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Blending students' feedback in flexible teaching-learning

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ABSTRACT: The on-line students' feedback collection platform at Curtin University, Perth, Western Australia is known as *eVALUate*. Four years' data (2008-2011) from the eVALUate survey for an undergraduate civil engineering unit is considered in this study. In 2008, traditional teaching methods (teacher-centred) were used and the overall students' satisfaction was found to be lower than university and faculty averages. Because of the students' feedback, from 2009, traditional teaching methods were blended with flexible learning resources (e.g. Blackboard and i-lecture). The 2009 eVALUate survey data showed that the learning outcomes and the overall students' satisfaction improved to the point where they exceeded the university and faculty averages. In 2010 and 2011, similar blended teaching methods were adapted and amended according to the constructive feedback received, and the validity and sustainability of the method were checked. The percentages of agreement consistently exceeded the university and faculty averages and interestingly, agreement with all the items in eVALUate was found above 80%. Students' overall performance also improved significantly indicating that blending students' feedback in teaching provides better learning outcomes.

Keywords: Blended, students, feedback, teaching, learning, flexible

INTRODUCTION

Over the last half century, there has been very little change in undergraduate engineering education [1]. Regular reviews have been undertaken in higher education institutions, but these have mainly tended to focus on the subject content of degree courses and its relevance to the needs of engineering employers. However, in the 1990s, pressure for more radical changes began to be built into the systems of many countries, including the United Kingdom [2], Australia [3], the United States [4] and New Zealand [5][6]. The motivation was more student-centred learning in higher education, such as out-come based learning processes.

In a higher education system, evaluation of units and teaching is an essential part of effective learning and continuous development in teaching-learning. Evaluation helps to increase knowledge of the level of students' understanding of the concepts, to analyse their different learning styles and to examine ways in which students could gain a deeper understanding of the required concepts [7]. Traditionally, students' feedback was obtained in informal ways, such as through classroom questionnaire surveys. The main disadvantage of these informal surveys was the need to analyse qualitative handwritten information, much of which is not understandable.

Until recently, the massive amount of student feedback collected in the Course Experience Questionnaire (CEQ) went unanalysed (at the national level) except when individual universities performed their own analyses [8]. In order to ensure an unbiased and fair evaluation, a centrally controlled on-line student evaluation system *eVALUate* has been implemented at Curtin University in Western Australia [9]. *e*VALUate is Curtin's on-line system for the gathering and reporting of feedback on teaching and learning both quantitatively and qualitatively. In many cases staff performance is measured by student satisfaction surveys in eVALUate and it is especially considered as one of the key performance indicators of academic staff in teaching-learning. The eVALUate system is mainly used to carry out the *e*VALUate unit survey and the *e*VALUate teaching survey, but it is also used to gather information through the *e*VALUate graduate survey and the *e*VALUate employer survey.

The author of this article developed the blended teaching approach and applied it to undergraduate engineering units and eVALUate data were used to show its applicability [10]. Later, the author applied this approach to undergraduate and postgraduate units respectively to understand whether it provides similar learning outcomes in both learning levels [11]. Both of these studies used two years' eVALUate data. In this article, an additional two years of eVALUate data (four

years of data in total) have been used to check the validity and sustainability of the method. The undergraduate civil engineering unit *Water Engineering 361* was chosen for this purpose and all the qualitative data were taken as the students' reflection (e.g. feedback).

Considering the students' feedback, the teaching methodology was subsequently redesigned and adjusted and a student-centred blended teaching approach was applied as a mode of flexible delivery in subsequent years. In the third and fourth years, the method was applied in order to check its validity and sustainability, respectively. Results of the eVALUate survey were analysed and discussions showed how students' feedback can help to deliver a blended teaching approach and enhance students' overall performance in a flexible teaching-learning environment.

e-SURVEY OF STUDENTS' FEEDBACK

The on-line eVALUate survey of student feedback was implemented at Curtin University in 2006 after a full-scale pilot in 2005 [9]. eVALUate was developed as an evaluation instrument for measuring the students' perceptions of their engagement and learning outcomes. eVALUate is available for students to provide their feedback from the 4th quarter of the semester and remains open until the end of the examination. The teaching staff can request an eVALUate report for their own teaching, which closes before being opened for students' feedback. The unit survey has eleven quantitative and two qualitative, items as listed in Table 1 [12].

Table 1: Quantitative and qualitative items used for unit evaluation [12].

