Paper ID #17316

Freshman Residential Schools for Undergraduate On-Campus and Online Engineering Students

Dr. John Matthew Long, Deakin University

Dr. John M. Long completed his undergraduate degree in physics at the University of Michigan (Flint) in 1987, while working as an analytical chemist at AC Spark Plug, General Motors Corporation. In 1995 he completed a PhD in physics at Monash University in Melbourne, Australia. Since then he has worked in the School of Engineering at Deakin University, where he teaches physics, materials, and electronics. His research interests include materials-analysis techniques and engineering education.

Dr. Sivachandran Chandrasekaran P.E., Deakin University

Dr. Sivachandran Chandrasekaran is a Research Fellow in Engineering Education at Deakin University. He has graduated his BE (CSE) in India and ME, MES (Electronics) from Victoria University and PhD (Engineering Education) from Deakin University respectively. He is active member of Deakin engineering education research Centre (DEERC), School of engineering in the Faculty of science, Engineering and Built Environment at Deakin University. Siva is an active researcher and his research interests include creativity and innovation in learning and teaching, Design based learning, Cloud learning & located learning and engineering education innovation. His education philosophy is founded on the Project Oriented Design Based Learning (PODBL) approach at Deakin University.

Mr. Simon William Cavenett

Simon Cavenett is a Senior Lecturer and Director of Professional Practice (Engineering) at the School of Engineering at Deakin University. Prior to joining Deakin University in 2007 his 20 year career was based in industry. His career includes a number of significant achievements both in Australia and internationally, particularly involving the design and implementation of leading edge telecommunications and IT technologies. Simon has extensive experience internationally; having worked professionally based the United States for over 11 years prior to returning to Australia to join Deakin University.

Freshman Residential Schools for Undergraduate on-campus and online Engineering Students

Abstract

By means of evidence-based practice, this paper describes the residential-school component of an accredited online (distance education) undergraduate engineering program in Australia, with a particular focus on how the residential school program is implemented at freshman year. During these residential schools, activities were organised around the respective engineering courses undertaken by students during the semester.

Elements considered suitable and worthwhile for inclusion in residential-school programs included:

- In-person engagement with academic lecturers,
- Practical and laboratory learning activities,
- Presentations and interaction with guest speakers from industry,
- Industry-based site visits,
- Engagement in sole and group-based learning and assessment activities on campus, and
- Social interaction with other students.

After running pilot residential schools for two years, it was found that a workable format consisted in a two-week residential experience in the first semester, linked to two key freshman courses, Fundamentals of Technology Management, and Engineering Physics. On-campus and online students' academic grades were compared for both courses over the years 2005 to 2012. We found that for physics lab, on-campus students' grades tended to be higher than those for online students, and *vice versa* for technology management. We also conclude that when carefully designed, residential schools for online students do enhance learning for both online students and their on-campus counterparts.

Introduction

Traditionally in higher education, at least until the 21st century, on-campus students undertook a majority of their learning activities while physically present at the campus while distance-education students undertook a majority (if not the entirety) of their learning activities remotely from the campus. In the 20th century distance education generally implied self-managed learning by students primarily relying hardcopy study materials provided by the institution and augmented with *ad-hoc* communication between academics and students, often on a one-to-one basis by telephone and mail correspondence. During the 21st century the ubiquitous adoption of Internet-enabled technologies and methods has most significantly changed the methods and technologies relied upon for distance education, such that these students now typically obtain and interact with their study materials, academics, and fellow students via the Internet, and hence known as 'online' students.

A combination of technologies and methods in conjunction with on-campus and online learning modes for distance education is defined by Huang as a mixed-mode *e*-learning environment (MMEL).[1] To accommodate on-campus as well as online students the term 'blended learning' has recently entered the education lexicon to describe a learning environment that utilises a mix of technologies and methods, both traditional and digital technology-enabled, so that both (campus) located and online learning modes exist within the student experience. Blended learning, whether implicitly or explicitly adopted, is increasingly popular in higher education for a number of reasons, including academic and administrative. From an academic perspective, blended learning enables the student experience to incorporate asynchronous elements (such as student self-managed, self-paced learning using online resources) as well as synchronous elements (such as real-time located and online classes and staff-student and student-student interactions).

In the United States, distance education in undergraduate engineering is still in its infancy. While there are some examples of individual courses being taught online,[2-4] there are very few full undergraduate programs offered online[5-7]. In Australia, distance education is more developed,[8] and the engineering community there has recognised its role in training future engineers.[9]

Distance education fulfils an important role in the provision of educational equity for students who live in remote Australian communities[10] and a continual demand of distance education (which is now predominantly implemented as online education) is to adequately engage and support students and staff. Online education has to enhance learner-to-staff and learner-to-learner interactions, as well as learning experiences of learners and academics.[11, 12] A challenge of providing a suitable student experience and learning environment for online students is to foster and enable a supportive ‘community’ for the student. Desai considers this need to be one of the greatest challenges for learning institutions and instructors.[13] A supportive community for the online student which is enabled through various types of interaction between students and between students and staff thus exists as a ‘community of inquiry’.[14, 15]

Engaging first year engineering students in online or blended learning modes has typically been more demanding on the academic than the traditional on campus mode. Staff must be committed, equipped and adequately resourced to support the implementation (and to achieve sufficient student satisfaction) of online learning. According to the Australian accreditation requirements for campus-based activities in online engineering education, it is mandated that all online engineering students have to reasonably and regularly attend the institution’s campus during the program.[12] During the 2003 accreditation review of our engineering program, the Engineers-Australia accreditation panel recommended campus-based activities for online engineering students as a mandatory component in the undergraduate engineering courses. Consequently it is now a requirement for online undergraduate engineering students to periodically attend residential schools during their studies at Deakin University.

