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Cloud-Linked and Campus-Linked Students' Perceptions of Collaborative Learning and Design Based Learning in Engineering

Sivachandran Chandrasekaran, Guy Littlefair, Matthew Joordens, Alex Stojcevski
Deakin University
75 Pigdons Rd, Waurn Ponds, Victoria 3216 Australia
schandra@deakin.edu.au, guy.littlefair@deakin.edu.au, matthew.joordens@deakin.edu.au, alex.stojcevski@deakin.edu.au

ABSTRACT

The aim of this paper is to analyse and present cloud-link as well as campus-linked students' perceptions of collaborative learning and design based learning in engineering. Project oriented design based learning (PODBL) is a learning and teaching approach, where students learn through design activities while being driven by project(s). PODBL enhances cloud-linked and campus-linked students' ability to acquire career essential skills that fulfill future industry needs. A paper-based survey is used to recognise a cohort of students' experience of collaborative learning and design based learning in engineering. The paper-based survey was given to 30 students from an engineering discipline.

The quantitative analysis of the survey results shows that more than 50% of the students view collaborative learning to have a large benefit in design-based learning.

KEYWORDS

Design based learning, project oriented design based learning, collaborative learning, cloud-linked and campus-linked.

1 INTRODUCTION

Collaborative learning is learning and teaching approach that encourages students to work together, share ideas, experiences and evaluate each other's results [1, 2]. In collaborative learning, each member of the team needs to understand what other team members have agreed to research and what them as individuals must contribute to the team. The students locate resources that are directly relevant to the learning issues. In project-oriented design based learning approach, cloud-linked (off-campus) and campus-linked (on-campus) students' work in teams of four to six members with a facilitator. The same group meets regularly throughout the trimester to work on a series of design activities. The learning and teaching delivery is a combination of cloud-linked and campus-linked learning activities. Design based learning enables students to evidence their achievement through collaborative learning in cloud-linked and campus-linked study mode.

Engineering at Deakin has used design-based learning (DBL) as one of its engineering learning principles for further development in teaching and learning. Deakin University has about a third of its students studying cloud linked [3]. It is required to improve the learning and teaching process as a holistic approach from the perspective of students' and staff over the entire degree program. The qualitative and quantitative paper based survey method is used to obtain cloud-linked and campus-linked students' perspectives. This research paper shows a cohort of students' perceptions of collaborative learning and design based learning in engineering.

2 DESIGN BASED LEARNING

Design based learning (DBL) is a self-directed approach in which students initiate learning by designing creative and innovative practical solutions which fulfil academic and industry expectations. Design based learning is an effective vehicle for learning that is centred on a design problem solving structure adopted from a

combination of problem and project based learning. Design projects have been used to motivate and teach science in elementary, middle, and high school classrooms and can help to open doors to possible engineering careers. Design based learning was implemented more than ten years ago, however it is a concept that still needs further development. With this in mind, it is very important to characterise DBL as an educational concept in higher engineering education [4] [5, 6].

A design based learning environment assists curriculum to move into the twenty first century with students being hands-on in their work, in addition to using problem solving skills, engaging in collaborative teamwork, creating innovative designs, learning actively, and engaging with real-world assignments. Figure 1 illustrates the design based learning process.

Figure 1. Design based learning process

By engaging students in learning design, DBL provides an opportunity to experience individual, inventive and creative projects that initiates the learning process in relation to their preferences, learning styles and various skills. Yaron Dopplet [5] states that DBL is used to produce a curriculum that improves learning for all students in science education. Students are involved in solving a problem through a creative project and experience meaningful ideas that allows them to analyse a suitable solution for it. To provide students with better practise in design and technology, DBL has several advantages that meet social, economic and industry needs. It is also an active learning process which makes students practice and recognize different learning styles and team based activity supports learning and sharing through cooperative methods [6].

3 PROJECT ORIENTED DESIGN BASED LEARNING (PODBL)

When students are involved in solving a problem through a creative project, they will experience meaningful ideas that allow them to analyse the suitable solution for it. It is a basic quality for a professional to deal with problems and find solutions for these problems. Educational institutions need to teach and train students not only to be a problem solver, but also think about achieving innovative and creative skills.

There are different kinds of problems exist in engineering. One of these is that design problems are most important to attract young and imaginative students' and projects are considered to be the best way for students to interact with teachers [7]. In addition to providing students with better practice in design and technology, project oriented design based learning will involve several advantages such as when good design meets social, economic and industrial needs [8]. This active learning process makes students practice and recognise different learning styles that support learning and sharing through cooperative methods [9].