Quantitative Items:
1. The learning outcomes in this unit are clearly identified.
The learning outcomes are what you are expected to know, understand or be able to do in order to be successful in this unit.
2. The learning experiences in this unit help me to achieve the learning outcomes.
The learning experiences could include: face-to-face lectures, tutorials, laboratories, clinical practicum, fieldwork, directed learning tasks, and on-line and distance education experiences.
3. The learning resources in this unit help me to achieve the learning outcomes.
Learning resources could include print, multimedia and on-line study materials, and equipment available in lectures, laboratories, clinics or studios.
4. The assessment tasks in this unit evaluate my achievement of the learning outcomes.
Assessment tasks are those which are rewarded by marks, grades or feedback. Assessment tasks directly assess your achievement of the learning outcomes.
5. Feedback on my work in this unit helps me to achieve the learning outcomes.
Feedback includes written or verbal comments on your work.
6. The workload in this unit is appropriate to the achievement of the learning outcomes.
Workload includes class attendance, reading, researching, group activities and assessment tasks.
7. The quality of teaching in this unit helps me to achieve the learning outcomes.
Quality teaching occurs when knowledgeable and enthusiastic teaching staff interacts positively with students in well-organised teaching and learning experiences.
8. I am motivated to achieve the learning outcomes in this unit.
Being motivated means having the desire or drive to learn, to complete tasks and to willingly strive for goals.
9. I make best use of the learning experiences in this unit.
I prepare for and follow up on the learning experiences offered in this unit.

10. I think about how I can learn more effectively in this unit. *I take time to think about how I can learn more effectively.* 11. Overall, I am satisfied with this unit. *Overall, this unit provides a quality learning experience.*
Qualitative Items: 12. What are the most helpful aspects of this unit? 13. How do you think this unit might be improved?

The quantitative items ask students to report their level of agreement with statements about: 1) what helps their achievement of unit learning outcomes (items 1 to 7); 2) their motivation and engagement in learning (items 8 to 10); and 3) their overall satisfaction (item 11). Each quantitative item is accompanied by a *help text* (shown in italics in Table 1). Students may indicate that they Strongly Agree, Agree, Disagree, Strongly Disagree or are Unable to Judge for each item. In addition, students are invited to make constructive comments on the qualitative items (limit of 600 characters) (item 12 to 13). Usually, a response rate of at least 35% is considered as representative in the eVALUate survey.

WATER ENGINEERING 361

Water Engineering 361 (civil engineering hydraulics) is a core unit for 3rd year civil engineering students at Curtin University, Western Australia (WA). This unit is run simultaneously at the Bentley campus, WA and the Miri Campus, Malaysia. The coordinator of this unit is from the Bentley campus and he is the principal lecturer of this unit. Currently, all the lecture notes are prepared in Microsoft PowerPoint and made available to the students through University-wide flexible learning instrument *Blackboard*. All the lecture notes are uploaded without solutions to the given examples. The solutions to the examples are discussed during the lecture in the form of group-based learning. The lecturer uses a white-board marker to illustrate the underlying engineering concepts. The on-line learning platform Blackboard was first implemented in 2009 at Curtin and before that, other on-line platforms, such as *WebCT* were used. The lecturer was new to Curtin in 2008 and used traditional teaching methods (teacher-centred). Based on the major feedback in 2008, the same lecturer introduced a blended teaching approach consisting of traditional methods and flexible learning resources in 2009. The same methodology was applied in 2010 and 2011 for checking the validity and sustainability of the method.

This unit has two main parts, pump hydraulics and open channel hydraulics. Each part has two components, lectures and a laboratory component. The unit outline is made available to the students at the beginning of the semester and all aspects of the units are described, especially the syllabuses, unit outcomes, assessment procedure and lecture schedule. The main unit learning outcomes of this unit are the appreciation of the application of civil engineering hydraulics in particular to the principles relating to hydraulic pumps and open channel hydraulics. The unit's learning outcomes must address Curtin graduate attributes as much as possible. There are nine Curtin graduate attributes and the learning outcomes of this unit map most of these attributes [13]. Water Engineering 361 had 150 enrolments in 2008, 121 in 2009, 165 in 2010 and 158 in 2011, respectively. In this article, eVALUate survey results on 11 quantitative items and two qualitative items were considered for 2008-2011.

RESULTS AND DISCUSSION

Quantitative Survey

The eVALUate survey produces a Full Unit Report (FUR) and a Unit Summary Report (USR) [14]. Unit Summary Reports are automatically published and anybody from Curtin who has on-line user access can see the report. Unit coordinators are expected to provide their response to the USR by mentioning how they intend to consider the students' feedback for future improvement of the unit. By providing an on-line response, a unit coordinator can be awarded points towards his or her Teaching Performance Index (TPI). The eVALUate data (2008-2011) for Water Engineering 361 are summarised in Table 2.

