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Student participation in and perceptions of regular formative assessment activities

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BACKGROUND
The benefits to student learning from participation in formative assessments have been reported by many educational researchers and scholars. This literature reports improved engagement when students see formative activities as being highly relevant and valuable for their learning. However, many academics still report that students are reluctant to participate in a learning activity unless it contributes some marks to their final subject grade.

PURPOSE
The purpose of this study was to investigate the impact on learning of undertaking a series of out-of-class formative learning activities. In addition, for the students that undertook these activities, we are interested in why they chose to participate and what, if any, learning benefits they experienced from participating. In regards to the students that chose not to undertake the activities, we are interested in their reasons for not participating. We are also interested in investigating the impact on students of scaffolding the learning activities used throughout the semester.

DESIGN/METHOD
For the Autumn 2012 offering of Engineering Mechanics, out-of-class formative learning activities were designed for four topics in the syllabus. These activities required the students to read the relevant section of the textbook and subsequently answer multiple-choice questions provided online including entering comments to explain their chosen answer. While there were no marks allocated to these activities, the instructor did allocate more time in lectures to the material related to questions with the largest variation in responses. Students who answered the online questions could log back on at the end of the submission period to compare their responses to the instructor's answers and reasoning. At the conclusion of the semester students were asked to complete a survey consisting of both closed and open-ended questions to investigate their perceptions of the effects of the online activities. Descriptive statistics were used to analyse the closed responses to this survey and also to determine if there is any significant correlation between participation in the formative assessment task and subsequent performance in summative assessment tasks in this subject.

RESULTS
The results show that the majority of students in the class did not undertake all of the activities. The results also indicate that students that participated in 3 or more activities scored, on average, almost one grade increment higher than those that participated in 0 or 1 activity. In addition, increases in the institutional student feedback survey results for the subject indicate an improvement in student perception of the learning experience compared to the previous semester.

CONCLUSIONS
Students who participated in the formative assessment activities in this subject benefitted in terms of their learning which was suggested in the final summative assessment task. These results and what we learnt about students' motivation to participate will be used in future semesters to demonstrate to students the link between participating in the formative activities and scoring well in the summative tasks. We argue that making this link explicit and scaffolding the learning activities are the keys to improving students motivation to learn.

KEYWORDS
Formative assessment, multiple-choice, scaffolding learning activities.

Introduction

The benefits to student learning from participating in formative assessment activities have been reported by many educational researchers and scholars (Black & Wiliam 1998, Ramsden 2003, Brown, 2004, Gibbs & Simpson 2004, Boud & Falchikov 2007, Carless 2007, Torrance 2007, Irons 2008). This literature reports improved engagement when students see formative activities as being highly relevant and valuable for their learning. Kember (2000) concludes that students will engage with an activity if they see it as an opportunity for learning. However, many academics still claim that students will not participate in a learning activity unless it has a mark that contributes to their final subject grade.

The purpose of this study was to identify and investigate the impact on learning for students who chose to undertake a series of out-of-class formative learning activities. For the group that undertook these activities, we are interested in what, if any, learning benefits they experienced from participating. We are also interested in why students chose not to undertake these activities. In addition we are looking for the impact of scaffolding the learning activities.

Background

For several years the authors have been researching the impact of learning-oriented activities on students' learning (Willey & Gardner, 2010, 2011a, 2011b; Gardner & Willey 2011). These activities have been both formative and summative but in each case were specifically designed to provide opportunities to learn.

In these studies, we found that when activities are summative, students, with some justification, tend to strategically focus on how to accumulate the most marks. We agree with Irons (2008) that "formative assessment is a 'safer' way for students to take risks and try things out in their learning" (p.27). The low-risk environment allows students to push their learning boundaries, make mistakes, identify gaps in their learning and have these addressed by their peers and if necessary the teaching academic. We regularly remind students that 'mistakes compress learning' and to benefit most from formative activities they should be pushing their learning boundaries until they make mistakes and/or discover what they do not know (Svinicki, 2004). Furthermore, the formative activities should be one of the best opportunities for students to assess and receive feedback on their learning in preparation for their eventual summative assessment.

