AC 2007-1015: PROMOTING LEARNER AUTONOMY IN ENGINEERING

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Promoting Learner Autonomy in Engineering

Abstract

This paper will report on a current project that is being conducted within one of the UK Centres for Excellence in Teaching and Learning (CETLs): 'The Centre for Promoting Learner Autonomy', at Sheffield Hallam University. The paper will outline the role of the CETLs within the UK, and then will go on to discuss the learning, teaching and assessment methods used on a first year engineering undergraduate module, in order to promote learner autonomy within the students. The module, 'Materials, Manufacturing and Environmental Engineering', has traditionally been taught over 2 semesters through a series of keynote lectures, followed by seminars and laboratory practical classes. Previously, case study work was undertaken by the students in semester 2 of the module; however, this did not develop autonomous learning in an effective way. The new assignment project work in semester 2 provided an opportunity for students to work in groups. Each group either undertook investigations into 'engineering disaster management', or investigated 'materials and manufacturing processes'. The result was an end of module 'student conference', where each group presented a technical paper. This paper will discuss development of the learning scenarios and the introduction of video and media to stimulate and present the learning. A questionnaire was completed by the students before they undertook these new assignments. This was then followed up by individual interviews with students, in order to ascertain how the students had developed within the module. An analysis of the results of these investigations is presented in the paper.

Introduction

In 2005 the Higher Education Funding Council for England (HEFCE) launched a £315 million programme of national Centres for Excellence in Teaching and Learning (CETLs)[1]. The creation of 74 CETLs was a result of a national bidding process. The CETL initiative has two main aims: to reward excellent teaching practice, and to further invest in that practice so that CETLs funding delivers substantial benefits to students, teachers and institutions. Funding of CETLs totals £315 million over five years from 2005-06 to 2009-10. Each CETL receives recurrent funding, ranging from £200,000 to £500,000 per annum for five years, and a capital sum ranging from £0.8 million to £2 million. This initiative represents HEFCE's largest ever single funding initiative in teaching and learning.

The Centre for Promoting Learner Autonomy (CPLA) at Sheffield Hallam University looks to the future and the knowledge economy in promoting self-efficacy through a partnership between large numbers of students, staff, and all those involved in supporting learning. CPLA empowers students at Sheffield Hallam University and beyond to acquire responsibility for their learning, to work in partnerships with tutors and other students. We want learners to demonstrate transformative approaches to constructing their own knowledge and integrate into academic communities. CPLA brings together excellence in developing learner autonomy, pedagogic innovation, and staff development for the benefit of the sector [2].

The characteristics of an autonomous learner are:

- Critical reflection

- Self-awareness
- Taking responsibility for own learning
- Working creatively with complex situations

Most recent research agrees that autonomy is a developmental process which cannot be taught or learnt [3]. However, the Sheffield Hallam model with constant interactions between pedagogic learning environments, learner autonomy characteristics and policy impacts, achieves 'pedagogic resonance' for students[4] - creating a space for new learning partnerships. We draw upon different traditions e.g. constructivist theories of learning, particularly experiential learning[5,6,7], and also the central idea of a learner-led curriculum[8] that is increasingly made possible through the appropriate use of technology. Constructivism is based on the premise that knowledge is constructed by each learner through processes of social interaction.

We concur with Boud [9] that 'assessment practices are often the major barrier to developing increasing student responsibility: if students look to others for judgements of their competence, how can they develop their ability to assess their own learning?; and with Heron[10] that the balance of power between staff and students in assessment critically affects the transactions between them.

Learner Autonomy in Engineering

One project, which is part of the CPLA, is concerned with working with first year (level 4) undergraduate engineering students taking the module, 'Materials, Manufacturing and Environmental Engineering'. Two student groups take this module, BSc Automotive Technology and BSc Engineering Design and Innovation. It has been traditionally taught over 2 semesters, with keynote lectures and laboratories/ tutorials in semester 1, followed by case studies in semester 2. However, learner autonomy is not explicitly developed within these case studies and so a new learning and teaching methodology has been used under the CPLA development work.

The main objectives of the project were:

- To develop learner autonomy in engineering first year students.
- To link individual critical review of knowledge and skill development of the students and relate this to their Personal Development Planning (progress files) through the use of project and problem based learning.
- For students to work effectively in teams and independently to develop communication, presentation, enterprising, creative and problem solving skills.

It was decided to use group working to develop learner autonomy in these first year students, based on the constructivist theories mentioned above, using experiential learning and social interaction enhanced by the use of technology.

Students therefore undertook two new types of project work in mixed multidisciplinary groups. The students were split into two sections. Both sections were asked to produce short video clips (less than 2 minutes) A current university Learning and Teaching Institute (LTI) initiative, 'Users as Producers', was introduced providing an opportunity for the students to learn and develop skills in video and media production. The students were introduced to camera skills, the language of television, interview techniques and editing skills. Each group

produced their own video asset which was either embedded within a PowerPoint presentation, or placed into the Blackboard VLE for peer review. As well as developing skills in media production there was also an opportunity for students to develop key skills such as presentation techniques, project management skills and conflict resolution (whilst working together in groups).

The first student section related to materials, manufacturing or environmental processes.

The second student section based themselves on the theme of 'Engineering Disaster Management'. Initially (within 2 weeks) the students were required to develop a half page 'brief' related to an engineering disaster that has happened anywhere in the world. This brief detailed:

- Background to the disaster and where it fits in within the context of materials and/or manufacturing and/or environmental engineering
- Define the project/ problem, give details, outcomes, solutions (future prevention)
- Work programme/ Project Plan of how they are going to undertake the project, e.g. find information, the type of information, who is responsible for the different aspects – team roles etc.

