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Student Experience of Project and Design Centred Curriculum

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Structured Abstract

BACKGROUND

The School of Engineering at Deakin University has embarked on a new path in engineering education with new learning model based on the principles of project based learning and design based learning. Design based learning is the driving force for the new learning model which also incorporates the principles from project based learning to deliver the skills and knowledge students require to understand and solve design problems. The new project and design centred curriculum was implemented in a third year engineering unit. This paper presents the student views on this process, their views on the knowledge transfer and the knowledge gained through this process.

PURPOSE

This paper focuses on the student perspectives on the project and design centred curriculum.

DESIGN/METHOD

This research study will illustrate the students' views on the project and design centred curriculum. The student experience of the new curriculum will be evaluated using the course experience questionnaire. The questionnaire provides the students evaluation of the teaching and the units

RESULTS

The analysis of the survey results will give the researchers feedback on the new curriculum in the particular unit. It will also give them an insight if the method has helped students understand the subject and its concepts better and if the approach has helped collaboration between the students and their peers.

CONCLUSIONS

Project based learning and design based learning approaches have been applied in a wide range of situations and it is known to simulate discussion and collaboration between the students. A new project and design centred curriculum has been applied to a third year engineering unit. This unit looks at students using a self-directed approach to gain knowledge in the area and also teaching and disseminating the knowledge to their peers and colleagues. The analysis of this process will give the effectiveness of the process and inform the school of engineering of any improvements needed.

KEYWORDS

Project based learning; design based learning; student evaluation.

Introduction

In learning and teaching, practicing design is one of the fundamental processes in engineering curriculum and all other engineering activities related to it. Learning is an active process of investigation and creation based on learner's interest, experience and curiosity and it should result in expanded knowledge and skills. Learning through projects is considered as a way of interactive learning. The School of Engineering at Deakin University has embarked on a new path in engineering education with a new learning and teaching model based on the principles of project based learning and design based learning. Design based learning is the driving force for the new learning model which also incorporates the principles from project based learning and problem based learning to deliver the skills and knowledge students require to understand and solve design problems. The aim of this approach is to promote student centered and self-directed learning and initiate creativity and a design thinking process along with strong interpersonal communication between staff and peers in project and design centric curriculum.

Project/Design Centred Approaches

Project-based learning is perceived to be a student centred approach to learning. Kolmos (1996) states that students need to produce a solution to solve the problem and they are required to produce an outcome as a report supervised by the teacher. Teaching is considered as an input directing the learning process. Du (2009) intended that problem-based learning is focused around problem scenarios rather than discrete subjects and the selection of the problem is essential here. The teacher is to facilitate the learning process rather than to provide knowledge. Solving the problem may be part of the process.

Accrediting bodies such as the Accreditation Board for Engineering and Technology (ABET), Engineers Australia (EA), as well as the European Accreditation of Engineering Programs (EUR-ACE), all specify that design is an essential element of graduate outcomes for an engineering program (ABET, 2012-2013; Engineers Australia, 2012; ENAEE, 2008). When students are required to apply their knowledge to solve design problems, design based learning is used as an innovative method for engineering education.

Design based learning (DBL) is a self-directed approach in which students initiate creative learning using hands on solutions to meet the academic and industrial expectations of society. DBL is an effective process centred on problem solving structures which flow from problem-oriented project based education (Doppelt & Schunn, 2008). By engaging students in design, DBL provides an opportunity to apply original and inventive ideas that aid in students' development and growth. The intention of engineering science education is to produce a curriculum that improves learning for all students. This can be achieved by using design based learning through the preparation and training of project based activities that support the learning of cooperative methods.

Project and Design Centred Curriculum

The School of Engineering at Deakin University has always tried to improve its unit delivery method to enrich the student experience and to produce capable job ready engineering graduates. To this end, it has explored new teaching methods to aid in this process. One such method is Design Based Learning (DBL). There is a strong evidence in these literatures about the new learning and teaching practice at Deakin University (Chandrasekaran S, 2013a, 2013b; Joordens, Chandrasekaran, Stojcevski, & Littlefair, 2012). Perrenet et.al (2003) states that unlike Problem Based Learning (PBL) and Project Based Learning (PjBL), DBL is a self-directed learning approach and opens up learning activity so design skills must be learnt and applied. Iwane et.al. (2011) also states students must locate the resources required, and analyse any needs in order to create a design. Wijnen (1999) intended that this

method gives students the freedom to apply their design skills as they think best. DBL not only looks at the end product but also at the underlying process in creating that product.

Students are encouraged to study subjects where they learn by building, creating and implementing products and prototypes. The objective is for students to integrate their knowledge in processes where problem solving is essential. Therefore, design based learning is used to enrich student involvement by integrating experience. DBL is a type of problem-based learning where problems are solved in teams. It is important to have a pedagogy style or approach, such as design based learning, which is similar to project based or problem based learning.

