**Promoting Learner Autonomy and Creative Engagement in First Year Engineering Students through Media**

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**Abstract**

This project builds on the premise that first year undergraduate students enter higher education with a high motivation to learn and to adapt to new ways of learning that differ from their previous learning experiences (Fazey and Fazey, 2001; Yorke and Longden, 2008). The central idea was then to give engineering students a challenge that would allow them to engage creatively with an 'authentic' learning task that would encourage them to develop a greater degree of learner autonomy. Ultimately, this positive engagement was seen as key to creating greater level of enthusiasm among first-year engineering students for their chosen degree course. Moreover, while learner autonomy and creativity characterise an ideal engineering graduate, it was felt that these qualities are typically less emphasised in engineering education itself, and this project also sought to address this obvious shortcoming.

This case study therefore presents the learning, teaching and assessment methods used in a first year engineering undergraduate module, with a view of tapping into what are perceived as first-year students' intrinsic aptitudes and motivations to learn actively and creatively. The aim was also to encourage students to take responsibility for their own learning processes, improve their confidence as new learners in Higher Education and so to improve module pass rates, and ultimately, student retention. In this case, video and media production were introduced in the module to allow engineering undergraduates to take a non-traditional approach to learning.

**Background and Rationale**

The module (‘Materials, Manufacturing and Environmental Engineering’) that the project focused on, had previously been taught over two semesters through a very traditional method which consisted of series of keynote lectures, followed by seminars and practical laboratory classes. Level 4 (first year) students enrolled on the BSc Automotive Technology and BSc Engineering Design and Innovation degree courses are required to take this module as part of their degree.

While some problem-based learning through case study exercises had been undertaken by previous cohorts of student during Semester 2, attendance rates were low and the first-time pass rates remained at a less than satisfactory level of 75%. Moreover, the exercises appeared not to develop learner autonomy in first-year students, even when this was identified as one of the key learning outcomes of the course. This appeared to be due to the fact that the exercises were technically prescriptive and very much tutor-led, and allowed students very little control over the learning task itself, or the way the task was completed.

It was therefore decided that a new approach that would encourage students to take the initiative and lead in exploring an engineering problem, in a hope increasing levels of motivation and learner autonomy. Drawing from the definitions developed by the Centre for Excellence in Teaching and Learning (Promoting Learner Autonomy) at Sheffield Hallam University, the characteristics of an autonomous learner were conceptualised as:

* Critical thinking skills
* Self-awareness and self efficacy
* Taking responsibility for one's own learning
* Confidence
* Working creatively in complex situations (CETL bid, 2004)

To develop these qualities in first-year undergraduates, the module organisers decided that the course should be, to a significant extent, learner-led so that the students would have a real opportunity develop the above qualities as learners (see Peters, 2004). One way of allowing this development to take place, was to allow students to learn through processes of social interaction while working in groups. The module leaders also wanted to capitalise on student's existing skills and competencies in using information technologies, which students now often 'take for granted and integrate them seamlessly into their daily lives' (Caruso and Salaway, 2007). In particular, as students in mainstream education are becoming increasingly knowledgeable and proficient in creating and up-loading digital media[[1]](#footnote-1), it was felt that these resources are bringing about new opportunities in the way teaching and learning is delivered and managed in higher education. Finally, the module leaders wanted to make the most of the fact that most first-year students are generally positive about their first year at university (Yorke and Longden, 2008) and are equally willing to adapt to new learning styles at this stage than during the preceding years when their ideas of what higher education is like is already formed (Fazey and Fazey, 2001).

The main aim was therefore to enhance student retention through improving student motivation and engagement, as well as fostering creativity and confidence in first-year engineering students through enquiry and authentic learning. To this end, students were asked to produce a digital media presentation on an engineering-based issue. The rationale behind asking engineering students to engage with visual and digital media was to offer them a creative opportunity to move beyond their 'comfort zone' through giving them a challenge that did not necessarily directly relate to their chosen topic of study. However, the idea was not to turn engineering students into media students, but to give them a task that required a considerable amount of background research and creative thinking in order to produce a video clip that was grounded on solid subject specific knowledge and understanding, but simultaneously presented in an 'easily-digestible' format.