A decade ago, many universities used traditional methods and practices in learning and teaching. With rapid technological advances, academic staff are starting to employ innovative learning and teaching models that meet educational requirements. On the other hand, many students are unable to link their skills with the professional learning curriculum. There is always a gap that exits between the learning expectations of students and the teaching approaches of staff.[16-18] To help bridge the gap between students and staff, and to enhance interactive learning between online and on-campus students, we established residential schools at all years of the engineering program. The freshman residential school at the School of Engineering at Deakin University, as it was conducted during 2005 to 2012, inclusive, was an initial foray into a blended-learning environment. (In hindsight, this foray was not fully recognised at the time.) This paper presents the development of the freshman professional-practice residential school for undergraduate engineering students in an accredited Bachelor of Engineering program in Australia, starting with the initial pilot in 2005, and finishing with the end of the first ‘era’ in 2012. The second era, from 2013 to the present, will be presented in a forthcoming paper.

Characteristics of online engineering education at Deakin University

Deakin University[19] promises students that it offers education by "providing premium cloud and located learning" and to "deliver globally connected education". The Deakin University strategic direction is achieved in part by delivering a quality online engineering program. Our goal is that online program will provide online students with a premium learning experience equal to that of on-campus students. The freshman residential school is a gateway for the first-year engineering on-campus/online students where the students could interact with each other, working as teams through collaborative learning. Some pedagogical characteristics of online education at Deakin University are:

1. The inspiration of an educational organization in planning, preparation and delivery of material for on-campus/online collaboration among students.
2. Provision of teacher-student and student-student learning through online collaboration, where students and staff have interactive discussion forums, access to units, assessments items and engage with lecturers, tutors and other students.[20]
3. Reimagined learning experience through media-rich study materials and virtual learning environments.[21]
4. Providing modern tools (such as *e-Portfolio*) for storing, organizing, reflecting and sharing student learning with others.[22]
5. Online peer support, seminar groups and workshops to improve the students study skills.

Deakin University students also have an opportunity to alternate and combine on-campus and online education study modes into the undergraduate engineering program on a course-by-course basis. This enables students to adjust their program enrolment according to their individual circumstances and needs as time goes on.

Methodology

The engineering residential schools run by the University of Southern Queensland served as our initial model.[23] The residential schools described here were designed to include the following features:

1. Increase the exposure of all students to practising engineers by inviting engineers from industry and commerce to give seminars on topics relevant to each of the units.
2. Act as capstone courses for each year. The activities and assessment tasks required students to demonstrate that they had attained the stated learning outcomes from courses in the appropriate year;
3. Enable online students to complete necessary experimentation and practical work associated with their program:
4. Enable online students to experience on-campus life via interaction with on-campus students, lecturers, tutors and other School staff, as well as have access to campus facilities.

During the years 2005-2012 inclusive the undergraduate Bachelor of Engineering program consisted of eight equally weighted academic courses for freshman year (table 1). Online students typically undertake a 50% study load for the program such that the freshman year is attempted and completed over two consecutive years.

Semester	**Course code**	**Name**	**Content**
1	SEB121	Fundamentals of Technology Management	Engineering design processes, research techniques, communication skills, teamwork skills, professional ethics, sustainability, technological impact
1	SEP101	Engineering Physics	Basic mechanics, rotation, fluids, electricity, DC circuits
1	SED102	Engineering Graphics and CAD	Engineering drawing, CAD, design
1	SIT199	Applied Algebra and Statistics	Matrices, vectors, complex numbers, probability, statistics
2	SEM111	Materials 1	Metals, ceramics, polymers, material properties
2	SEE103	Electronics	AC circuits, logic devices, diodes, transistors, op-amps
2	SIT194	Introduction to Mathematical Modelling	Derivatives, integrals, exponential functions, power series, first-order differential equations
2	SIT172	Programming for Engineers	*C*-programming, MATLAB, Excel

Table 1: Freshman engineering courses.

Pilot residential schools. The first residential school at was conducted during the second semester of 2005. Held over two weeks, it was administered as a zero-credit course (SEP199, Engineering Professional Practice). Attendance was compulsory for all students (on-campus and online) enrolled in any freshman course during that semester. The two-week course comprised four topics: professional responsibilities, communication (oral, written, report writing), management ethics, laboratory or practical work. Assessment was based around four tasks: Completion of required lab work, a short group-design project report and oral presentation, and starting a reflective journal mapping the student's learning to the Engineers Australia stage-one competencies for professional engineers.[24] The final grade was either pass or fail.

To help make adequate classroom space for the attendees, it was held overlapping one week of the mid-semester break (during which no classes were scheduled for on-campus students). During this week practical sessions were held in physics (held over from semester one), electronics, and materials. On-campus students were not required to attend the first week. During the second week, guest lectures were held, students completed their design projects, social activities were held, and students went on a site visit. Students were also given free time to work on assignments, attend on-campus classes, meet their lecturers, and collaborate with their peers. The freshman residential school proceeded in the same form in 2006. For example, table 2 shows the schedule for the 2006 residential school.