Third Year Design Project

The new approach based on the principles of project and design centered learning was implemented in the first semester of third year engineering. The new approach following the principles of project/design centered learning used a design project to teach students the fundamentals of electronic signals and systems. The students worked in teams of five to six members and each team was given a design problem which encompassed the learning outcomes for the unit. The staff member played the role of a facilitator, facilitating the student centred learning process. The same group met regularly throughout the trimester to work on a series of design activities. The design activities in the project drive the learning process which follows the design thinking process. The design thinking process can be grouped in three stages: definition, ideation and prototype & testing. The key idea behind the learning process is to drive student centred learning with a rich interpersonal interaction with peers and staff.

In the definition stage the students come together to identify and define the design problem. An open ended project was presented to the students by the staff member which has open ended solutions. The students brainstorm on the project and start to identify the significant issues and try to understand the problem outlined in the project brief. They involve in concept research, in this stage the team members having identified the significant issues go on to discuss and identify the learning issues which are assigned to each and every member of the team. Each member of the team understands what all members of the team have agreed to research and what them as individuals must contribute to the team. Students locate resources that are directly relevant to the learning issues and the other members of their team need to be advised by posting a message in the appropriate discussion forum on the cloud.

In the ideate stage the teams develop the design brief which is the key project planning document. The teams specify the objectives the project will achieve and detail the means and timeframe for it. The development of this document is correlated to ideas and finding from the concept research. With the design brief developed, the team members evaluate the findings to determine concept appropriate to develop the final design and the student teams finalise and develop the final design.

The final stage is of prototype and testing; teams start by modelling and building their design and testing and evaluating the design against the requirements and specifications. Once the design has been verified and validated against the specifications the final product is delivered.

In all the stages of the design/learning process there is continuous interaction between the peers. This interaction is facilitated through the use of discussion forums and through the use of technology resources to set up meetings in the online environment. The meeting link is set up with access allowed only to the members of the team and the facilitator. Team members discuss the progress of the project and the progress of the individuals' tasks in the project. The facilitator's role in these meetings is very limited and many times the student carry on without the facilitator. These interactions promote learning and understanding of the subject

matter. The team members reflect on the tasks they have carried and are provided critique from other member, this process of reflection and feedback ensures peer to peer learning.

The project and design learning process motivates students to learn engineering in a way that is student-centred and project driven. The learning process provides a blended environment of cloud and located learning for peer interaction and peer to peer learning. The cloud and located leaning experience is a convergence of experience provided on the cloud in a seamless digital environment with learning activities linked with tasks performed by student in their chosen professions and opportunities to interact with staff and peers through located learning.

Student Experience of Project and Design centred Learning

Students at Deakin University are given the opportunity to provide feedback on the units they are studying and the teaching staff through the use of a course experience survey. The course experience survey collected anonymously from student's gathers student evaluations of the quality of the unit, its material and the way it was taught. The course experience survey is collected every semester and this presented us with an opportunity to compare the student experience of the third year engineering unit when it was offered in the traditional lecture based approach to the new project and design centred curriculum.