The newly proposed approach, Project Oriented Design Based Learning method is able to motivate the students and teach engineering design in classrooms to achieve more practical experience that fulfill the academics and industry needs. Project Oriented Design Based Learning is set to have a positive effect on students' knowledge of the content and development of skills, such as innovation and creativity that increases their motivation and engagement [10-12].

In PODBL, learning is initiated by design based learning through projects, which incorporates aspects of design by active learning, learning by doing, creative problem solving and innovative designing [13]. Engineering programs are required

to demonstrate that their graduates are capable of acquiring and achieving career focused learning outcomes. It creates a boundary for a student learning capability, when programs are content driven that is focused on engineering science and technology courses. PODBL is a structured framework, which will overcome insufficiency of design practice related to industry requirement.

3.1 Cloud-Linked and Campus-Linked

The cloud-linked (online education) has played an important role in the provision of educational equity for learners who live in remote Australian communities [14]. Engaging students and lectures will always ensure a positive experience in off-campus education (cloud-linked) [15]. The teaching staff team must be committed, equipped and adequately resourced to support implementation of the cloud-linked (distance based learning) mode.

Cloud-linked must enhance learner-staff and learner-learner interactions as well as enriching the learning experiences of both learners and staff [16]. The technology will never replace the teacher in any classroom, but with careful planning and judicious use. It can provide ways of enhancing rural education. The Problems exists in distance education are quality of instruction, misuse of technology, attitudes of instructors, students and administrators. To fulfill cloud-linked (distance learning) students' expectations, the Internet and compressed video have taken distance learning in new directions, allowing distance learning to occur in real time [17].

Engineers Australia, Accreditation of engineering programs in Australia recognizes that educational and learning techniques are continually changing and advancing [18]. Engineers Australia policy on Accreditation of programs offered in distance mode guidelines states, " Electronic and face-to-face opportunities must be provided for distance mode learners to interact, particularly to ensure that group and team based learning experiences are equitable for both campus-linked (on-campus) and cloud-linked (online mode) cohorts" and "The learning and assessment design, learning activities, learning resources and assessment measures for a distance mode implementation of a program must be purpose built to support the external learner in a comprehensive and independent manner" [16]. The key to successful learning and teaching is to create flexible systems (a sustainable online content development model) that can accommodate changes in content, technology, and student needs [19].

3.2 The PODBL Cycle

The PODBL model is applied across all four years of engineering and across the four disciplines of civil, mechanical, electrical and mechatronics taught in the school of engineering, Deakin University. Students are introduced to projects from the first year of engineering; the projects in the first year are university projects and as the students' progress in year two through to year four projects from the industry are introduced.

In the PODBL model participants work in teams four to six members with a facilitator, which is similar to the project based learning approach. The same group meets regularly throughout the trimester to work on a series of design activities.

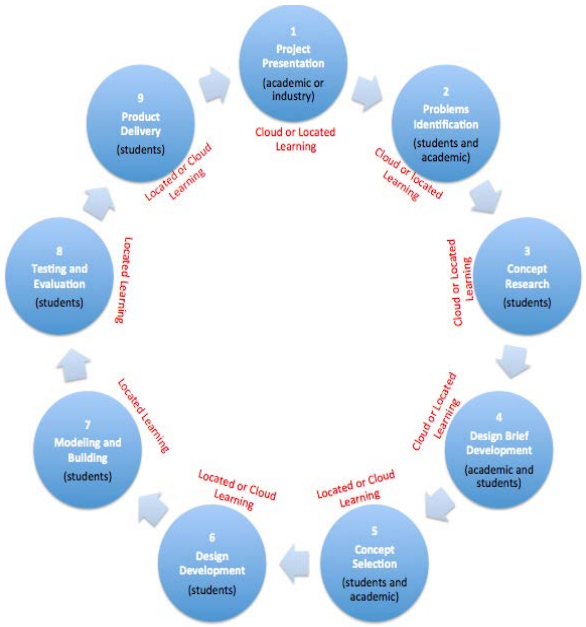

Figure 2. The PODBL cycle

The PODBL cycle (figure 2) involves nine main steps. The steps are illustrated in figure 2 above. Steps 1-6 & step 9 are a combination of both cloud and located learning (campus-linked), and steps 7-8 are performed through located learning. Steps 1 to 3 of the PODBL cycle the project is presented to the students by the academic or industry based facilitator and the students are given the opportunity to brainstorm on the project to identify the problems and engage in concept research to understand the essential learning issues and the overlapping issues. These activities are conducted in the seamless digital environment for cloud-linked learning. The students are provided with integrated short, accessible, highly visual, media-rich, interactive learning experiences rebuilt for the mobile screen, and integrating learning resources created by Deakin and other worldly universities and premium providers.

