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STUDENT ENGINEERS: LECTURING, TEACHING AND ASSESSING

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Abstract — *A traditional lecture tends to operate in only one or two quadrants of Kolb's learning circle and promotes strategic and, at worse, surface learning. Software engineering is an important subject for computing engineering students. It is imperative they establish a deep understanding of the subject to ensure best working practices. Supplemental instruction, teaching others a subject, often promotes a high level of learning. The paper demonstrates the results of such an exercise by groups of students lecturing on a component of the software engineering course. Both peer and self-assessment was used to measure individual performances, efforts and impact. The paper reports on student reactions to this assessment and offers a strategy for the informed practice and development of peer assessment and some guidelines on how to assist students to develop and present a lecture.*

INTRODUCTION

Supplementary Teaching

Software engineering is an important subject for computing engineering students. It is imperative that they establish a deep understanding of the subject and its practice in order to maintain best practices in researching, designing and implementing software to produce a reliable, good quality product that fully meets user requirements. Quality is central to the software industry as demonstrated by the commitment to, for instance, ISO2000 and Tick IT accreditation and, more importantly, what customers and users are demanding of the software industry and its products.

It is accepted [1] that the traditional approach of chalk and talk offers limited potential for learning and only benefits a few students. This is because lectures typically operate in just one or two quadrants of the Kolb experiential learning cycle [2], offering students a theoretical and practical framework but rarely allowing time for reflective observation or active experimentation. The emphasis is on “covering” the material rather than allowing students an opportunity to “uncover” it for themselves [2]. As a result, a traditional lecture leads learners into surface learning mode because they are offered no opportunities to inquire around a subject and, thus, move into deep learning mode [1]. Essentially, a traditional lecture can be likened to a cannon

randomly firing ping pong balls at a small audience in a very large room: only a handful of balls make contact with the target. Best practice would be to employ a range of interactive strategies, including case studies, examples and question and answer sessions, within the framework of a traditional lecture to facilitate student movement through all four quadrants of Kolb's learning cycle, [2]. Nevertheless, such lectures may still be weak in the sense that they may promote strategic or achievement focused learning rather than deep or independent learning. Typically, the emphasis for strategic learners is on learning what they need to know to achieve a high grade [3] rather than seeking either real understanding or meaning. In addition, there may still be a perception amongst some students that the academic is the fountain of all knowledge, thus discouraging them from seeking information from other sources. Reference [4] suggested that this perception is fostered by academics despite heavy workloads. This may be because of a concern that offering students greater opportunities to learn outside the classroom might make them redundant or that developing such modes of learning may further add to the pressures of an already demanding and increasing workload. In reality, however, innovation not only provides light relief but also actively promotes the learning goals of our higher educational establishment. These are listed in the SHU Student Handbook [5] and include a commitment to:

- help students to develop intellectual, professional and practical skills to their maximum potential, through vocationally relevant study developed in partnership with industry, commerce, the arts and professions
- quality of work, ensured through a rigorous system of course monitoring.
- student centred learning, development of personal skills and qualities, together with course flexibility, in order to provide high quality learning
- student responsibility for their own learning, which the University will facilitate, and participation in the learning opportunities provided
- University and the student have obligations in the Partnership in Learning.

In essence, we seek to promote:

- independent student learning,
- lifelong learning
- quantifiable and quality learning

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Despite its limitations, the traditional lecture is an established means of measuring quantifiable and quality learning, both in terms of delivery by the academic and student receivership. Therefore, further predisposing some academics against innovation. Further, any innovation needs to be determinable for QAA purposes. Under current regulations and QAA procedures, for instance, Powell's 1962 [4] classroom experiment, which allowed students to define course content, structure and assessment, could not take place. It would not meet SHU QAA procedures, including the need for unit description, although the concept of students teaching part of the course, within an organised framework would be possible.