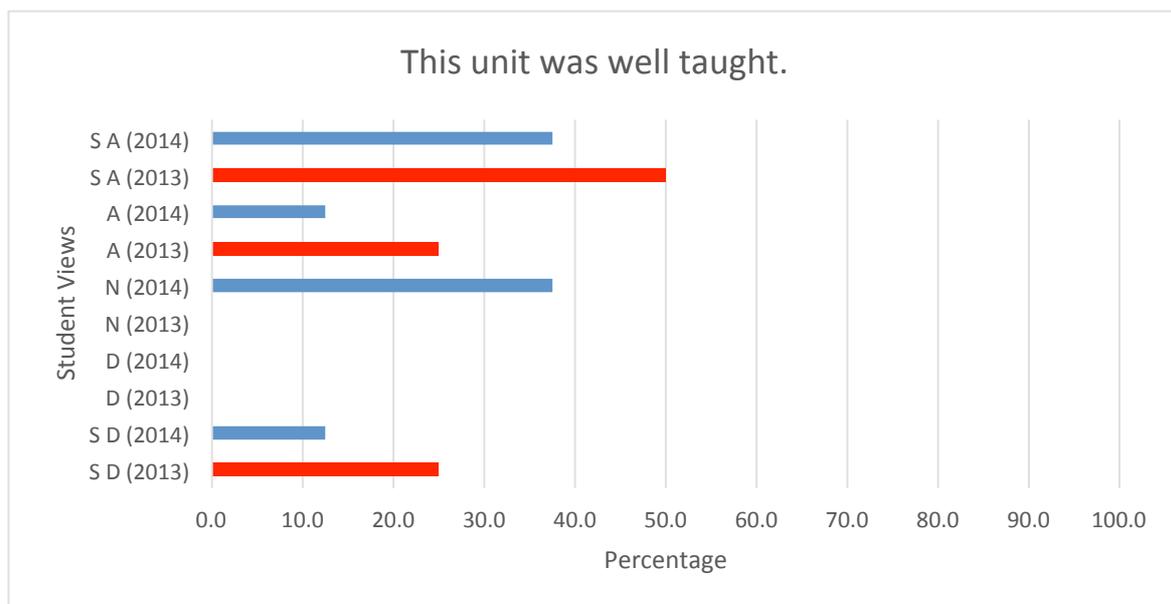


Figure 1: Student views on if the unit was well taught in 2013 and 2014

Figure 1 shows a comparison of student views on how well the unit was taught, the traditional lecture fairs better with 75% agreeing the unit was well taught in 2013 as compared to 50% in 2014 when the new learning approach was introduced; this was expected as the students were experiencing a new learning process but it is good to see the number of students who disagreed that the unit was well taught has been halved from the previous year. There is a significant number of students who have a neutral view on the new learning process but other questions on the unit have shed more light on their views. On the question of recommending the unit to others there is an increase of 25% on the students agreeing to recommend the unit and again a drop in half for the number disagreeing shown in figure 2. Figure 2 also shows the number of students who had a neutral view is considerably lower thereby suggesting the students enjoyed the new learning process and were happy to recommend it to others.

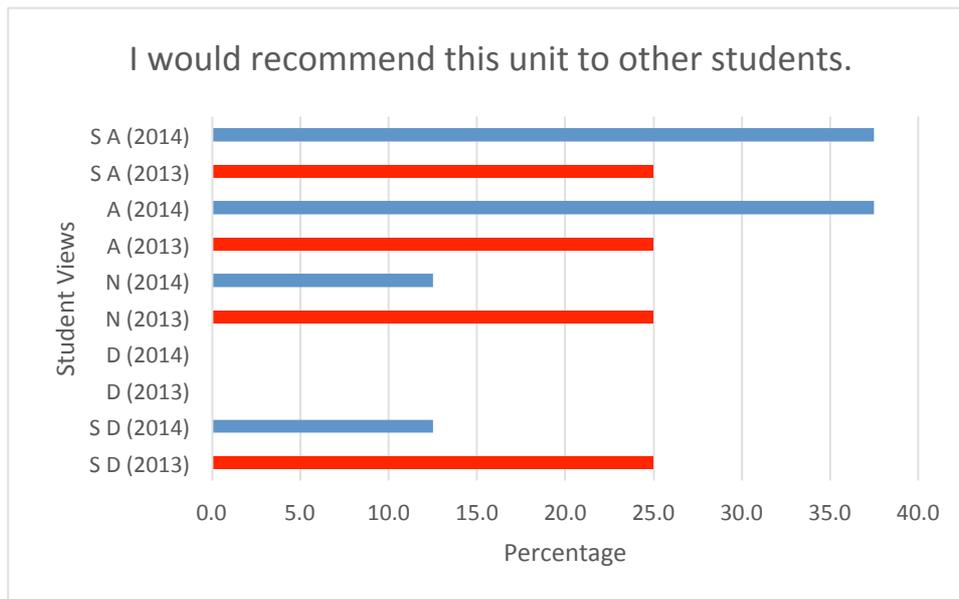


Figure 2: Student views on recommending the unit in 2013 and 2014

The students' views on the how well the unit was taught along with their views on recommending the unit to others suggest the new learning and teaching approach was well received by the students. The project and design centred approach promotes a self-directed learning approach and greater interaction with staff and this evident from figure 3 and 4 which demonstrate the student response to questions on feedback received from staff and if the unit challenged them to learn.