Residential schools 2007-2012. In 2007 the Engineering program included multiple residential schools, one per year of study. The residential schools were attached to the corresponding engineering management unit for each year of the program. The freshman residential school was moved to first semester so that all enrolled students were required to attend the associated residential school during that semester. Since most of the topics matched those in SEB121, and since SEP101 (physics) ran in first semester, this made sense and made administration much easier for both students and staff. After 2007 the freshman school was directly linked to the educational objectives and tasks of SEB121 and SEP101. Thus online students normally enrolled in SEB121 and SEP101 together, and took the remaining two courses in another year.

In the course SEB121, Fundamentals of Technology Management, the learning objectives were for a completing student to understand the roles of engineering and technology in society, understand the fundamentals of professional ethics, be aware of Engineers Australia's competency standards, effectively use written and oral business-communication skills, understand the fundamentals of management theory, understand the basic concepts of quality-management theory, and to learn about real situations in engineering practice via presentations by industry professionals. The study materials were online lecture and tutorial notes, and a popular engineering-management textbook.[25] As an example, table 3 shows the assessment items for this course in 2008. Student groups were selected to be on-campus, online, or mixed. Online students gave their oral presentations in the second week of the residential school. The engineering-issues report was completed and submitted during the residential school. The minimum grade to pass the course was 50%.

In Engineering Physics, the lecture and tutorial content was taught to the online students according to methods outlined elsewhere. [20] Except for a very small number (five or less each year), online students performed five physics experiments during the residential school (table 4). In contrast, the on-campus students attended bi-weekly lab sessions over a 12-week semester, performing the same experiments. On-campus students submitted lab reports at the end of each lab session for grading, whereas online students submitted their reports either at the end of the residential school or at the end of semester. Lab reports were graded on a scale from one to ten. The lab component of the course contributed 20% to the overall grade. The exam was 60%, and additional problem-based assignments contributed the remaining 20%. Of interest here is the relative academic performance in the lab component.

Week 1:

Day	Topics	Task	Time	Speaker Topic
Monday	**Arrival**	1	9:30-10:00 AM	Registration
	Welcome and overview		10:00-10:50 AM	Welcome to SEP199
	Guest Speaker	4	**11:00-11:50 AM**	**Interaction between research, universities, and industry**
	Lunch		noon-1:00 PM	
	Group design problem.			
	Overview		1:00-1:50 PM	
	Library research		2:00-2:50 PM	Library resources
	Work on tasks 1 and 2		3:00-5:00 PM	
	Submit task 1	1	5:00 PM	
Tuesday	Practicals SEP101 group 1	3	9:00 AM to 5:00 PM	Physics pracs
	Practicals SEE103 group 2		9:00 AM to 5:00 PM	Analog Electronics pracs
Wednesday	Practicals SEP101 group 2	3	9:00 AM to 5:00 PM	Physics pracs
	Practicals SEE103 group 1		9:00 AM to 5:00 PM	Analog Electronics pracs
Thursday	Practical- SEM111 group 1		9:00 AM to 1:00 PM	Materials pracs
	Practicals SEM111 group 2		1:00 PM to 5:00 PM	Materials pracs
	Lab and campus tours		10:00 AM and 2:00 PM	
	Submit task 2	2	5:00 PM	
Friday	Work on SEP101 Prac write-ups.	3	9:00 AM to 5:00 PM	Also time for SEM111 assignment 4 and SEE103 assignment 5. BBQ lunch

Week 2:

Day	Topics	Task	Time	Speaker Topic
Monday	**Guest Speakers**	4	9:30 to 10:00 AM	Welcome and overview of week 2
			10:00 to 10:50 AM	**Professional Pathways for Engineers**
			11:00 to 11:50 AM	Mechanical, Mechatronics & Robotics, Electronics.
			Noon to 12:30 PM	Student Life services for off-campus students
			12:30 to 12:50 PM	Welcome from the Head of School
	Lunch		1:00 to 2:30 PM	Pizza provided by the School of Eng.
	Guest Speakers	4	2:30 to 3:00 PM	Deakin's Industry-based learning Program
			3:00 to 3:50 PM	Preparing for graduate employment
			4:00 to 4:50 PM	Career planning
Tuesday	**Group design final report**	5	9:00 AM to 5:00 PM	Team work
	Attend on-campus lectures			
Wednesday	**Professional presentation**	4	**10:00 to 10:50 PM**	**Your Career in the Profession of Engineering**
	Student oral presentations	6	11:00 AM to 5:00 PM	Team work
	Attend on-campus lectures		11:00 AM to 5:00 PM	
Thursday	**Student oral presentations**	6	10:00 AM to 5:00 PM	Team work
	Attend on-campus lectures		9:00 AM to 5:00 PM	
Friday	**Staff/student consultative forum Completion of feedback sheet**	8	10:00 AM to noon	Staff/student forum
	Attend on-campus lectures		9:00 AM to 5:00 PM	
	Submission of journal	7	11:30 AM	
	Lunch		noon - 1:30 PM	BBQ with academic staff
	Finish		Afternoon	Collection of Journal and other tasks

Table 2: Schedule for the 2006 residential school

Item	% of total grade	Type
Assignment 1: LMS Introduction Message	3	Individual
Assignment 2: List of References	5	Individual
Assignment 3: Engineering Issues Report	15	Group
Assignment 4: Professional Ethics Report and Presentation	20	Group
Assignment 5: Online Test	12	Individual
Assignment 6: Management Report	10	Group or individual
Assignment 7: Engineering Education Journal	5	Individual
Examination	30	Individual

Table 3: Assignment and grade items for SEB121, Fundamentals of Technology Management.