Ideally, any innovation should incorporate some sort of assessment process as assessment is recognised as a primary factor motivating student learning [6]. In addition, any assessment process should not overburden the academic in terms of marking. Reference [7] calculated that in 2000 approximately 100,000 essays and reports would be written and marked at University Technology, Sydney. Additionally, sticking to tried and tested methods of assessment, e.g. essays, is also restrictive in terms of limiting student access to different methods of learning and the development of a full range of key skills.

Some learning theorists [8] have suggested that supplemental instruction, that is, teaching others a subject, helps promote higher levels of learning than other modes of learning. In order to test this, groups of students were set the task of developing and presenting a lecture on one component of the software engineering course module. This paper will present the results of this exercise and, importantly, the reactions of students to their experience as supplemental instructors.

As the assessment was a group task and an academic cannot be present 24-7 to observe group dynamics and individual contributions to the assessment task, it was, therefore, appropriate to adopt peer and self assessment to measure the impact of individual contributions and the use of key skills within the group.

Peer Assessment

Research has shown that students find the peer assessment process stressful and that they question its appropriateness [9]. This can inhibit learning, although, in reality all of us apply peer assessment everyday whether in the playground or at work – choosing sides for a childhood game or taking part in QAA processes, for example.

From the students' point of view, however, one of the advantages of peer assessment is that the introduction of an increased number of assessors increases the reliability of the assessment process [10]. On the other hand, some sources [9] and [11] suggest that racial prejudice, personality clashes and personal loyalties may distort the results. However recognised racial prejudice as a particular problem, but suggested that bias due to personal loyalties was not

supported by recent evidence [12]. Personal experience in the second semester suggests otherwise – there was an incident where both racial prejudice and personal loyalties affected the distribution of peer assessed marks.

Nevertheless, [9] suggested that peer assessment provided valued peer feedback. In practice, such feedback tends to be incomplete and somewhat negatively biased. Reference [11] also found that student feedback focused on the negative rather than the positive attributes of the assessed work whilst [13] found that in summative assessments students often failed to adhere to the detailed assessment criteria provided.

Finally, students may perceive peer assessment as a tool for reducing the marking workload of academics, thus making their lives easier. True, the marking workload is reduced but [14] reported that, freed from a pre-occupation with marking, academics were able to take on a more supportive tutorial role.

PEER ASSESSMENT AND LEARNING

Traditional methods of assessment, such as examinations, promote a linear model of learning. Two distinct processes are involved (learning and assessment) and these are carried out by two distinct groups of people (learners and lecturers).

An essay, on the other hand, promotes a simple cyclical model of learning. (See figure one) In this case:

- three distinct but related processes are involved (learning, assessment, feedback)
- carried out by two distinct groups of people
- groups of people

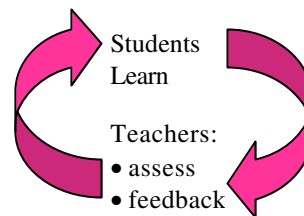


FIGURE. 1
SIMPLE CYCLICAL MODEL

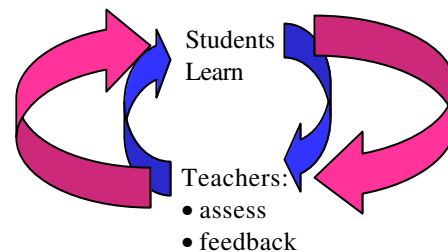


FIGURE. 2
COMPLEX CYCLICAL MODEL

Peer assessment, however, promotes a more complex cyclical model of learning involving:

- three interrelated processes (learning, assessment, feedback)
- carried out by one group of people (students) with multiple roles

Peer assessment is particularly effective at promoting reflective practice, an important element in Kolb's theory of experiential learning. A peer assessed group presentation, for example, involves the assessment of group working skills and dynamics promoting:

- concrete experience - group work member
- reflective observation - peer assessment process

GROUP TASK

The first semester the exercise was applied to 2nd Year IENG (BEng and HND) students. The students were split into groups of between three and five members and each was assigned an area of software design to research in sufficient depth to enable them to deliver a lecture to the entire cohort. The students were to lecture for the first hour of two hour session, the academic remaining continuing with the subject filling in any gaps or re-explaining areas that were not understood. The time scale of the lecture timetable correlated to the scale of difficulty of the subject matter. For example, students researching and lecturing on Jackson Structured Programming Design had six weeks notice as opposed to those teaching Structured Programming who had just three weeks preparation.