The school of engineering has already started in this direction with the use of technology to enable learning practice and under this initiative encouraged staff to record the lectures and tutorials. The staff could record their lecture on video or use screen capture software to record the lecture slides along with audio and the recording are provided to the students via the cloud. These lecture resources provide the students with an opportunity to revisit lectures and go through the concepts discussed during the session. The lecture videos allow the students to catch up on missed lectures with an experience similar to attending a lecture. Students have indicated in a survey they use the lecture as a catch up exercise and it allows them greater interaction [20]. The school is moving towards the recording of short topic based clips no longer than ten minutes which will allow the students to access material which are media rich and visually engaging.

Steps 4 to 6 in the PODBL cycle the teams are involved in developing the design brief to produce the key planning document with the specifications for the project and project plan, select the concept for the solution based on the ideas generated during the concept research step and move on to the design and development step to develop the final design. These activities are a combination of cloud and located learning activities. The students will interact with the staff during the design brief and concept selection stage; this interaction can be over the cloud or on campus for students who are able to come on campus.

The school of engineering has taken a step in this through the use of online tutorials. Tutorials conducted in the classroom provide the students to interact with the staff member and also revisit concepts covered in the lectures and collaborate with staff. This initiative of collaboration and interaction between the students and staff has been taken online through the use of Elluminate Live! eLive, a technology resource which facilitates communication and collaboration between staff and students. It allows the staff and students to talk over the Internet and also via an online chat room and to have online meetings and facilitates learning and training. It presents cloud-linked students to interact and collaborate with the staff and their peers in a safe and secure environment. Staff members can share audio and visual materials with the participants and can also invite guest speakers like experts from the industry. The flexibility of the online environment allows for the meeting to set up without the boundaries of time and space. The initiative from the school has been well received by the cloud-linked students and also by the campus-linked students who use this as an extra opportunity to collaborate with the staff and their peers.

Project oriented design based learning approach focuses on this interactivity between the staff and students and among themselves and this resource provides them opportunity to interact in various setting in which members from the industry can also be invited to share their ideas and views. This resource also allows the school to provide the enhanced interaction between student and staff as mentioned in the cloud learning policy.

The project in the PODBL model allows for the learning and teaching delivery to take place as a combination of cloud-linked and campus-linked learning activities. Cloud learning enables students to evidence their achievement and requires students to be generators of content, collaborators

in solving real world problems, and evidence their achievements in professional and personal digital portfolios. With premium cloud learning experiences in place, students who come to campus will have the opportunity to engage with teaching staff and peers in opportunities for rich interpersonal interaction through large and small team activities and also provided through the use of lecture videos, online tutorial for students who are able to make it campus-linked.

4 COLLABORATIVE LEARNING

When students work in groups of two or more where the centre of attention is project report or a design is known as collaborative learning. Participants have their individual accountability along with several conditions. Collaborative learning requires working together towards a common goal where students are responsible for one another's learning [21]. It is an educational approach to learning and teaching that involves a group of learners working together to solve a problem, complete a task or create a product [22].

With different learning styles students are able to express their skills and talents through working on projects or by simply designing experiments in authentic learning environments [4, 23]. Integrating design and technology tools into science education provides students with dynamic learning opportunities to actively investigate and construct innovative design solutions. By engaging students in collaborative learning, PODBL provides an opportunity to experience individual, inventive and creative projects that initiate the learning process in relation to their preferences, learning styles and various skills.

4 METHODOLOGY

Engineering at Deakin has used design-based learning (DBL) as one of its engineering learning principles for further development in teaching and learning. It is required to improve the learning and teaching process as a holistic approach from the perspective of students' and staff over the entire degree program. The qualitative and quantitative paper based survey method is used to obtain cloud-linked and campus-linked students' perspectives. Qualitative methods are useful for evaluating, developing program goals and for involving participants in the evaluation process to gain their insight and perspective [24].

From the quantitative and qualitative analysis performed, the results are analysed and presented from a students' perspective about collaborative learning and design based learning in engineering curriculum. The survey is paper based which was conducted by a third person not involved in the research project. The survey was given to cloud-linked/campus-linked students in the third year of engineering and was anonymous and non-identifiable. These results are from students' own experiences and the results present various views, which include students' knowledge and expectations of collaborative learning and design based learning in engineering.