This was a considerable challenge for students who had typically just less than a year before finished their 'A'-levels exams and felt confident about studying independently to pass an exam, set in a familiar format. For many, the prospect of learning to work collaboratively (and yet autonomously in that there was no familiar exam format for them to study for) was a challenge. They were therefore required to 'think outside the box' in that while the subject topic was directly relevant to their degree course, none of the students had previously had an opportunity to approach and showcase an engineering-related learning task in this way.

As well as developing skills in media production, this was also presented as an opportunity for students to develop other key employability skills, such as presentation techniques, project management and communication skills whilst working collaboratively and effectively in groups.

## Teaching Practice

The first semester of the two-semester module was taught in more 'traditional' way in that teaching consisted of lectures and seminars, which gave students grounding in the study of engineering. The new learning and teaching approach took place in the second semester over a period of twelve teaching weeks. The main difference was that students were asked to be more autonomous and self-directed in their learning. The cohort was divided into two groups, which in turn were divided into smaller groups of no more than five students. The small groups were expected to work on their projects independently and in collaboration with their group members. The two tutors involved in teaching this module met with the groups every two or three weeks, where the students could discuss their progress and raise any issues that they might have with regards to their project.

There were two types of project work that the students were asked to choose from:

*Video presentation*: One half of the first year group of students was required to produce short video clips (of less than two minutes) related to the theme of ‘Materials, Manufacturing or Environmental Processes’. This involved filming in the laboratories to capture some actual materials engineering processes. These students were then introduced to basic digital media skills through a series of lectures on video and media production, such as camera skills, the 'grammar' of television, interview techniques and editing skills. The resultant clip (or asset) was embedded within a PowerPoint presentation, and located within the Blackboard Virtual Learning Environment (VLE) for other students to view.

 *Students making video clips*

*Brief*: The second half of the student cohort covered the theme of ‘Engineering Disaster Management’. As part of their task, during the first two weeks of the semester the students were required to develop a half page ‘brief’ related to an engineering disaster that had happened anywhere in the world, on real-life topics such as 'Why did the Twin Towers collapse after impact?' Or 'The NASA shuttle disaster'. The brief was developed during the first two weeks of the semester. This brief had to:

* give the background to the disaster and where it fits within the context of materials and/or manufacturing and/or environmental engineering;
* define the project/problem, provide details of the outcomes/solutions (particularly in relation to future prevention); and
* present a work programme or project plan to include how they would find information, the type of information, responsibilities and team roles for the different aspects of the project.

The final piece of work also involved students having to download pre-edited video clips from the internet to use as visual aids in their presentation.

Both groups of students presented their projects at the end of module ‘Student Conference’. An external speaker was invited from industry to deliver the keynote on 'Engineering Disasters'. This added a level of formality and allowed students to get a feel for a ’real-world’ conference event.



*Students presenting at the end of module conference*

*Support*

Because the students were not used to this type of assessment, it was deemed essential that they would be well supported throughout the semester. The students were supported and prepared for the project work in a number of ways. A series of seminars on video and media production skills was provided during semester 1 and then again in semester 2. Scheduled drop-in sessions were also provided, where students could raise and discuss any relevant issues with the tutors.

In order to allow the groups to build on each group member's strengths, students were also introduced to the Belbin's description of roles within an effective team (2003) at the beginning of the semester and before embarking on researching for their assignment. Students then undertook a self-perception analysis of their Belbin team role and were encouraged to reflect upon this analysis in assigning roles within the group.

**Assessment**

The assessment for the module involved:

* Student conference presentations (25%)
* A time-constrained, multi-choice test based on the research findings presented at the student conference (50%)
* Report (25%)

The end of module ‘student conference’ was held during the latter part of semester 2, but early enough to be able to have the in-class test a few weeks afterwards. To ensure that the students engaged with their peers presentations, questions based on the knowledge disseminated at the conference were included in the test.

Students were assessed on their presentations and marked by a panel of staff and external specialists working in the engineering industry. Students were asked to submit copies of the presentations prior to the conference, which allowed the tutors to produce a conference programme. This again added to the gravitas of the event itself.

Only the presentations were marked as no group reports were required. This reduced the staff assessment burden and allowed for a fast turn around of feedback to the students as well.

The students were also invited to reflect on the skills they had gained through the process and include these in their Personal Development Portfolios (PDPs), although this was not part of the formal assessment.