In the second semester the exercise was applied to 1st year BSc Networking Engineering Students. The class size was larger, therefore, students were asked to arrange themselves in groups of seven and eight members. Each group was assigned a programming language to research with a view to delivering a lecture that provided an introduction to the language and a justification as to when to use this programming language. The students were required to lecture for ¾ hour of an hour lecture session, answering questions for reminding ¼ hour fielded from academic and student audience. Again, the timescale of notice correlated with the level of difficulty of the subject matter.

In both case studies of supplementary teaching with peer assessment, the subject matter was an important issue with respect to software engineering.

The second year student groups were pre-selected because the class contained a large proportion of students studying for an HND and it was important to ensure an even distribution of abilities. The first year students were allowed to select their own groups in the hope that this would minimise personality clashes.

RESULTS

After the sessions each student was awarded an individual assessment mark that incorporated the group's mark for the lecture and lecture notes, terms of contents and presentation,

level of learning, plus a mark reflecting individual contribution, effort and impact on the group.

The formula used to calculate an individual mark for the 2nd year students from the peer and self assessment results and group result was as follows;

$$I = G * (PS / MaxPS)$$

where

I is individual mark

G is group mark for the assessment both lecture and lecture notes

PS is an individual total peer and self assessment mark

Max PS is the maximum achievable peer and self assessment mark

The PS/MaxPS value was typically 1 to 0.9.

The class average mark was 46%, both the moderator and I agreed that this was a true reflection of the quality and ability of the class during this assessment. After each lecture level of input required by the academic varied each week, but each week there were areas that needed to be re-explained and gaps in the information communicated. The contribution of this assessment to a student's overall unit mark is low, that is 20%, the students perceived it warranted less effort and hence the class average mark is a true reflection of this perception by the majority in the class. Feedback from the students on this matter was that:

"20% was not enough marks! Should have been at least 30%"

In the light of comments made in semester one by 2nd year students the assessment weighting was revised to 25% for the first year course where course work has a 60% loading. The assessment formula had to be revised for the first year students as the original proved flawed with individuals typically achieving (PS/MaxPS) of 0.7. With a group mark of 70% a typical individual was achieving 49% - a mark that did not truly reflect the weight of assignment. A scaling factor could have been applied but, after discussions with the moderator, it was clear that some individuals had contributed more than others and that a formula was required to recognise and reward this effort. revised formula was:

$$I = G * (1 - ((AvePS - PS) / MaxPS))$$

where

AvePS is the average individual total peer and self assessment mark

There was also some difficulty concerning an incident with one group where the distribution of peer marks was governed by racial prejudice and personal loyalties. The group consisted of four white males and four Asian males: one student awarded all those in his opposite ethnic group a mark of 7 and gave a maximum mark of 26 to his friends. The former students were typically averaging approximately 20 from all other members of the peer group. Therefore, I agreed with the moderator that it was appropriate to exclude all this individual's peer marks as they were not a true

reflection of each member’s effort, contribution or key skills within the group.

A further difficulty involved inconsistent marking on the part of one peer group where each individual within the group failed one other group member – but each failed a different individual. However, since the group had not correctly applied the peer assessment criteria, and had been subject to a number of personality clashes, individual interviews were held with each group member to ascertain a true picture of the group dynamics and to assess the impact of individual contributions. The PS mark was revised accordingly.

Observation of the groups from semester one and two suggest that those who had longer to prepare their lecture i.e. six weeks instead of three suffered more personality clashes. One could argue that the groups with less time were more focused on the task and had less time to fall out with one another.

The quality and quantity of work produced by the first years was very good. They demonstrated a clear ability to research the subject, made good efforts to explain it and proved very adept at answering questions. The level of learning was greater than for the second year lectures – the class mean mark was 61 and a standard deviation of seven reflects the quality of the lectures.