To assist students to make the most of the opportunities provided by formative learning activities their design should include scaffolding to promote a learning focused, as opposed to a task-focused, disposition in students as shown in Figure 1 (Willey & Gardner, 2012).

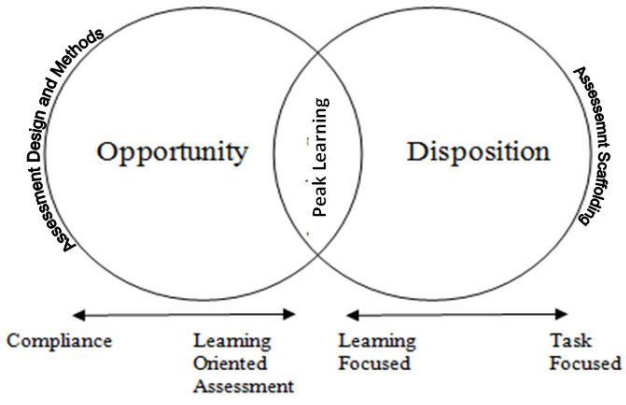

Figure 1: Opportunity and disposition framework

In this model we suggest that learning potential is maximised when an assessment

activity provides a well-designed learning opportunity and students approach the activity with a learning focus. Carless (2007) describes learning-oriented assessment tasks as ones that encourage learning, involve students in the assessment process, and use feedback as feed forward to future assessment tasks. These tasks encourage students to evaluate their learning and identify any gaps and/or areas that need to be addressed.

Through discussions with academics examining their assessment tasks we identified a tendency to include compliance measures to encourage students to engage with these tasks (Willey & Gardner 2012). However, we suggest that designing an activity for the less motivated students serves to over-assess the conscientious ones who told us there was "no time to really learn" the material. While poorer students conceded such measures did force them to at least participate more with such activities, we suggest that often this engagement may only be at a surface level. Some of these compliance measures were also running counter to what Sadler (2010) refers to as "assessment fidelity" i.e. marks should be allocated only to achievement of the subject learning outcomes at the standard expected by the end of the semester. This suggests that instructors should not be allocating marks for e.g. attendance, or effort, or for activities pitched at lower than the achievement level expected at the end of the semester.

We would argue that instructors should focus on developing a good learning opportunity and then design scaffolding aimed at moving students towards approaching the activity with a learning focus. Subsequently we recommend that for all assessment activities (both summative and formative) academics should explain to students (Willey & Gardner 2012):

- why they designed the assessment activity the way they did,
- what students can expect to learn by undertaking the activity,
- how students can evaluate their learning from the activity, and
- how this learning will help them in practical applications relevant to their discipline (e.g. how this will help them view the world like a structural engineer).

Method

For the Autumn 2012 offering of Engineering Mechanics at the University of Technology, Sydney (UTS), out-of-class learning activities were designed for four topics in the syllabus. These activities required the students to read the relevant section of the textbook and subsequently answer multiple-choice questions provided online via SPARK^{PLUS} as shown in Figure 2. This included entering comments to explain why they chose the selected answer. The activities were designed for the start of each topic so that students could assess their level of understanding before the lecture. This design intent, that lecture time should be spent on material that most students 'didn't get' rather than on material that most of them could understand by themselves, was explained to the students at the start of the semester. The diagram in Figure 1 was also explained to students at the start of the semester and throughout the semester each activity was supported by the explicit learning scaffolding outlined above with the intention of shifting students from seeing assessment tasks as vehicles to accumulate marks to recognising them as learning opportunities, and how to make the most of these opportunities.

At the end of each submission period for these online activities the lecturer could view the student answers and comments on summary screens such as the one shown in Figure 3. While there were no marks allocated to these activities, the instructor did allocate more time in lectures to the material related to questions with the largest variation in responses as shown in the histogram (see Figure 3). Students who answered the online questions could log back on at the end of the submission period to compare their responses to the instructor's answers and reasoning, and to all other students' answers and comments for each specific question.