Experiment	Activity
1	Introduction to Microsoft Excel
2	The simple pendulum and measurement uncertainties
3	Rotational inertia of a flywheel
4	Viscosity of a fluid
5	DC electric circuits
6	The capacitor and the RC circuit

Table 4: Lab experiments assigned in SEP101, Engineering Physics.
Online students performed the Excel exercise at home.[26]

Because most online students took them together in a separate year, the remaining two semester-one courses, Engineering Graphics and CAD; and Applied Algebra and Statistics, did not have a formal program within the residential school. These courses were taught by the established methods of distance education.[27] If a student attending the residential school happened to also be enrolled in one of these two subjects, he was free to visit the lecturer and attend any available on-campus classes. The semester-two courses ran in the usual online fashion. Practical work in SEM111 and SEE103 were done separately, either at a Saturday lab class or at home by means of an experimental kit.[28,29] The structure of the whole residential program thus consisted of four compulsory residential schools, each of two-week duration, to be undertaken by online students progressively as they advanced through the course and for most, a requirement to participate an residential school at the campus at least once every two years. This practice and format continued through to 2012, inclusive.

Results

In 2005, 70 students (on-campus plus online) completed SEP199, Engineering Professional Practice, and in 2006, 98 students completed this course. From 2008 onwards, students were separated administratively into on-campus and online. Figures 1 and 2 show the numbers of students completing the course and the median grades for SEB121. Even though the online enrolment numbers were 35% or less the on-campus numbers, the median online grades were always greater than the corresponding on-campus grades, including those years where online enrolment numbers could be said to have more statistical significance (2006, 2011, 2012). This agrees with an earlier study of on-campus and off-campus performance in this course, where it was found that academically, off-campus students performed better than on-campus students.[30]

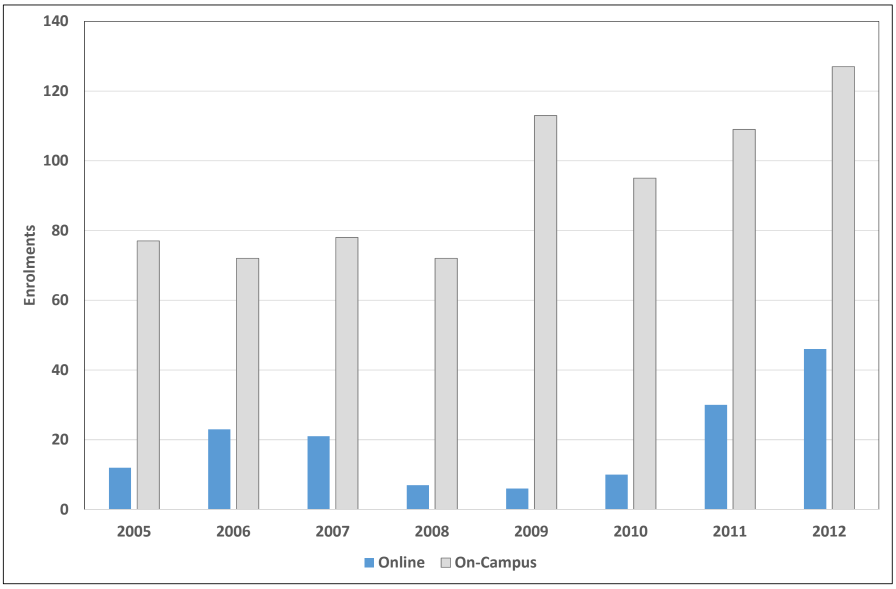

Figure 1: Numbers of students completing the course SEB121, 2005–2012.

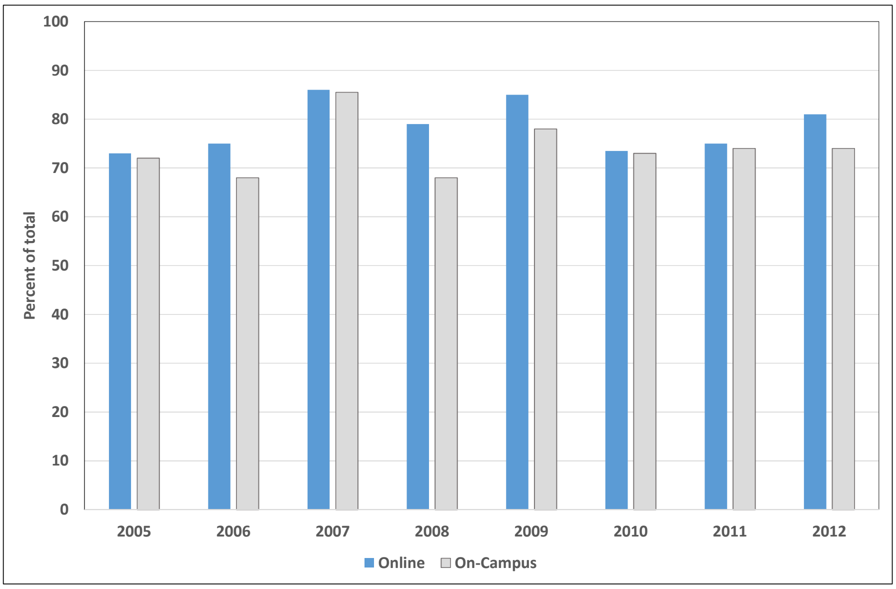

Figure 2: SEB121 median grades 2005–2012.