REFLECTION IN PRACTICE

Supplementary Teaching

TABLE I
2ND YEAR STUDENT’S REFLECTION ONTEACHING

QUESTION	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	DON'T KNOW	MAYBE	CAN BE
Did it empower you?	1	7			1		
Did it give you a sense of being in charge of your learning?	1	3	4		1		
Did you find it stressful?		3	6				
Did you learn from the experience?	1	7	1				
Did you learn more than if you had a lecture on the material?	1	5	1		2		
Do you feel students should deliver part of the course content?		3	2	1	3		
Do you feel the academic should continue the theme after the student’s presentation?	2	6	1				
Would you prefer to choose the topic of the lecture?	1	3	2	1	2		

The reflections of second year students are illustrated in Table 1. The feedback response rate was 82% of those who participated in the supplementary teaching exercise.

To quote the feedback from degree course review:

“This unit is generally very well liked. Students complimented lecturer for her innovative teaching style, which involves students researching a subject and then presenting the lecture to themselves.” [15]

The students enjoyed this assessment and learnt from it. Certainly this form of assessment should be used again in this unit.

The reflections of first year students are illustrated in Table 2. The feedback response rate was 50% of those who participated in the supplementary teaching exercise.

TABLE 2
1ST YEAR STUDENT’S REFLECTION ONTEACHING

QUESTION	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	DON'T KNOW	MAYBE	CAN BE
Did it empower you?	3	5	2			1	
Did it give you a sense of being in charge of your learning?	1	2	2	2	2	2	
Did you find it stressful?		4	2	5			
Did you learn from the experience?		2	1	2	2	4	
Did you learn more than if you had a lecture on the material?	3	4	1		2		
Do you feel students should deliver part of the course content?		2	4	3		2	
Do you feel the academic should continue the theme after the student’s presentation?		2	2	3	1	3	
Would you prefer to choose the topic of the lecture?		5	2	2	1	1	

The assessment results for the first year contradict some of the feedback from the students. They say they are unsure if they learnt from the experience although they acknowledge that they learnt more from the experience than they would have done from a traditional lecture. There are a number of reasons for this mixed response. One, personality clashes within groups made the exercise more stressful than necessary. Two, the size of the groups – many students felt that smaller groups of, perhaps, four or five people, would have been more manageable. Three, the immaturity of some students meant they had difficulty working with individuals with whom they clashed and failed to see the assessment as an exercise in independent learning. Further, in discussion with some individuals there was a clear impression that an academic was the fountain of all knowledge and would provide students with everything they need to complete a unit successfully. They had not heard of the concept of “reading” a degree, nor understood that this meant students should read around a subject to supplement a lecture course or, alternatively, considered the idea that a lecture course supplemented a student’s independent reading.

Peer Review

TABLE 3
2ND YEAR STUDENT’S REFLECTION ON THE PEER ASSESSMENT

QUESTION	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	DON'T KNOW	MAYBE	CAN BE
In general, can Students assess fairly?	8						1
Did it empower you?	2	5	1	1			
Was this a fair method of assessing each member's performance in a group?	7	1					1
Will the final mark of the assignment be a fair reflection each individual contribution?	4	2		1	2		
Is the formula of weighting peer results with academic mark fair way to derive each individual mark?	1	4	1		2	1	
Was peer assessment stressful?	2		3	4			
Was peer assessment helpful for this assignment?	4	2			2	1	
Would you like to do it again to measure individual contributions in other group-work assignments?	1	5		1		2	
Did the assessment guide assist in evaluating your peer's performance to the group assignment?	7				1	1	
Did the assessment guide enable you to reflect whether you were an effective member of the group?	7						2

Second year Student’s reflections is illustrated in Table 3. The feedback response rate was 82% of those who participated in the exercise of supplementary teaching.

Previous research suggests that students often find peer assessment stressful. However, these second year students don't conform to this norm since they found the exercise empowering rather than stressful. They certainly perceived it is an effective and fair method of measuring performance and generally would not be put off from doing it again.