In 2008, 35% of students provided a rating for Water Engineering 361 and the proportion of students agreeing with the proposition stated in most of the items was below the university or faculty agreement level. This was mainly because of the use of traditional teaching methods and the lack of availability of on-line lecture materials in due time in the flexible learning platform. In 2009, the response percentage increased to 41% and the proportion of students agreeing with the proposition in all 11 items was above the university or faculty agreement level. In 2010, the method was updated and the response rate increased to 42%. In 2010-2011, the unit satisfaction remained consistent, but exceeded the university or faculty agreement level and all the items in eVALUate were rated above 80%. Given that there was a positive response rate of over 80% provides means for the unit coordinator to be awarded extra points towards the calculation of the annual TPI.

Item 5, which is about feedback, has attracted the highest percentage of *Unable to Judge* responses, as well as the lowest percentage of agreement. The tendency, at all levels of course, faculty and university has also been observed by Oliver et al [9]. Analysis of the qualitative items confirmed that this is, in fact, an area of concern for the University to address. Some students are unclear about the feedback they receive and whether it helps them to achieve the learning outcomes or not. Other students believe that the amount of feedback they receive is insufficient or unhelpful. Investigating the qualitative data, it was found that there are misunderstandings among the students about the feedback. Students think that feedback relates only to the written comments given to them in response to their submission.

The meaning of *feedback* was made clearer during teaching in Water Engineering 361 using a blended teaching approach. Meaningful feedback is an essential part of the learning process and it is a process that must function in both directions. It is critical for the lecturer to know how students are learning and to provide feedback on their progress, but it is also essential for the students to provide feedback on a lecturer's teaching. Students were encouraged to put their feedback in eVALUate and the lecturer made a point of returning assignments within one to two weeks and made himself available through a variety of media (e-mail, telephone, consultation hours, after lectures, informal corridor discussions or through discussion board in on-line learning platform such as Blackboard) for this unit. This two-way feedback made the learning process more flexible and motivated the students for learning. This is clearly reflected by the continuous increase of students' agreement on the *feedback* item in eVALUate (from 55% to 85% between 2008 and 2011) for Water Engineering 361 (see Table 2).

Table 2: On-line quantitative survey results of Water Engineering 361 for four consecutive years (2008-2011).

Unit Survey Item	2008: n = 150; Response rate 35%	2009: n = 121; Response rate 41%	2010: n = 165; Response rate 42%	2011: n = 158; Response rate 38%
1. The learning outcomes in this unit are clearly identified.	90	94	91	93
2. The learning experiences in this unit help me to achieve the learning outcomes.	69	96	85	90
3. The learning resources in this unit help me to achieve the learning outcomes.	75	94	84	90
4. The assessment tasks in this unit evaluate my achievement of the learning outcomes.	67	90	90	90
5. Feedback on my work in this unit helps me to achieve the learning outcomes.	55	76	81	85
6. The workload in this unit is appropriate to the achievement of the learning outcomes.	69	86	82	88
7. The quality of teaching in this unit helps me to achieve the learning outcomes.	49	88	87	87
8. I am motivated to achieve the learning outcomes in this unit.	76	92	88	92
9. I make best use of the learning experiences in this unit.	71	86	85	92
10. I think about how I can learn more effectively in this unit.	73	80	88	95
11. Overall, I am satisfied with this unit.	63	92	85	84

Qualitative Survey and its Effect on Learning

Students provide their qualitative evaluation according to two evaluation criteria as given in Table 1. They first identify the most helpful aspects of the unit during their learning process, and later, express their thoughts as to how the unit could be improved and lead to a better learning outcome. Some contradictory opinions on the teaching method were expressed, which may be due to some of the student group not attending all the lectures but still participating in eVALUate. However, analysis of qualitative data revealed that this percentage is very low.

The qualitative data obtained in 2008 were summarised and the most useful suggestions were listed. All the useful feedback from 2008 was taken into consideration and presented at the beginning of the lectures in 2009, and the ways these could be incorporated into the teaching methodology were discussed with the students. Similarly, responses to students' eVALUate feedback data were shown in the first lecture in the following year and explained how it is considered in lecture delivery. In the last week (week 12), the lecturer restates the responses and reminds the class about what was promised at the beginning.