# Module Evaluation

The evaluation focused both on the students' views on the module, as well as on the extent to which the students' felt that this course had enhanced their autonomy as learners. At the beginning of Semester 2, a questionnaire was distributed to students to find out about their perceptions of learner autonomy, their existing learning styles and expectations, as well as on the extent to which they felt they were confident in their vocational skills. The questionnaire has a good response rate at approximately 70% (28 out of 40 students). Additionally, a number of focus groups were carried out at the end of the module to further explore student views on the assignments in order to identify the benefits (and possible challenges) of this type of learning and teaching methodology.

*Initial Questionnaire on Learner Autonomy and Learning Styles*

Perhaps unsurprisingly, more than half of the students who responded to the questionnaire had no idea what the term ‘autonomous learning’ might refer to (students were not given a definition but were invited to give their own views on what the term might refer to). The remainder thought it meant either ‘to take control of one’s own learning’ (7 responses), ‘independent or self learning’ (4 responses) and ‘planning my own studies’ (3 responses). The fact that most equated autonomous learning with independent study was reflected in their responses whereby majority of students felt that they were 'autonomous learners' already, and that although group work was considered beneficial, they felt that the best way to develop learner autonomy was through independent study.

Other findings showed that students were very strongly assessment driven, and would only research and gather information when undertaking an assignment. In addition, most students expected clear guidance from their tutors and lecturers with regards to learning tasks and relevant sources of information.

With regards to which vocations skills they thought most important for a qualified engineer were problem-solving skills, ability to work in a multidisciplinary environment, ability to organise workloads effectively in order to meet deadlines. Not surprisingly, the students also rated IT skills important, but felt that they were already competent in using IT.

*Focus group findings (after the student conference)*

A focus group was organised to find out the extent to which the students had found the assignment and the experience of presenting at the student conference helpful or challenging.

The day itself was a great success and students commented on how much they had learnt from their engagement on the project. They particularly enjoyed the fact that presenting at a simulated technical conference in front of their peers and keynote speakers from the industry allowed them to practice for the 'real world of work'. They also felt much more confident and motivated about tacking engineering related problems in the future, and felt more employable as a result:

*“Presenting information and ideas to an audience helps with employers."*

*“[Working like this] gave me skills to apply in any situation in the future.”*

*“Doing this has boosted my confidence."*

Presenting at a simulated conference also enhanced students' motivation and confidence, and also gave them the impetus to make the most of the strengths that can be capitalised when working effectively as a team:

*“We [as a group] also benefited from….the experience of doing something like this [student conference. It’s the first time I’ve done something like this."*

*“Working as a group is the best option as you get to know who they are and how other people work, what are their strengths plus their weaknesses.”*

Finally, the students felt that the active and autonomous nature of this assignment was a motivational factor, and allowed them to learn more effectively as a result:

*“Going away and looking for the information for ourselves was quite good, rather than being spoon fed."*

*"I’ve found out much more about manufacturing and materials and how engineering disasters are investigated […] my presentation skills have definitely improved as well.”*

The challenges the students typically faced during the process included:

* Technical issues (getting to grips with the audio-visual technology)
* Engagement with other member in their groups (difficulties in encouraging some of their fellow students to attend)
* Fear of the 'unknown' (the open-ended nature of the new case study work; undertaking a student-led activity, rather than tutor-led)
* Time management (balancing the time spent on this type of project compared to other assessments as most spent more on the project time than originally envisaged)
* Discipline-specific issues (the need to quickly gain understanding of the deeper technical concepts that underpinned their case studies)

Conversely, tangible benefits of this learning process included:

* Increased student motivation which lead to much deeper learning
* Employability skills gained through this way of working were directly linked to students' Personal Development Plans (PDPs)
* Increased confidence
* Enhanced skills in effective team working and project management
* Course marks improved
* Working with multimedia promoted digital fluency
* Students felt much more autonomous as learners from early on in their studies

**Staff perspectives**

For staff embarking on a new way of approaching learning and teaching was fraught with risk as there was no guarantee that the approach would actually work. Initially, there was also a considerable amount of 'front-loading' to be done, which was quite time consuming. However, once the module was running, there was less direct contact with students, and the contact hours were always directly relevant to the students' learning needs - albeit this required the staff to be highly adaptable and quick to respond when it came to the students' learning needs. The assessment method also reduced the burden of marking for staff quite significantly, and therefore the overall teaching burden on the staff was less than in previous years.

