with industry or to support a community organisation. Students are required to run the project and are far more engaged when they can see that their work is of benefit to others.

The course coordinator acts as a facilitator, drawing on their own experience/expertise and that of their networks to push obstacles out of the way and enable a successful student outcome.

This project-based course also allows educators to upskill into new technologies, software, hardware and techniques. They can structure projects to cater for a range of skill sets and encourage all students to be as best as they can be. Educators almost act as coaches in a team.

Project-based courses require energy, creativity, agility and commitment but they are certainly not boring. Student feedback is routinely very positive. Students feel very empowered and for the first time are exercising all they have learnt into a useful project – just like working.

Project-based courses provide great opportunities for outreach and marketing of the profession to potential new students.

Hopefully this paper provides a recipe for other surveying educators to choose their own adventure. Please email the authors for example reports or supporting materials.

10. REFERENCES

AWRU (2025) Academic ranking of world universities, http://www.shanghairanking.com/ [Last accessed Jan 2025]

BOSSI, 2025 – Board of Surveying and Spatial Information, https://www.bossi.nsw.gov.au/candidates/become_a_surveyor_in_nsw [Last Accessed Jan 2025]

CRKennedy (2025) https://survey.crkennedy.com.au/ [Last Accessed Jan 2025]

CRSBANZ (2025) Council of Reciprocating Surveyors Boards of Australia and New Zealand, https://crsbanz.wixsite.com/crsbanz [Last accessed Jan 2025].

House, T. (2015) A multi-function map for Cataract Scout Park, Undergraduate Hons Research Thesis, School of Civil and Environmental Engineering, UNSW, Sydney, Australia.

Kruszelnicki, K. (1999) Murphy's Law, https://www.abc.net.au/science/k2/moments/gmis9906.htm#:~:text=thunder,%20Edward%20A.-,Murphy%20Jnr.,original%20form%20of%20Murphy's%20Law [Last accessed Dec 2024]

Miao, G., Ranaraja, I., Grundy, S., Brown, N., Belkina, M. and Goldfinch, T. (2024) Project-based learning in Australian & New Zealand universities: sustainability and scalability, Australian Journal of Engineering Education, DOI:10.1080/22054952.2024.2358585

MNG (2025) https://www.mngsurvey.com.au/ [Last accessed Jan 2025]

QS (2025) QS world university rankings, https://www.topuniversities.com/qs-world-university-rankings [Last accessed Jan 2025]

Riegl (2025) https://www.riegl.com.au/ [Last accessed Jan 2025]

Roberts, C. (2024) Where are we at with SouthPAN? IGNSS2024, UNSW, Sydney

Roberts, C. (2023) Testing SouthPAN and commercial GNSS services, Position, No. 128, Dec/Jan 2023/2024

Roberts, C. (2022) Putting RTK units to the test, Position, No. 120, Aug/Sept 2022

Roberts, C. (2021) A densified vertical control network to support groundwater studies at Thirlmere Lakes, APAS 2021, online – Conference cancelled due to COVID – online presentation and paper https://www.apas.org.au/files/conferences/2021/APAS2021-proceedings.pdf

Roberts, C. and Harvey, B. (2019) The Critical Importance of Practical Exercises in a Modern Surveying Curriculum, APAS 2019, Pokolbin, 1-3 April https://www.apas.org.au/files/conferences/2019/APAS2019-proceedings.pdf

THE (2025) Times Higher Education world university rankings, https://www.timeshighereducation.com/world-university-rankings [Last accessed Jan 2025]

Tse, N. M. and di Bona, R. (2019) Large Scale Vertically Integrated PBL, Proceedings of the 30th Annual Conference for the Australasian Association for Engineering Education (AAEE 2019), Brisbane, Queensland, 618-625, Engineers Australia.

BIOGRAPHICAL NOTES

Craig Roberts bridges the gap between teaching and research, industry and academia for modern high technology precision geospatial technologies and their practical application. Expanding from a humble degree in surveying, pioneering experiences in international geodetic field work using GPS for tectonic studies and a PhD in GPS volcano monitoring have ignited his passion for teaching and sharing expertise.

He is the National Education Representative on the ICSM Geodesy Working Group, the Public Officer and Secretary of the IGNSS Association Inc (responsible for the bi-annual IGNSS conferences) and Chair of the subsurface utility committee on the NSW Surveying and Mapping Industry Council.

Current research interests; promotion of datum modernisation, multi-GNSS, UAVs and laser scanning for high precision mapping.

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