This method of responding to students' feedback provides a feeling that the lecturer has really looked into their feedback carefully and improved the unit accordingly: *...makes a solid effort to ensure students understand the content - open to suggestions and actually makes changes to his teaching style based on feedback* (Student eVALUate response). It

provides shared ownership in improving the units. As a result, the significant revamping in teaching approaches influenced the students' motivation in learning. This is evidenced by the significant improvement in item 8 for *motivation*, e.g. 76% in 2008 to 92% in 2009. This item remains consistent in 2010 (88%) and 2011 (92%), respectively (see Table 2).

Students' Performance

Pass requirements for this unit are mentioned in the unit outline. The unit outline is uploaded onto the on-line flexible learning platform *Blackboard* before the semester starts. The assessment of this unit is divided into two categories: an examination component and laboratory reports. The examination component consists of a mid-semester examination and a final examination. The mid-semester examination (30%) is mainly on pump hydraulics and the final examination (50%) is on open channel hydraulics. There are two laboratories on pump hydraulics and open channel hydraulics, respectively. Students are responsible for submitting their laboratory reports two weeks after their laboratory session.

The submission is managed by the Curtin engineering assignment office, which records their submission time and date electronically. Any late submission without valid reason (e.g. unavoidable circumstances) is penalised according to the Faculty's late submission policy. Each of these laboratory reports carries 10% of the total marks. To pass this unit, a student must achieve a grade/mark greater than or equal to 5/50. A minimum mark of 50% in the examination component and 50% in each laboratory component are required to register a pass in this unit.

The students' final performance in this unit was analysed for four consecutive years (2008-2011). The 2008 data are considered as representing the pre-blended teaching approach performance and 2009-2011 represent the period after the introduction of a blended teaching approach informed by the students' feedback. The frequency of students and the grades they obtained are plotted in a histogram for 2008-2011 and shown in Figure 1.

Only the students who participated in the final examination have been considered in this analysis. This number differs slightly from the actual number of enrolments, because some students deferred their final examination due to illness or other unavoidable reasons and have not been shown here. Their results are published at a later date after a deferred examination has been completed. However, the percentages of students deferring the examination varied from 0.8% to 7.5% for this unit in 2008-2011. The pass-fail ratio (%), average marks and frequency of students obtained grade ≥ 7 and or ≤ 6 are shown in Table 3.

The results reveal that there were significant improvements in student performance due to the introduction of a blended teaching approach. The average marks increased from 66 in 2008 to 75 in 2009 and remained consistent in 2010 (71) and 2011 (73), respectively. The histogram shows that the overall curve is skewed towards better performance in 2009. The histogram in 2010 and 2011 shows student performance to be normally distributed about a mean grade of 7 with a decrease in the number of students failing. The pass-fail ratio shows significant improvement from 2008 to 2011. This is clear evidence that the continuous adjustments in blended teaching approach informed by subsequent student feedback provides better learning outcomes and enhances students' performance.

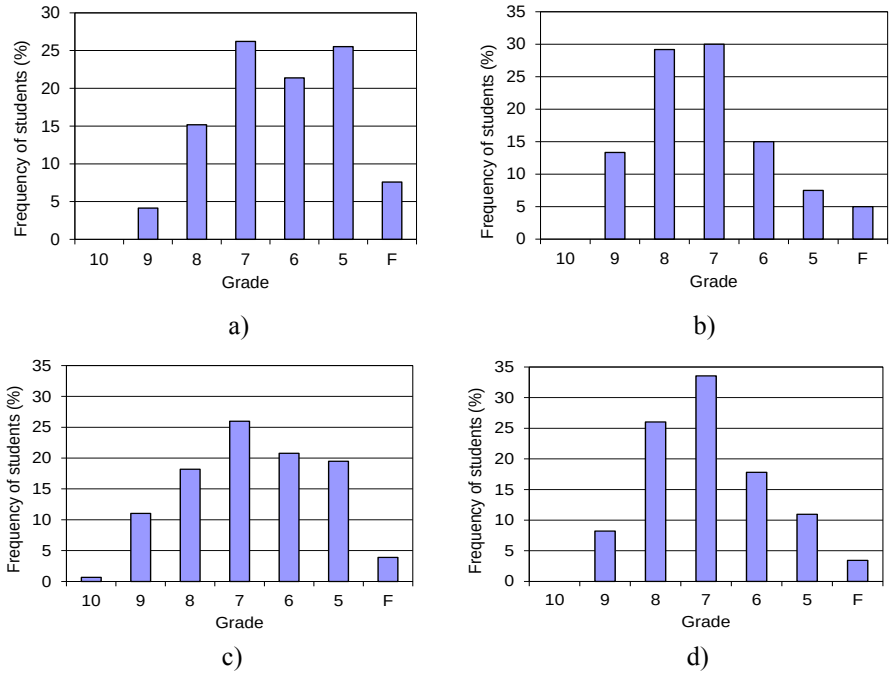

Figure 1: Student performances in Water Engineering 361 in a) 2008 (n = 145); b) 2009 (n = 120); c) 2010 (n = 154); and d) 2011 (n = 146).