At the end of the semester students were asked to complete a paper-based survey consisting of both closed and open-ended questions to investigate their perceptions of the effects of the online question process. The purpose of the survey was outlined to the students by the lecturer (also an author of this paper). In line with ethical practice students were assured that their participation was completely voluntary, that their responses would have absolutely no bearing on their result in the subject and were particularly asked for honest responses. The students agreed to one of them collecting the surveys and placing them in an envelope which they then sealed. This was opened after the subject results had been published. Descriptive statistics were used to analyse the closed responses to this survey and also to investigate any correlation between participation in these formative assessment tasks and subsequent performance in the final exam in this subject.

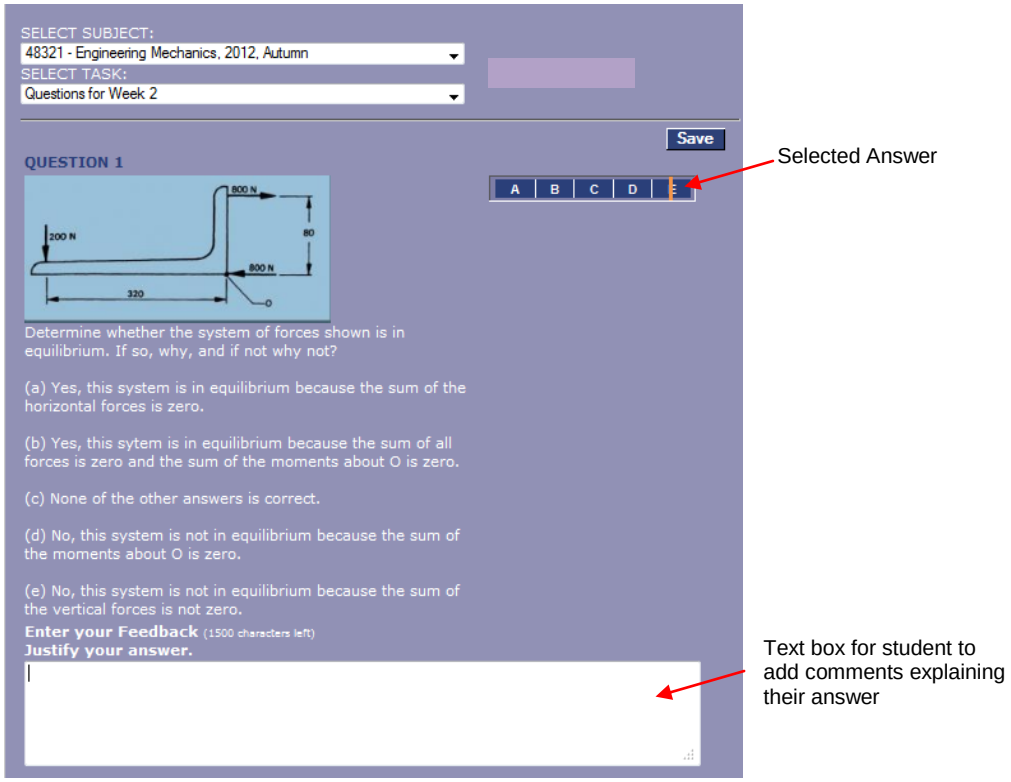

Figure 2: Example question screen in SPARK^{PLUS}.