First year Student’s reflections is illustrated in Table 4. The feedback response rate was 50% of those who participated in the exercise of supplementary teaching.

These results indicate that first year students did find this a stressful experience, and don't perceive it as a fair and effective means of measuring performance. However, they agreed with the second year students that it supported the theory that peer assessment promoted learning through reflective practice. A clear simple assessment criteria guide assisted them to learn and evaluate performance.

Some first year student comments:

“More information given on how we are going to assess.”

“Fair grades can only come from lectures”

“Obviously the grading system was not explained as we had to be re-assessed. This was to the best of my knowledge due to some people not assessing, but just ticking in columns.”

“The formula used allows for a person to get a better mark than the group”

TABLE 4
1ST YEAR STUDENT’S REFLECTION ON THE PEER ASSESSMENT

QUESTION	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE	DON'T KNOW	MAYBE	CAN BE
In general, can Students assess fairly?	3	5	2				1
Did it empower you?	1	2	2	2	2		2
Was this a fair method of assessing each member's performance in a group?		4	2	5			
Will the final mark of the assignment be a fair reflection each individual contribution?	2	1	2	2	4		
Is the formula of weighting peer results with academic mark fair way to derive each individual mark?	1	1		3	2	1	
Was peer assessment stressful?	3	4	1		2		
Was peer assessment helpful for this assignment?		2	4	3		2	
Would you like to do it again to measure individual contributions in other group-work assignments?		2	2	3	1	3	
Did the assessment guide assist in evaluating your peer's performance to the group assignment?		5	2	2	1	1	
Did the assessment guide enable you to reflect whether you were an effective member of the group?	2	4	1	3		1	

There is a need to explain more clearly to the students the process of peer assessment and how the marking strategy should be applied. The feedback from students indicates that a marginal majority strongly disagreed with the use of a formula that allowed individuals to gain a better mark than the rest of the group. In some respects, this reaction may be due to a lack of consultation with students about the change in the marking formula. Later in the semester, with a different set of second year students and a different group assessment, I explained the formulas and gave them a choice about which should be applied – they were happy to use the rectified formula that allowed the possibility of rewarding more hard-working individuals.

Observations of the groups suggest that some of the problems encountered with the first year group may be related to their lack of maturity.

CONCLUSION

Supplementary Teaching

This exercise promotes high levels of learning and offers an opportunity for students to develop different learning and key skills. The role of the academic during this assessment is to be that of facilitator as opposed to teacher, to question their perceptions and provide guidance

where necessary. Ideally, groups of students should have no more than five members and need careful planning in order to reduce personality clashes. There is also a need on the part of the academic to monitor groups for personality clashes and to intervene where necessary. One way to prevent problems is to remind students at the beginning of the assessment task that in the commercial sector they will also be expected to work in teams and that it is unlikely they will get on with everyone. They need to appreciate that they need to get the job done. This means they will have to put aside their personal differences and be professional and co-operative.

Peer Assessment

Our strategy for best practice for any summative assessment:

- Moderate grades, [9] highlighted the need for moderation to resolve the issues of equal marks and provide objectivity.
- Use a guide or weighting factor in conjunction with the academic's mark [9].
- Ask students to provide either verbal or written justification for the allocation of marks [9].
- Promote anonymous marking or marking under exam conditions, thus reducing the threat of undue influence by others. This allows the peer assessment to be a true reflection of the impact, contribution and effort of each individual within the group [9].
- Carefully plan groups to be homogenous, [12] in order to minimise personality clashes, racial prejudice and friendship bias.
- Ensure that assessment criteria are carefully planned and implemented. Keep the assessment criteria simple and check that all the students interpret it in the same way. If flaws arise, reflect on the assessment and revise it [14].
- Staff to take on supportive and tutor role. Reference [14] found staff were more available to support students and answer questions, than if preoccupied with marking.
- Remind students that peer assessment is a part of every day life.
- Highlight the advantages and benefits of being involved in peer assessment, e.g. academics cannot be there 24-7, and a higher level of learning can be achieved by reflecting on one's own performance and that of others.

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