The numbers of completing students and median lab grades for Engineering Physics are shown in figures 3 and 4, respectively. In 2005 and 2006, the lab grades tended to be higher for online than for on-campus, although the statistical significance of the online figures may be questionable. Except for 2009, between 2007 and 2012 the median on-campus grades were higher. In 2005 and 2006, the lab experiments for online students were delayed until semester two, whereas for on-campus they were not. Thus online students had more time to prepare for the lab experiments than their on-campus counterparts. From 2007 onwards, all students performed their physics experiments in the same semester.

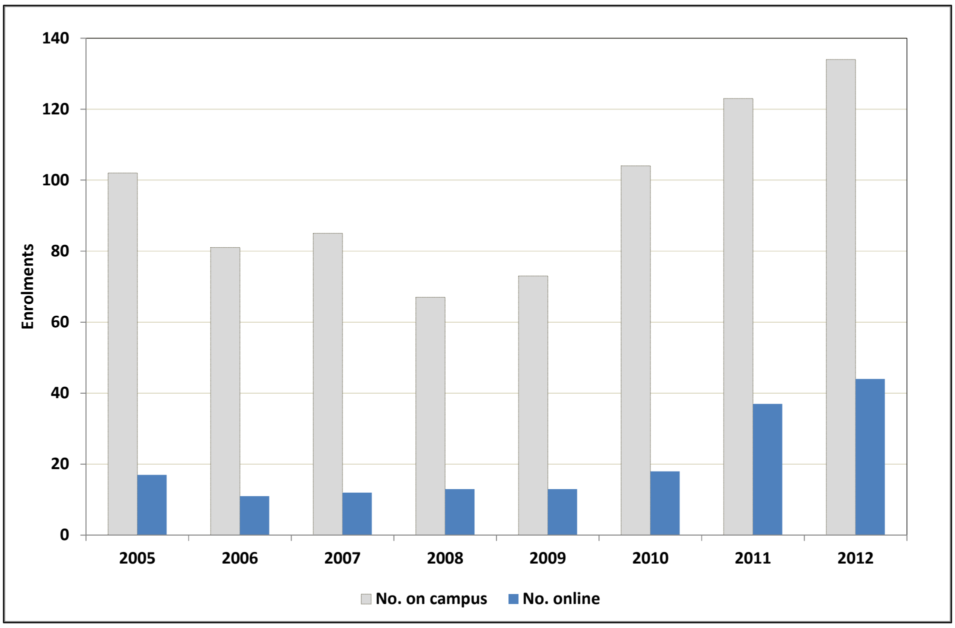

Figure 3: Numbers of Engineering-Physics students completing the course, 2005–2012.

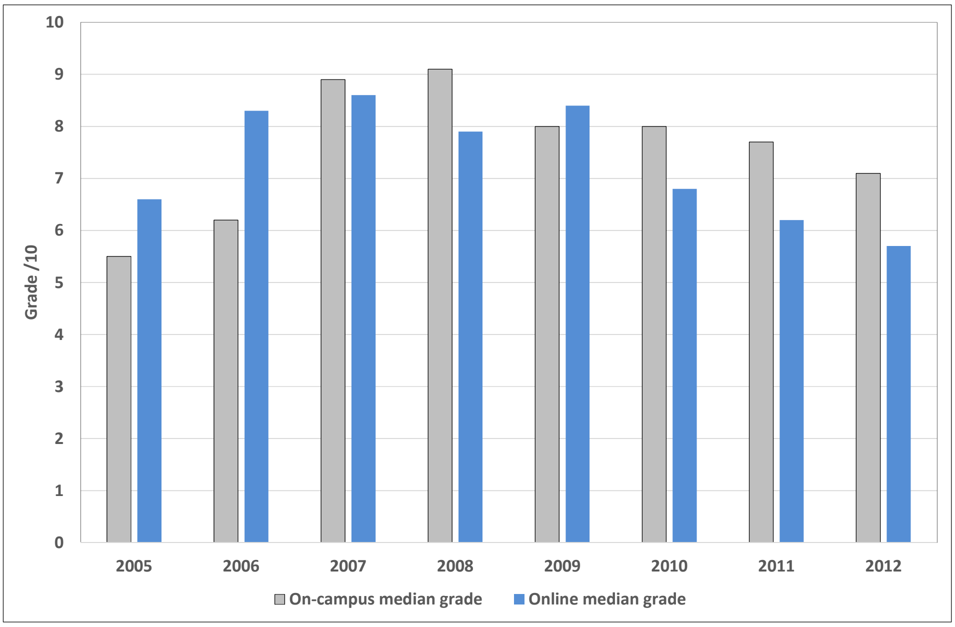

Figure 4: Median lab grades for Engineering Physics, 2005-2012.