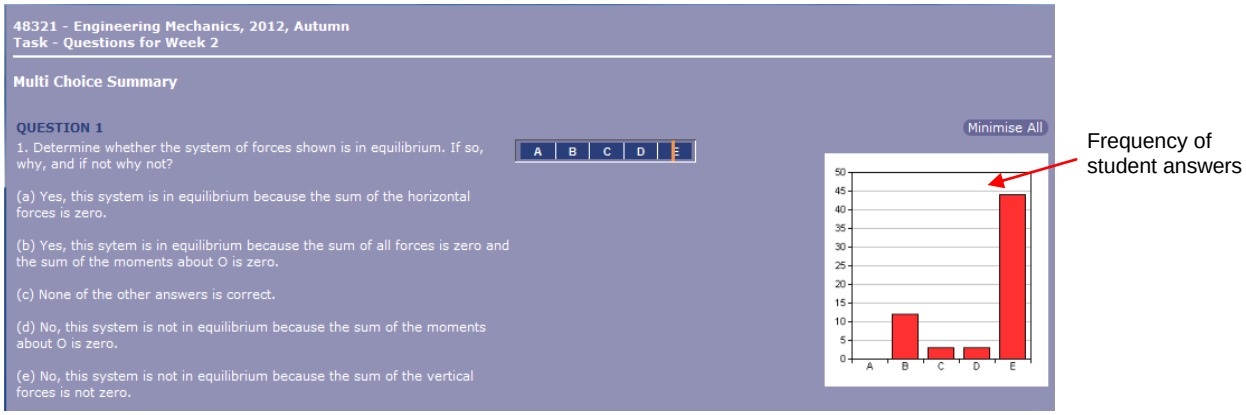

Figure 3: Example result summary screen

Results

Analysis of the participation rate recorded by the software showed that only 3% of students attempted all four of the SPARK^{PLUS} multiple-choice activities: 32% did none at all, 45% did

one, 17% did two, and 6% did three or more. Perhaps not surprisingly, more students attempted the questions just prior to the corresponding summative topic quiz. We also observed that the number of students answering the questions dropped after the mid-semester break which coincided with summative assessment tasks in most of the other subjects in which these students were enrolled.

Table 1 below shows the average final exam marks earned by students versus the number of SPARK^{PLUS} multiple-choice activities they attempted. The results indicate that students who participated in 3 or more activities scored, on average, almost one grade increment higher than those that participated in 0 or 1 activity.

Table 1: Average of final exam marks vs number of SPARK^{PLUS} activities attempted

No. of SPARK^{PLUS} activities attempted	0	1	2	≥ 3
Average final exam mark (%)	50.5	50.5	52.5	63.4

The end-of-semester survey was completed by 24 students from a cohort of 119 which represents a response rate of 20%. While this small sample means we cannot make definitive statements about the survey results, it gives us more information than we had before (i.e. none) and suggests aspects of the process that could be improved. Of these respondents 21% had attempted no online activities, 47% had attempted one, 21% had attempted two, and 11% had attempted three or more.

Table 2 below shows that most students (67%) agreed to varying degrees that the "...SPARK^{PLUS} multiple-choice questions were effective in helping [them] learn the subject material". Students were asked to explain their response. These explanations were categorised in regard to learning benefits, timing, difficulty, and format of resources as discussed in the next section.

Table 2: Survey responses to the question: The SPARK^{PLUS} questions were effective in helping you learn the subject material (n =24)

	% of respondents		% of respondents
Strongly disagree	8	Strongly agree	4
Disagree	13	Agree	25
Slightly disagree	4	Slightly agree	38

Figure 4 shows the percentage of responses to potential reasons for not attempting a SPARK^{PLUS} activity, and whether that was the reason most of the time, sometimes, or never.

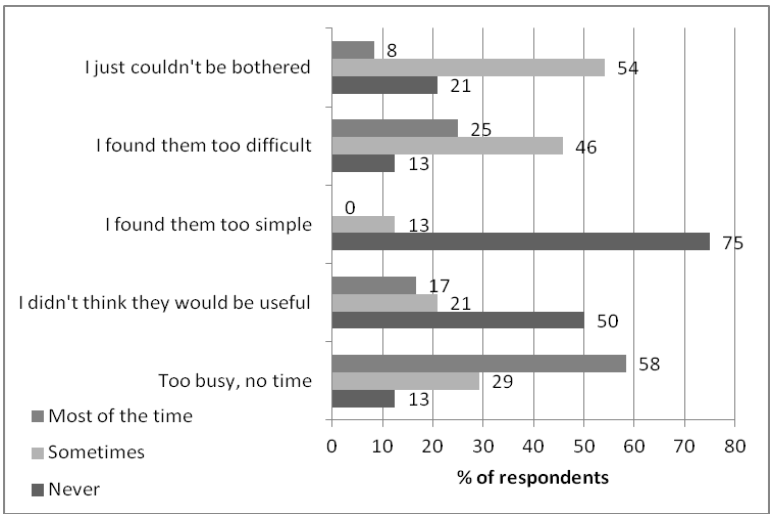

Figure 4: Percentage of responses to the question: If there were any sets of SPARK^{PLUS} questions that you did not attempt, please indicate why (n=24).