5 RESULTS

5.1 Students' Perceptions of Collaborative Learning

The cloud-linked and campus-linked students' views of collaborative learning through project oriented design based learning in this research come from a cohort of senior year undergraduate engineering. This study goal is to determine the students' perspective of DBL and collaborative learning and how the perspective changes over the years studying engineering.

Table 1 shows students' perceptions of advantages of teamwork (collaborative learning) in design-based learning, which includes real world experience, teamwork and interaction. This indicates that the present curriculum needs a change in teaching by implementing the DBL units from senior year engineering programs. About 30% of campus-linked and 4% of cloud-linked students says through teamwork DBL, they acquired interactive knowledge, 15% of students mentioned that it develops collaborative skill, management skill and social science. It's interesting to see 11% senior year students says that they get the opportunity of managing large

projects through real world problems with industrial experiences.

Table 1: Advantages of collaborative learning

Students perceptions	Cloud linked (%)	Campus linked (%)
More discussion Opportunities, distribution of knowledge	4	11
Good experience, Time efficient	6	5
The work is divided, faster to give results	0	7
Team work, interactive knowledge	4	30
Develops Collaborative, management skills, social skills	0	15
Real world experience, like industry experience, build large projects	5	6
No answer	0	7

Table 2 illustrates students' perceptions on disadvantages of (teamwork) collaborative learning through design-based learning. Most of the cloud-linked and campus-linked students mentioned the problems exist in teamwork such as lack of consistence, communication, decision-making, co-operation and time management. When students are questioned about their preference of learning design based education through collaborative learning. Figure 3 clearly shows 52% of campus-linked and 9% of cloud-linked students' preferred half teams and half individuals' mode of design based learning through collaborative learning.

Table 2: Disadvantages of collaborative learning

Students perceptions	Cloud linked (%)	Campus linked (%)
Team members are not contributing	0	27
Independent learning not applicable, Relaying on other tasks	10	12
No individual effort, loss of time	5	15
Hard to make decisions and organize	0	16
Lack of consistence, slack students	5	10

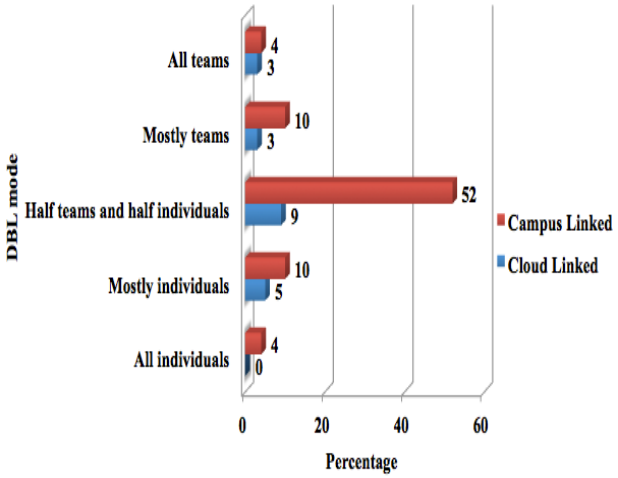

Figure 3: Modes of Design based learning preferred

The quantitative analysis of the survey results shows about more than 50% of the students' view some aspect of the advantage of teamwork (collaborative learning) in design-based learning includes real world experience and interaction, develops collaborative, management and social skills. Overall students views resembles that most of the essential graduate abilities are attained through collaborative learning (teamwork) in DBL mode. The students' perspectives are required to verify the learning and teaching methods and to identify the best practices in these methods to ensure the best possible learning experiences for the student.

5.2 Students' Perceptions on Design Based Learning

The students' views on design-based learning (DBL) in this research come from cloud-linked and campus-linked students in undergraduate engineering. The study goal is to determine the students' perspective of DBL and how the perspective changes over the cloud-linked and campus-linked students studying engineering. The way engineering students tackle their university degrees are somewhat very different to the way engineering students went through their studies few years ago. The tables and figures below show a comparison of cloud-linked and campus-linked students' perspectives.

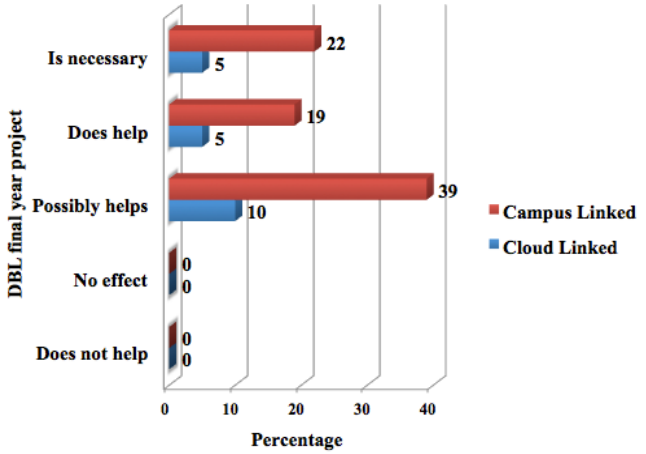

Figure 4: DBL final year project

When students are asked about the influence of DBL in their future career and importance of DBL in their final year project. Figure 4 show that (39%) campus-linked students and (10%) cloud-linked students perceived that DBL is important in their final year project. Almost 22% of campus-linked and 5% of cloud-linked students strongly maintains that DBL is necessary in their final year project.