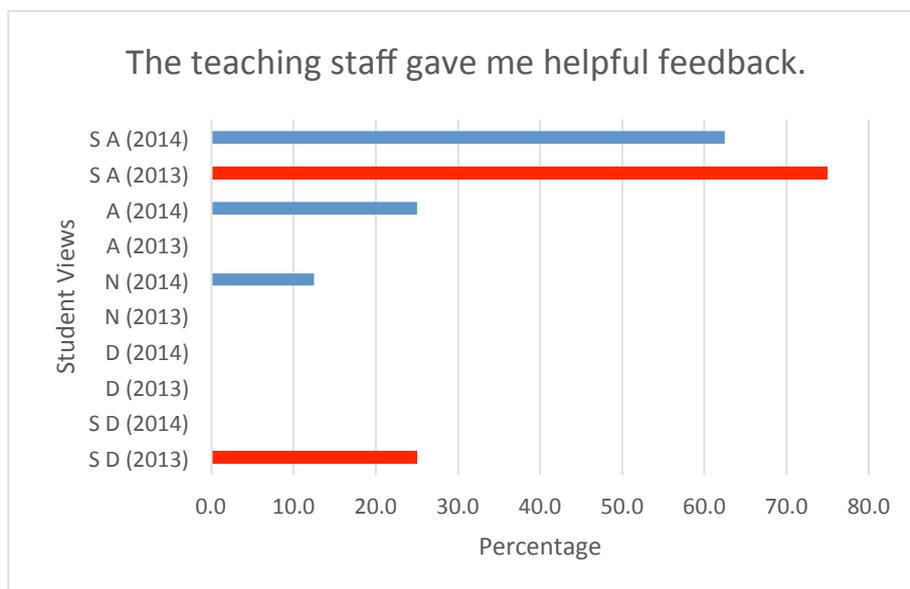


Figure 3: Student views on feedback received in the unit in 2013 and 2014

The student staff interaction is highlighted and supported as nearly all students in the new learning approach in 2014 stated they received helpful feedback from staff. The greater interaction has helped student learning as the interaction is not only between students and staff but also between peers. The project and design centred approach encourages students to learn through design activities and locate the resources and analyse the needs of the project to create the design and the key objective is for students to integrate the knowledge gained through various sources to develop problem solving skills and solve the problem presented in the project. This is made evident with a strong 75% of the students agreeing the

unit challenged them to learn shown in figure 4 and to quote student comments on the unit one student stated “The project based learning approach was great. The task set was challenging and interesting.” Another student quoted “I really enjoyed the fact that the unit was design based. It was challenging and at times very confusing but in the end when the final solution comes together it is worth it. We got to focus on what we found challenging at our own pace.” In comparison in the comments for the unit in 2013 the students quoted the unit was enjoyable and they liked it but it also mentioned “The lecturer engaged with the class frequently and gave useful feedback and solutions” putting the onus on the staff member to engage the class and drive the learning in the unit.

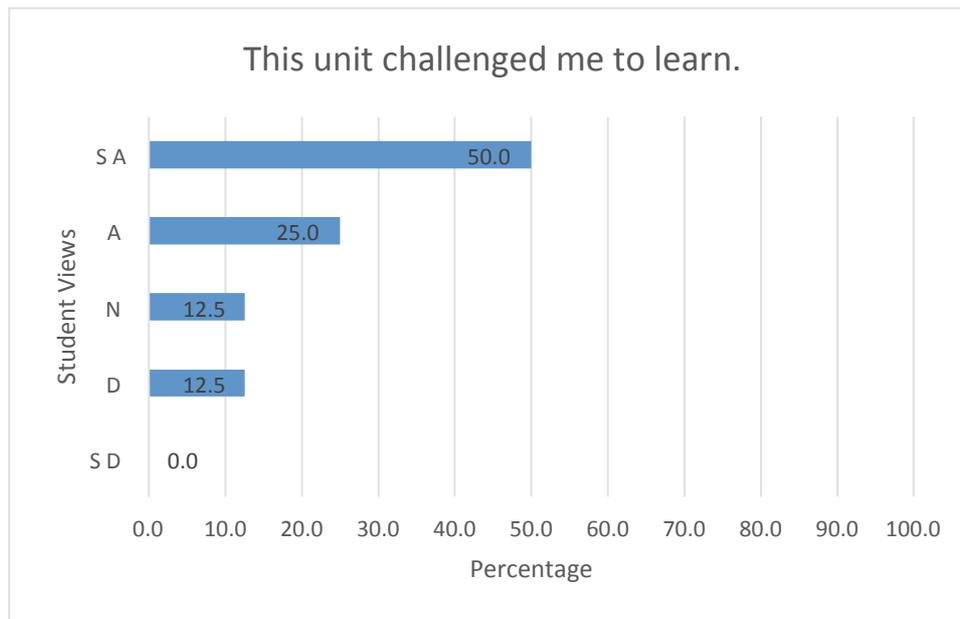


Figure 4: Student views if the unit challenged them to learn

Overall the student views support the claim that a project and design learning process motivates students to learn engineering in a way that is student-centred and project driven. The design project challenges the students to learn and also set the pace of their learning and the interpersonal communication with staff and peers provides timely feedback which encourages further learning.

Conclusion

Project and design based learning promote a student centred and self-directed approach to learning, the project and design centred curriculum combines and incorporates these learning models. The project and design centred learning approach motivates students to independent learning with the development of information literacy and the design thinking process. The design thinking process of define, ideate, prototype and test adopted in a project promotes strong interpersonal interaction between peers and staff and also improves student learning. The student response to the new learning model in the course experience survey shows they liked the new learning approach which challenged them to learn, develop independent thinking, and the results also indicates the students liked the interpersonal interaction with staff and they are happy to recommend the unit to other students.

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