Figure 5 indicates the percentage of students responding to the question: If you did not attempt any SPARK^{PLUS} questions at all, which if any of the following would have motivated you to attempt them? Students were also asked to outline anything else that would have motivated them to attempt the SPARK^{PLUS} activity.

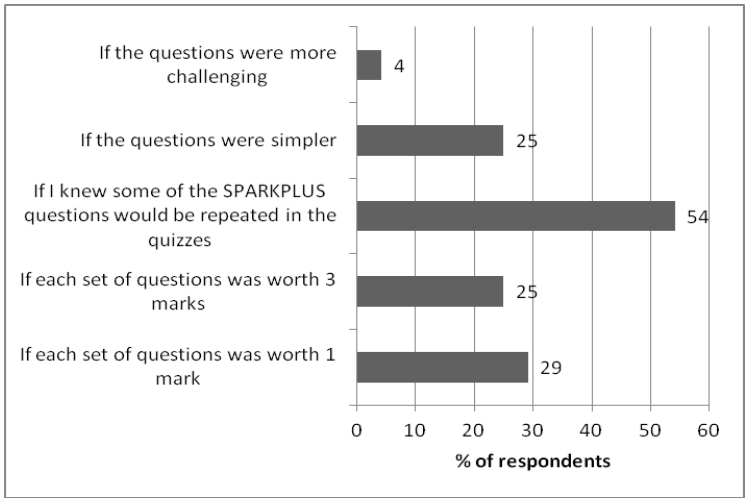

Figure 5: Percentage of responses to "...which if any of the following would have motivated you..."

Further data became available when the institutional student feedback survey (SFS) results were released. Significant increases in these results compared to the previous year (Autumn 2011) as shown in Table 3, indicate an improvement in student perception of the learning experience. Significance was calculated at the 95% confidence level using the t-test.

Table 3: SFS results of Autumn 2011 and Autumn 2012 cohorts

	Autumn 2011 results (n=28, 30% of cohort)		Autumn 2012 results (n=59, 50% of cohort)			
	mean	Standard dev.	mean	Standard dev.	p value	Significant difference?
Q1.The subject was delivered in a way which was consistent with its stated objectives.	3.79	0.88	4.17	0.63	0.0237	Yes
Q2. My learning experiences in this subject were interesting and thought provoking.	3.71	0.81	4.16	0.72	0.0105	Yes
Q3. I found the assessment fair and reasonable.	3.18	1.16	3.84	1.05	0.0097	Yes
Q4. There were appropriate resources available to support the subject.	3.54	1.04	4.04	0.90	0.0238	Yes
Q6. Overall I am satisfied with the quality of this subject.	3.46	1.10	4.10	0.66	0.0011	Yes
Q7. The teacher appears to be well prepared and presents the material in a well organised manner.	3.93	1.00	4.30	0.54	0.0275	Yes
Q9. Overall, I am satisfied with the teaching of this staff member.	3.78	1.05	4.24	0.66	0.0147	Yes

Discussion

Table 1 shows students who attempted 3 or more SPARK^{PLUS} activities earned final exam marks that averaged at 63.4%, while students who attempted 0 or 1 activity earned final exam marks that averaged at 50.5%. This difference is just under one grade increment i.e.

Pass = 50% and Credit = 65%. While students may regard this as a significant correlation we should note that exam results are only an indicator of learning and these results could be because the students who attempted more SPARK^{PLUS} activities were the ones most motivated to learn anyway, so spent more 'time on task' and hence could perform at a higher level in the exam. With this in mind we move to the survey results to give us a fuller picture of the use of the SPARK^{PLUS} activities.