Moreover, the tutors involved in the running of this module also relished the challenge of being pushed out of their own comfort zone (along with the students), and strongly felt that 'something creative like this' was needed in order for the first year students to showcase their true potential. The success of this teaching approach, evidenced in the highly creative and high-quality presentations produced by the first-year engineering students, was therefore particularly satisfying experience for the staff. The staff felt that this had allowed students to showcase the two key qualities of skilful engineers: creativity and critical thinking. Moreover, they felt that they had also managed to capitalise on the fact that most first-year students *do* typically feel very positive about their studies (see also Yorke and Longden, 2008), and that allowing students to engage in enquiry-based and authentic learning, while handing over the responsibility for their own learning from the tutor-led mode to a student-led one, had enabled students to keep motivated and challenged throughout their first year at University.

The increased attendance and retention rates were also evidenced in the pass rate for this module. Overall, the first time pass rate for the first year module increased from the previous 3 years from 77% 75% and 80% to 95%. (The only referrals were those students that failed to attend the conference.)

**Conclusions**

Overall, this approach was highly successful, albeit the less flexible format assigned to 'Manufacturing Processes' groups was less popular simply because it did not capture the students' imaginations in the same way as the 'Engineering Disasters' did. This, whoever, was more to do with the subject topic than the process itself. The main issue was with the fact that simply filming manufacturing processes in a lab appeared to have much less connection with how materials engineering impacts what happens in the 'real world', like it was in the case of the NASA space shuttle disaster.

Despite the risks initially associated with introducing new media technology to students, the staff found that students quickly adapt to the technology. They also readily rose to the challenge of managing their own learning processes, and many commented having got immense satisfaction from having tackled and mastered a new skill as part of their engineering course.

For staff, facilitating course was challenging, yet rewarding. In terms of cost and staffing, the format proved highly cost-effective, despite the initial front-loading. The media files that students produced, could be used as a learning resource for future cohorts of students, adding to the long-term benefit of working in this way. Most importantly, however, it was satisfying to observe that compared to previous years' cohorts, who had been taught in much more 'traditional' way, students were more motivated and enthusiastic about their chosen degree of study.

*Interview clips on student feedback on this module can be viewed at:*

[http://cyclops.shu.ac.uk:8080/ramgen/archive/lits/LTI/studentvoices-1.rmvb](http://cyclops.shu.ac.uk:8080/ramgen/archive/lits/LTI/studentvoices-1.rmvb%20)

**References**

Bramhall, M, Radley K, Metcalf, J, ‘Users as producers: students using video to develop learner autonomy’, presented at Engineering Education 2008 - Innovation, Good Practice and Research in Engineering Education, Loughborough University (2008).

Belbin, R M., ‘Management Teams- Why they succeed or fail’, 2nd Edition, Butterworth Heinemann (2003).

Caruso JB and Salaway G, (2007). ECAR Study of undergraduate students and information technology[online]

Last accessed 23 November 2008 at: <http://www.educause.edu/ir/library/pdf/ers0706/rs/ERS0706w.pdf>

**Fazey, D. and Fazey, J. (2001), 'The potential for autonomy in learning: perceptions of competence, motivation and locus of control in first-year undergraduate students', *Studies in Higher Education* 26(3): 345-361**

JISC (2007). Student expectations study [online]

Last accessed 23 January 2008 at:

http://www.jisc.ac.uk/media/documents/publications/studentexpectations.pdf

Peters, O. (2004), 'Visions of Autonomous Learning', keynote at the European Distance and E-learning Network (EDE), Conference University of Oldenberg.

Yorke, M. and Longden, b., (2008), *The First Year Experience of Higher Education in the UK*, Final report to the Higher Education Academy. York: HEA.

1. 'MySpace' and 'YouTube' are just two examples of free user-generated on-line video sharing. Recent studies conducted by JISC (2007) and ECAR (2007) show that those who do enter Higher Education tend to have higher expectations, and are much more skilled compared with their predecessors. [↑](#footnote-ref-1)