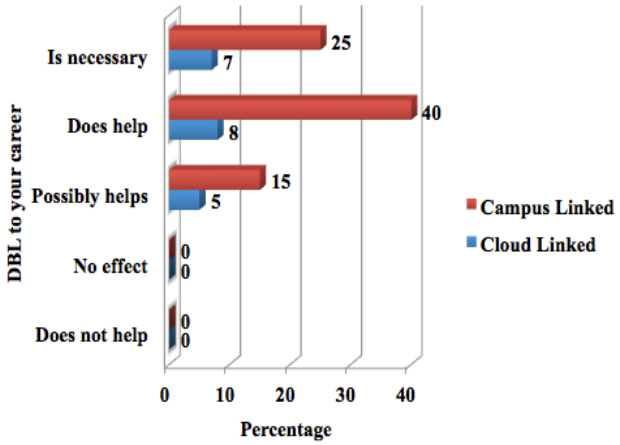

Figure 5: DBL to your career

It is clearly shown in figure 5, campus-linked (40%) and cloud-linked (8%) students recommended DBL is necessary for their future engineering career. Almost 25% of campus-linked and 7% of cloud-linked students strongly maintains that DBL is very important in their future career.

Table 3: Design based learning means

Students perceptions	Cloud linked (%)	Campus linked (%)
No answer	0	22
Learning in a particular way, Learning by doing, hands on projects	3	19
Learning through Practical application of engineering (design problem)	7	31
Project based learning (real world projects), learning through projects (design projects)	10	8

Table 3 shows students perception of design based learning approach, which is used as current curriculum methodology at Deakin engineering. Approximately 3% to 19% of students in both study mode revealed that DBL is learning in a particular manner, learning by doing, hands on project. About 18% of cloud-linked and campus-linked students says that DBL is a project based learning (real world projects), learning through projects (design projects). The cloud-linked and campus-linked students' perception on DBL gives an encouraging sign for the engineering curriculum educators in the School of Engineering at Deakin University.

Table 4: DBL in the curriculum

Students perceptions	Cloud linked (%)	Campus linked (%)
No answer	0	37
Practical Learning, Demos in classes, more practical less theory	7	19
Learning through projects, design techniques	4	3
Integrate with teaching (Individual DBL units)	5	10
Labs, practical's, lectures, tutorials, more assessments based on practical's	4	11

Table 4 indicates cloud-linked/campus-linked students' perceptions of DBL in their curriculum, almost 19% of students from campus linked and 7% from cloud-linked experienced DBL as practical learning, demos in their classroom.

About 7% of all students in both study mode believed DBL through industry related projects; learning through projects, design techniques.

Through a design based learning approach, design is driven by qualitative thinking, speculation, ideation, prototyping and specification [25, 26]. To achieve the goal of developing education, design educators provide practical strategies that exhibit the pedagogy of design education and problem solving processes. The goal of the design approach was not to change the whole curriculum of art education but for students to develop the ability to enhance and transform ideas through visualization, manipulation and the application of data to problem solving through design activities [27, 28].

The purpose of design education is to enhance learning in order to teach students to become active participants to solve the design problems around them [29, 30]. The aim of all educational institutions is to educate students as graduate engineers, and equip them with the ability to work in industry with graduate ready skills such as creativity, innovation, teamwork, problem solving, observation, analytical thinking, communication, and prototyping etc. Every learning and teaching approach has its own special way of confronting engineering problems. In design based learning, students solve engineering problems by using design as a vehicle.

6 CONCLUSION

This research paper focused on identifying cloud-linked and campus-linked students' perceptions on collaborative learning and design-based learning in engineering. The quantitative analysis of the survey results shows that more than 50% of the students view collaborative learning to have a large benefit in design-based learning. Project oriented design based learning approach created an enhancing environment for students and staff members through collaborative learning in cloud-linked and campus-linked study mode. The students' perceptions always have an important value in an engineering curriculum to foster their learning outcomes.

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