Table 3: Pass-fail ratio (%) and average marks in 2008-2010 (2008: traditional teaching method; 2009-2011: blended teaching method informed by students' feedback).

Year	Number of students participated in final examination	Pass/fail ratio (%)	Frequency of students with grade ≥7	Frequency of students with grade ≤6	Average marks
2008	145 (150)*	8	45	55	66
2009	120 (121)*	19	72	28	75
2010	154 (165)*	25	55	44	71
2011	146 (158)*	28	67	32	73

*The bracket value indicates the actual enrolments in Water Engineering 361.

Blended Teaching Approach and Flexible Learning

In this article, the blended approach has been defined as a combination of traditional methods of whiteboard-marker and on-line learning resources found in flexible the teaching-learning platform at Curtin University. At Curtin, Blackboard is currently used as a flexible teaching-learning platform where the i-lecture provided by Echo360 is integrated. On-line lecture materials are uploaded onto the Blackboard well before the lecture schedule. The use of the flexible mode of delivery, such as the simultaneous use of white board-marker and power point slides made the student engagement in the classroom more effective. At the same time, the combined use of Wikipedia, on-line movie clips and group based problem-solving made the classroom learning more interesting. All the lectures were recorded electronically and the i-lectures were made available on-line to all those taking the unit.

Based on the students' feedback, continuous assessment was introduced instead of having only one final examination at the end and problem-based learning (PBL) was also introduced. Problem-based learning is mainly defined as being where students work collaboratively in a group to solve a particular problem. The problem, which may be interdisciplinary, drives the curriculum; students must define the problem, identify and acquire the skills and knowledge needed to solve it, and work through the solution [6]. The problems are mostly related to real life and are industry-based. Engineers see themselves as problem-solvers, so the learning context is seen by students as being relevant. Engineering students gain experience in the integration and application of analytical knowledge.

In the Water Engineering 361 unit, the curriculum is entirely problem-based. Students work in groups on design-oriented problems which are supported by lectures, reading, group discussion, tutorials, laboratory sessions and practical exercises, as appropriate. As a result, this revamping of the unit improved the overall satisfaction rating significantly from 63% in 2008 to 92% in 2009, which is far above the faculty and universitiy averages of 81% and 83%, respectively. In 2010 and 2011, the satisfaction level of all eleven items in eVALUate fall far above the university (83%) and faculty average (82%) and all the items remain above 80% consistently.

These results clearly show that adequate student performance and learning outcomes can be obtained when the teaching methodology is developed using student feedback. Integrating the methodology in a flexible learning environment can motivate and inspire students for learning and as a whole, it improves the students engagements in learning. However, most of the students feel comfortable while attending lectures in the whiteboard-marker system together with PowerPoint presentations in a blended form, but weaker students and students with disabilities or suffering from illness face difficulties when they start to study for the examination using i-lecture. Some of the qualitative feedback shows that the students could not find any written material on the whiteboard in i-lecture. They could only listen to the lecturer's voice, which does not always correspond to the PowerPoint slides that they see in i-lecture. This issue is now of major concern for users of i-lecture and needs further investigation especially for weaker students and students with disabilities or illness. However, various options to overcome this problem are currently under investigation.

CONCLUSIONS

This article illustrates the use of on-line student feedback in blended teaching and shows how it enhances student performance and learning outcomes in a flexible teaching-learning environment. The on-line survey data for four consecutive years of an undergraduate civil engineering unit were used. The results from the first year show that satisfaction with the unit fell below university and faculty targets because traditional teaching methods were used. The first year survey data were summarised and the unit was redesigned for the next year using a blended teaching approach.

This teaching approach integrates the students' feedback together with the traditional teaching method and flexible learning resources. This method enhanced the learning outcomes, which showed an improvement in overall student satisfaction rating from 63% to 92%. This rating was far above the university and faculty averages of 83% and 81%, respectively. The method was again checked in third and fourth year for its validity and suatainabilty and found it very suitable for applying in egineering education.

The pass/fail ratio was improved significantly and the number of students with grade ≥7 also increased. Results further revealed that student performance in terms of pass rates and average marks improved significantly after the introduction of this method. However, to improve learning and students' motivation for learning further, the course content delivery structure needs to be reviewed and adjusted on a regular basis and made as clear as possible for 21st Century engineering learners.

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BIOGRAPHY

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