Table 2 shows that most students (67%) agreed to varying degrees that the "...SPARK^{PLUS} questions were effective in helping [them] learn the subject material". Of more interest to us are their comments for why or why not. Where students are quoted the comment is shown with the student's final exam mark as a percentage and the number of SPARK^{PLUS} activities they participated in shown after each comment e.g.[50%,3]. Comments from students who chose not to include any identification on the survey are indicated as [anonymous]. Student comments aligned with the following themes:

- **the online activities were helpful for learning**: "*they were useful for revising and preparing for quizzes...*"[42%,3] "*Before class, I know what is going to learn. After class, I can use them to practice.*"[sic] [82%,1]
- **the timing i.e. that material had not been covered in class yet**: "*they helped, once I've learnt how to do similar questions in class*.."[58%,2] "*I found it too difficult to answer the questions before the content was taught in lectures*..."[65%,1]
- **the difficulty of the questions**: "*they help to put your knowledge in practice but some of them are really hard*."[anonymous]
- **online resources are not helpful for learning**: "*I like to work from books and past tests or exams. I don't really like using computers*."[70%, 0] "...*I prefer more traditional methods*"[71%,1].

Several students commented on the timing and difficulty of the questions. They found answering the questions before the lecture i.e. relying on the textbook alone, was too difficult. Since these are first year students it may be the first time they have been exposed to a different learning paradigm and are hence resistant to change. However if the aim of the whole engineering program is to develop independent learners by the end of the degree then we argue that the best time to start is first year. If we can help first year students think about their learning and influence that thinking then we have the opportunity to impact their learning in every other year of the course. However, consideration will be given to producing a short introductory video on each topic to promote learning and assist students to undertake the other out-of-class activities.

Student comments showed that not all of them understood the design intent of the activities i.e. that they were meant to be attempted before the lecture so that lecture time could be spent on the more difficult material. In light of these comments and those regarding the difficulty of learning from the textbook alone, the lecturer this semester, Spring 2012, has explained to students that the point of reading the text is not to immediately understand everything, but to start to understand the material.

These comments also point to some students using the questions for purposes other than for pre-lecture assessment as designed e.g. "…see how well you remember what you learnt in class"; "after class I use them to practice…"; " …reinforce what I have all ready learnt…"[sic]. If we are encouraging students to be responsible for their learning then that includes allowing them to use resources in ways they find useful, when they want to use them.

Figure 4 indicates that for students who did not attempt at least one SPARK^{PLUS} activity, 'most of the time' this was because they were too busy, but sometimes it was because they simply couldn't be bothered, it was never because they thought they were too simple. Like academics, students have difficulty juggling multiple activities and responsibilities. We realise that not all students are going to participate – our responsibility is not to enforce full

participation, but to design activities that provide valuable learning for those students that do take the time to attempt them.

The most popular response for what would motivate students to attempt more activities was if some of the SPARK^{PLUS} questions were repeated in class quizzes (see Figure 5). This was surprising as this was more than twice as popular as the direct allocation of marks for the activities, yet each question in a class quiz was only worth 0.5 marks toward their final subject mark and hence would contribute less to their final grade than allocating marks directly to these activities. Comments confirmed that some students would have been motivated by marks: “if they counted towards final marks” [76%, 1]; a variation of this was “if they would definitely come up as exam questions” [54%,2]. However, at least for some students giving the SPARK^{PLUS} activities a mark would be a negative change: “I would have reluctantly done them if they were worth marks”; “being forced to do them by giving them a value”. This would also not align with Sadler’s (2010) advice about not allocating marks for difficulty below the standard expected for the threshold learning level for that subject. The SPARK^{PLUS} questions were intended to facilitate learning the material and hence were generally at a lower level of performance than that expected from students by the time they reach the end of the semester. Hence allocating marks to SPARK^{PLUS} questions would be giving marks for achievement at less than the level expected for the subject.