It should be noted that at this university, even though the admission requirements are the same, there is a large difference between the online cohort and the on-campus cohort. The on-campus cohort is largely made up of young students, 18-19 years old, fresh out of high school. Many, but not all, of the on-campus students studied physics in 11th and 12th grades of high school. The off-campus cohort is more mature – 23 years old at the younger end and sometimes over 50 at the older end. Their academic abilities in SEP101 and SEB121 are really quite different. The younger students have more recent experience in studying mathematics and science at high school, but less experience in many of the skills taught in SEB121, such as communication and writing. On the other hand, the older students have been in the workplace for some years. Many are in business, work in technical fields, have some experience around engineers, and are familiar with oral and written communication. But the older students have long periods of time between when they studied math or physics and when they enrol in a university engineering program. Thus it is not too surprising to see here that in general, online students performed better in SEB121, but mostly worse in SEP101 lab.

Discussion

Apart from one survey of participating students,[31] to our knowledge, this study is the first to examine, in some detail, residential schools and academic performance for online students in engineering. A more detailed analysis of student attendance, perceptions, and grades will be presented in a forthcoming paper. From anecdotal evidence and discussions with attending students, the largest difficulties online students faced in attending residential schools were travelling long distances (including interstate), and the need to take time away from work and family. One unfortunate immediate result was that off-campus numbers in the Bachelor of Engineering dropped from nearly half of the total enrolment in 2004 to less than 25% by 2008.[32] This result is not surprising, and is consistent with other studies.[33-35] Thus while residential schools have many education advantages for all students as outlined here, the downside is that there will always be some students who would benefit from a university education in engineering who miss out because even travelling to the main campus once every couple of years is beyond their means.

In 2013 the undergraduate engineering programs at Deakin were revised so that the on-campus attendance requirement for online students was no longer facilitated by the four two-week residential schools. Instead on-campus attendance requirements by online students were mandated for course-specific activities in the program: a shift from a multi-activity, multi-week residential school per year (level) of the program that required on campus attendance to course-specific learning and/or assessment activities that nominally required one day of on campus presence per course and are predominately activities directly related to assessment-only needs.

While the academic data for 2013 to the present is still being analysed, we have noticed two significant impacts from this change in 2013. The first was an increase in the minimum frequency of campus presence by online students from once every two years on average to every semester of enrolment. The second was to reduce the amount of time that the student was present on campus during any trimester (since the duration depended on the number of academic courses being studied and the corresponding activities for that course requiring attendance). We believe that this recent change to the partially-blended learning environment for online students studying undergraduate engineering at Deakin University may be a missed opportunity to further foster a community of inquiry among all students (online and on-campus) and also reduce opportunities to identify, evaluate, and address deficiencies in online student's thinking and learning abilities, due to their on-campus presence currently mandated only for summative-assessment activities.

Brodie has identified the value of online and on-campus student interaction to enhance 'learning in the classroom' by exploiting the typical characteristic of online engineering students having, or had, engineering-related industry experience in their current, or a prior, occupation.[36] Residential schools also help serve to assess and address student thinking and learning deficiencies during live in-person oral presentations and interactive peer discussions.[37] A restriction or limitation of interactions and activities experienced by online students when present on-campus may lead to errors and perceptions of the on-campus learning environment (and possibly of the online learning environment as well) being sustained and possibly reinforced and with causality, resulting in lower learning performance, lower motivation, and retention issues for online students.[38]

At Deakin University there has recently been a deliberate focus on implementing blended learning in all programs. Accordingly the undergraduate engineering programs have recently undergone revision to increase their blended-learning characteristics. (For an example, see the recent work by Long.[39]) In addition, from 2016, the engineering curriculum is seeing a significant shift towards project and design-based learning.[40] This will result in even more changes to the residential-school programs.[41]

With many on-campus programs, including at Deakin University, there exists a popular trend in higher education towards the development and implementation of blended learning, in particular integrating Internet-enabled learning and assessment methods, to strive for institutional academic and administrative goals. What remains is the development and implementation of authentic blended learning for online programs to introduce, enhance, and integrate campus-based methods in order to produce an effective community of inquiry benefitting all students regardless of enrolment mode and able to be efficiently implemented and supported by institutional staff.

Conclusions

In response to accreditation guidelines given by Engineers Australia, Deakin University has, since 2005, required undergraduate online students in engineering to attend a periodic on-campus residential school. Over the years 2005-2012, the residential school for the freshman year has been closely linked to two courses: Fundamentals of Technology Management and Engineering Physics. Looking at relative academic performance, while the on-campus and online students' grades have been comparable, there are differences between their performances in the two courses. In Technology Management, online students' grades tended to be higher than those for on-campus students. In Physics lab, we generally observed the reverse. We attribute the results to differences in the maturity and experience of the two cohorts. That being said, there are many factors at play and establishing causal relationships is difficult.

The observations at Deakin University of requiring online students' presence on campus periodically throughout their enrolment to participate in various student-student and staff-student social, learning, and assessment-related interactions, and initial research of the impact of subsequently reducing (since 2013) this presence to primarily assessment-only related interactions on-campus, indicates that to establish a community of inquiry amongst students, the students need to experience a diversity of interactions across both, and possibly within each of the, online and on-campus modes of student presence involved in blended learning.