As indicated in Table 3 there was a significant increase in the ratings in Autumn 2012 compared to Autumn 2011 for those questions in the institutional student feedback survey that we judge to be potentially affected by the online formative activities. The greatest improvement was with Questions 3 and 6 which relate to the assessment being fair and reasonable and overall satisfaction with the quality of the subject. To test if this may have been because the standard of summative assessment tasks in 2012 was lower than in 2011 we compared final subject marks for the Autumn 2011 and Autumn 2012 cohorts as shown in Table 4. This shows the percentage of students in each semester earning each grade. The use of the t-test at the 95% confidence level again, showed that there was no significant difference in the number of Z, P, C, and D grades awarded – note we could not compare the number of HD grades because there were less than 5 awarded. This indicates that the summative assessment tasks in Autumn 2012 were not ‘easier’ than in Autumn 2011 and hence this is not the reason behind the increase in the student feedback survey results.

Table 4: Comparison of final subject results for Autumn 2011 and 2012.

	Autumn 2011	Autumn 2012	p-value	significant?
Z (fail, <50%)	36%	28%	0.2066	no
P (pass, 50% - 64%)	33%	41%	0.1991	no
C (credit, 65% - 74%)	20%	22%	0.7414	no
D (distinction, 75% - 84%)	8%	8%	0.996	no
HD (high distinction, >84%)	3%	1%		

The institutional student feedback survey results and the grade comparison between Autumn 2011 and Autumn 2012 show that there was a different perception of the subject even though it had a similar level of difficulty. This lecturer did not teach the subject in Spring 2011. Autumn 2011 was the first time the subject was offered with the current syllabus and we acknowledge that this may have contributed to the lower ratings for that semester. We should also note that students completing the standard program enrol in this subject in the Spring semester which means that the Autumn cohort is a mixture of students repeating the subject, and students who entered the university in the mid-year intake, often via non-standard pathways. However, adding this data to the student marks and the other survey results creates a stronger indication that having the opportunity to participate in formative learning activities and providing scaffolding around these activities improves the student learning experience. The increase in the proportion of students completing the student

feedback survey in Autumn 2012 also suggests there was more student engagement in the subject in 2012, this is reinforced when we note that the feedback survey is completed online. These results prompt us to question whether it was simply providing the formative activities or whether it was the scaffolding of activities that improved the student learning experience. The aim of the scaffolding was for students to see their learning differently i.e. to change their learning goal.

Formative assessment tasks reinforce a learning goal orientation since "...instructors who accept mistakes as part of learning are making it possible for students to adopt learning goals" (Svinicki, 2004, p. 166). Learning goal orientation recognises the different motivations students have for learning. 'Mastery' orientation students usually employ deep learning strategies and are motivated to develop competence i.e. become masters of the material. Performance orientation is more about being seen to be a student who gets high marks and these students will use surface learning techniques if these are effective or deep learning methods if that is what's necessary to get high marks. This semester (Spring 2012) we have administered a pre-test learning goal orientation inventory (Elliot & Church, 1997, Elliot, 2001) at the very start of the first lecture and plan to administer the same inventory at the end of the semester to assess any impact on the learning goal orientation of the students. Klein, Noe and Wang (2006) report that learning goal orientation can be domain-specific so we speculate that the pre and post tests will indicate whether the scaffolding of the subject's learning activities has been able to influence the students' learning goal orientation over the course of the semester as suggested by the change in student feedback survey results.

Conclusions

Students who participated in formative assessment activities in this subject benefitted in terms of their learning which was demonstrated in the final summative assessment task. These results and what we learnt about students' motivation to participate will be used in future semesters to demonstrate to students the link between participating in the formative activities and scoring well in the summative tasks. We argue that making this link explicit and scaffolding learning activities are the key elements in motivating students to learn.

We recommend that all assessment activities include scaffolding directed at promoting a culture of learning in students. This scaffolding would involve instructors explaining to their students why they designed their assessment activity the way they did, what learning opportunities the activity provides to students, how students can evaluate their learning from the activity and how it will potentially change the way they view the world.

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