Weighing up the advantages and disadvantages of residential schools, we conclude that they are a very important component in an online undergraduate engineering program. As far as online education in engineering is concerned, a balance needs to be found between ensuring proper training and assessment of trainee engineers and the very worthwhile goal of providing engineering education "anywhere, anytime".[42]

Acknowledgements
The authors express their sincere thanks to K.L. Chenery, W.B. Stannard, S. Palmer, and M. Khalife who gave invaluable advice and assistance with the freshmen residential schools. They also thank the reviewers for their very helpful comments and suggestions.

References

[1] Huang, E.Y., Lin, S.W., and Huang, T.K. (2012), "What Type of Learning Style Leads to Online Participation in the Mixed-Mode E-Learning Environment? A Study of Software Usage Instruction " *Computers & Education* **58**(1), pp. 338-349.

[2] Dickrell, D. (2012), "Applying Distance Education Technologies to a Large-Scale Engineering Mechanics Course," *2012 American Society for Engineering Education Annual Conference* (San Antonio, TX, USA), 10-13 June, paper No. AC 2012-4790, session T518.

[3] Lawanto, O., Santoso, H.B., Goodridge, W., and Lawanto, K.N. (2014), "Task Value, Self-Regulated Learning, and Performance in a Web-Intensive Undergraduate Engineering Course: How Are They Related?," *MERLOT Journal of Online Learning and Teaching* **10**(1), pp. 97-111.

[4] Goodridge, W.H., Greenhalgh, S.D., and Lawanto, O. (2012), "Measured Differences in Spatial Ability between a Face-to-Face and a Synchronous Distance Education Undergraduate Engineering Graphics Course," *2012 Annual Conference of the American Society for Engineering Education* (San Antonio, TX), 10-13 June, paper No. AC 2012-5153.

[5] Krute, L., Keltie, R.F., Lavelle, J.P., Meno, M., and Fortney, W.B. (2012), "Distance Education Partnerships," *119th American Society for Engineering Education Annual Conference* (San Antonio, TX), 10-13 June, session M614.

[6] Tang, W.K., Liu, P.L., Westgate, C.R., and Scalzo, K.A. (2015),"Online-BSEE (Online Bachelor of Science in Electrical Engineering): A Multi-University Collaboration Project in Partnership with Open Suny," in *Proceedings of the 122nd American Society of Engineering Education Annual Conference*, Seattle: ASEE.

[7] Hughes, J.L.A. and Frost, J.D. (2001), "GTREP: A New Model for Expanding the Availability of Engineering Education," *31st ASEE/IEEE Frontiers in Education Conference* (Reno), October 10-13, Session F4B.

[8] Reiach, S., Cassidy, V., and Averbeck, C. (2012), "The Evolution of Distance Education in Australia," *The Quarterly Review of Distance Education* **13**(4), pp. 247-252.

[9] Lloyd, B.E., Ferguson, C., Palmer, S., and Rice, M.R. (2001), *Engineering the Future: Preparing Professional Engineers for the 21st Century*. Melbourne: Histec Publications.

[10] Stevens, K. (1994), "Australian Developments in Distance Education and Their Implications for Rural Schools," *Journal of Research in Rural Education* **10**(1), pp. 78-83.

[11] Palmer, S.R. and Bray, S.L. (2002), "On-and Off-Campus Student Persistence and Academic Performance," *Engineering Science & Education Journal* **11**(2), pp. 66-72.

[12] Bradley, A. (2007), *Engineers Australia Policy on Accreditation of Programs Offered in Distance Mode*, Canberra: Engineers Australia, document P04ET.

[13] Desai, M.S., Hart, J., and Richards, T.C. (2008), "E-Learning: Paradigm Shift in Education," *Education* **129**(2), p. 327.

[14] Garrison, D.R. and Cleveland-Innes, M. (2005), "Facilitating Cognitive Presence in Online Learning: Interaction Is Not Enough," *American Journal of Distance Education* **19**(3), pp. 133-148.

[15] Moore, M.G. (1989), "Editorial: Three Types of Interaction," *American Journal of Distance Education* **3**(2), pp. 1-7.

[16] Trigwell, K., Prosser, M., and Waterhouse, F. (1999), "Relations between Teachers' Approaches to Teaching and Students' Approaches to Learning," *Higher Education* **37**(1), pp. 57-70.

[17] Lomas, L. (2007), "Are Students Customers? Perceptions of Academic Staff," *Quality in Higher Education* **13**(1), pp. 31-44.

[18] Sander, P., Stevenson, K., King, M., and Coates, D. (2000), "University Students' Expectations of Teaching," *Studies in Higher Education* **25**(3), pp. 309-323.

[19] *Deakin University*, www.deakin.edu.au.

[20] Long, J.M., Cavenett, S.W., Gordon, E., and Joordens, M. (2014), "Enhancing Learning for Distance Students in an Undergraduate Engineering Course through Real-Time Web-Conferencing," *2014 American Society for Engineering Education International Forum* (Indianapolis, Indiana), 14 June, paper No. 11024.

[21] Catford, J. (2012, July 23),"Cloud Learning's 12 Key Features," in *Campus Review*, Woolloomooloo, NSW Australia: APN Educational Media.

[22] Challis, D. (2005), "Towards the Mature *E*-portfolio: Some Implications for Higher Education," *Canadian Journal of Learning and Technology* **31**(3), http://www.cjlt.ca/index.php/cjlt/article/viewArticle/93.

[23] Morgan, M.J., Fulcher, R.L., and Ku, H.S. (1999), "Innovative Residential Schools for Engineering Degree Courses," *Quarterly Journal of Singapore Institute of Engineering Technologists* **18**(4), p. 53.

[24] Engineers Australia (2011), *The Australian Engineering Stage-1 Competancy Standards*, www.engineersaustralia.org.au/stage_1_competencies.

[25] Babcock, D. and Morse, L. (2006), *Managing Engineering and Technology*, 4th ed.: Prentice Hall.

[26] Long, J.M., Stannard, W.B., Chenery, K., and Joordens, M.A. (2012),"Physics Practicals for Distance Education in an Undergraduate Engineering Course," in *Proceedings of the 2012 Australasian Association for Engineering Education Conference*, Mann, L. and Daniel, S., eds., Melbourne: Australasian Association for Engineering Education.

[27] Palmer, S. and Tulloch, W. (2001), "The Evolution of on-Line Teaching and Learning in Engineering at Deakin University," *Journal of Computing in Higher Education* **13**(1), pp. 91-109.

[28] Long, J.M., Florance, J.R., and Joordens, M. (2004), "The Use of Home Experimentation Kits for Distance Students in First-Year Undergraduate Electronics," *2004 American Society for Engineering Education Annual Conference & Exposition* (Salt Lake City).

[29] Long, J.M., Horan, B.P., and Hall, R.H. (2012), "Undergraduate Electronics Students' Use of Home Experiment Kits for Distance Education," *2012 Annual Conference of the American Society for Engineering Education* (San Antonio, TX), 10-13 June.

[30] Palmer, S. and Bray, S.L. (2002), "On- and Off-Campus Student Persistence and Academic Performance," *Engineering Science and Education Journal* **11**(2), pp. 66-72.

[31] Keleher, P., Patil, A., and Duan, K. (2011), "Evaluating the Effectiveness of Residential School Program for Materials Engineering Course at CQ University, Australia," *International Engineering and Technology Education Conference (IETEC'11)* (Kuala Lumpur), 16-19 January, http://www.ietec-conference.com/ietec11/Conference%20Proceedings/ietec/.

[32] Long, J.M., Joordens, M.A., and Littlefair, G. (2014), "Engineering Distance Education at Deakin University Australia," *IACEE 14th World Conference on Continuing Engineering Education* (Stanford University, California), 24-27 June 2014, http://iacee2014.stanford.edu/papers.php, paper 113.
[33] Herrmann, H., Cameron, J., and Davidson, G. (1991), "On-Campus Requirements in Remote Area Australian Distance Education," *Open Learning* **6**(2), pp. 21-27.
[34] Palmer, S. and Bray, S. (2005), "Assessing the Likely Impact of Mandatory Residential Sessions for Engineering and Technology Students," *2005 ASEE/AaeE 4th Global Colloquium on Engineering Education* (Sydney), September 26-30 2005.
[35] Cameron, J., Davidson, G., Herrmann, H., Dekkers, J., Livingston, K., Warner, L., *et al.* (1991), *On Campus Activities in the Nationwide Provision of Distance Education*. Canberra: Australian Government Department of Employment, Education, and Training.
[36] Brodie, L., Brodie, I., and Lucke, T. (2014),"CDIO–Can It Be Adapted for Distance Education?" in *Proceedings of the 2014 Australasian Association for Engineering Education Conference*, Bainbridge-Smith, A., Qi, Z.T., Gupta, G.S., eds. (Wellington, New Zealand), 8-10 December 2014 (ISBN 978-0-473-30428-7)..
[37] Herrington, J., Reeves, T., and Oliver, R. (2014),"Authentic Learning Environments," in *Handbook of Research on Educational Communications and Technology*, Spector, J.M., Merrill, M.D., Elen, J., and Bishop, M.J., eds.: Springer New York, pp. 401-412.
[38] Lizzio, A., Wilson, K., and Simons, R. (2002), "University Students' Perceptions of the Learning Environment and Academic Outcomes: Implications for Theory and Practice," *Studies in Higher Education* **27**(1), pp. 27-52.
[39] Long, J.M. (2015),"Cloud-Based Teaching in an Engineering-Physics Course," in *2015 IEEE Frontiers in Education Conference Proceedings*, DeAntonio, M., ed., Piscataway, NJ: IEEE, pp. 1832-1839.
[40] Chandrasekaran, S., Stojcevski, A., Littlefair, G., and Joordens, M. (2013),"Accreditation Inspired Project Oriented Design Based Learning Curriculum for Engineering Education," in *IETEC 2013: Enhancing Global Engineering and Technology Education: Meeting the Future: Proceedings of the 2nd International Engineering and Technology Education Conference 2013*, Ho Chi Minh City: University of Technical Education.
[41] Chandrasekaran, S., Littlefair, G., Joordens, M., and Stojcevski, A. (2014), "Cloud-Linked and Campus-Linked Students' Perceptions of Collaborative Learning and Design Based Learning in Engineering," *International Journal of Digital Information and Wireless Communications* **4**(3), pp. 267-275.
[42] Bourne, J., Harris, D., and Mayadas, F. (2005), "Online Engineering Education: Learning Anywhere, Anytime," *Journal of Engineering Education* **94**(1), pp. 131-146.