They work as a group within one topic area from the list below:

TOPICS:

1. Automotive
2. Aerospace
3. Civil/ construction
4. Environmental
5. Railway

During semester 2 they carried out the project and reported back at certain milestone points on progress. The project work required that both staff and students were trained and supported in the use of new teaching methodologies, particularly the use and production of media material.

Students were prepared for their project work in a number of ways. A series of seminars on video and media production were given during semester 1 and reinforced in semester 2 with 'drop-in' sessions available. Also, students were introduced to the Belbin[11] model of team roles to help them get the most from their group working. Students undertook a self-perception Belbin questionnaire in class, which highlighted their perceived team role. This can then be reflected upon both during, and at the end of the project.

Ultimately, both groups of students presented their project at the end of module 'Student Conference'. The presentations were PowerPoint based, containing embedded media, either from existing sources or produced by the students themselves. The conference was a simulated technical conference with a keynote speaker form industry.

Assessment

The module is currently assessed by coursework only, with one of the elements of assessment being an in-class time constrained multi-choice test. 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, so that questions based on the knowledge disseminated at the conference was included. This meant that the students had to engage with all the student presentations, as staff used the conference to produce more multi-choice questions from the day's event. In addition an external speaker was invited to give a keynote presentation at the conference on 'Engineering disasters'. This gave more realism to the conference and allowed students to get the feel of a 'real-world' conference event.

The assessment of the students was on their presentations, with a panel of staff and external industrialists marking them. Copies of the presentations were obtained from the students prior to the conference day in order to formulate the conference programme. The staff only marked the presentations with no group reports, which reduced the staff assessment burden and allowed for a fast turn around of feedback to the students.

Overall, the first time pass rate for the module increased from the previous 3 years of 77% 75% and 80% to 95%. The only referrals were those students that failed to attend the conference. This is believed to be due to the increased attendance and motivation of the students by using this type of project work.

These project assignments gave students the opportunity to reflect on their participation, within their Personal Development Planning (PDP) progress files. Students could include their Belbin analysis and critically reflect upon how the assignment went, the role they played and what they have learnt about their strengths and areas for future development.

Evaluation

At the beginning of semester 2, a questionnaire was given out that found out from the students what they perceived as learner autonomy; also seeking to evidence their current learning styles and expectations, as well as their views on vocational skills. 28 questionnaire responses were received from the 40 students that took part. A follow-up at the end of the module with some focus group discussions was used to further evaluate the student view of the assignments in order to identify the benefits of this type of learning and teaching methodology.

Results and Discussion

Students' perceptions of learner autonomy: Half of the students did not understand what the term 'autonomous learning' meant. The remainder thought it meant 'to take control of one's own learning' (7 responses), 'independent or self learning' (4 responses) and 'planning my own studies' (3 responses).

In educational settings, autonomy is most commonly defined as a capacity to take charge or control of one's learning [2,12] Candy [13] places the development of autonomy on a continuum

with teacher-control at one end and learner-control at the other. Learners achieve different points at the learner-control end of the continuum depending upon context.

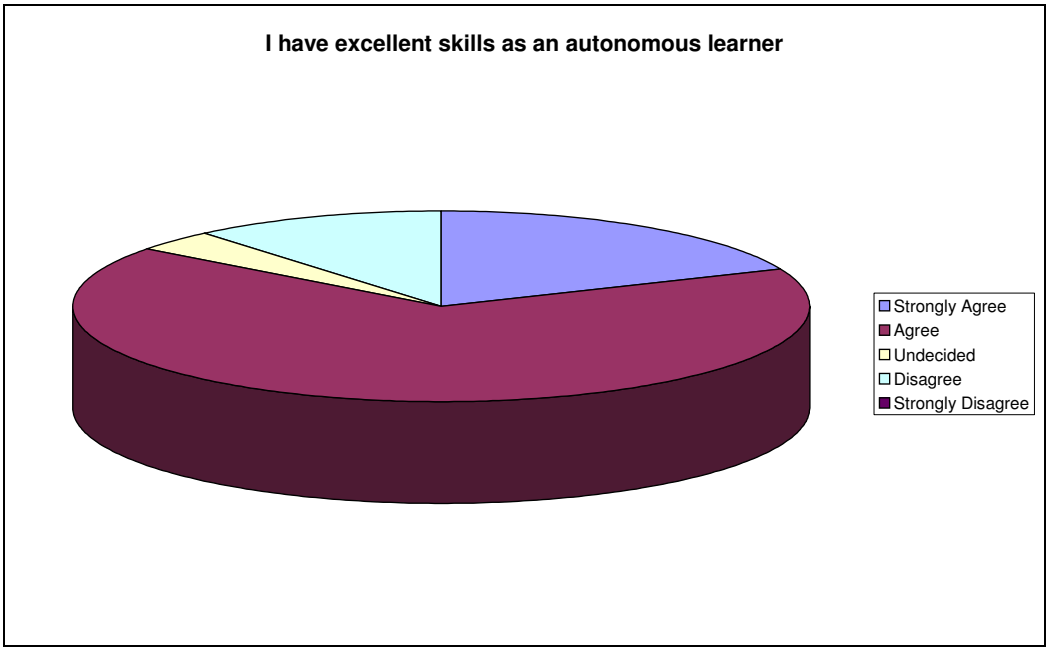

Figure 1 – Student views on their autonomous learning skills

A further series of questions attempted to find out more about their perceptions on autonomy, types of learning and tutor guidance. Students were asked various statements for which they had to rank on a five point scale from 'strongly agree' to 'strongly disagree'.

Most students thought that they had excellent skills as an autonomous learner, Figure 1, and that group working helped them develop this further, figure 2:

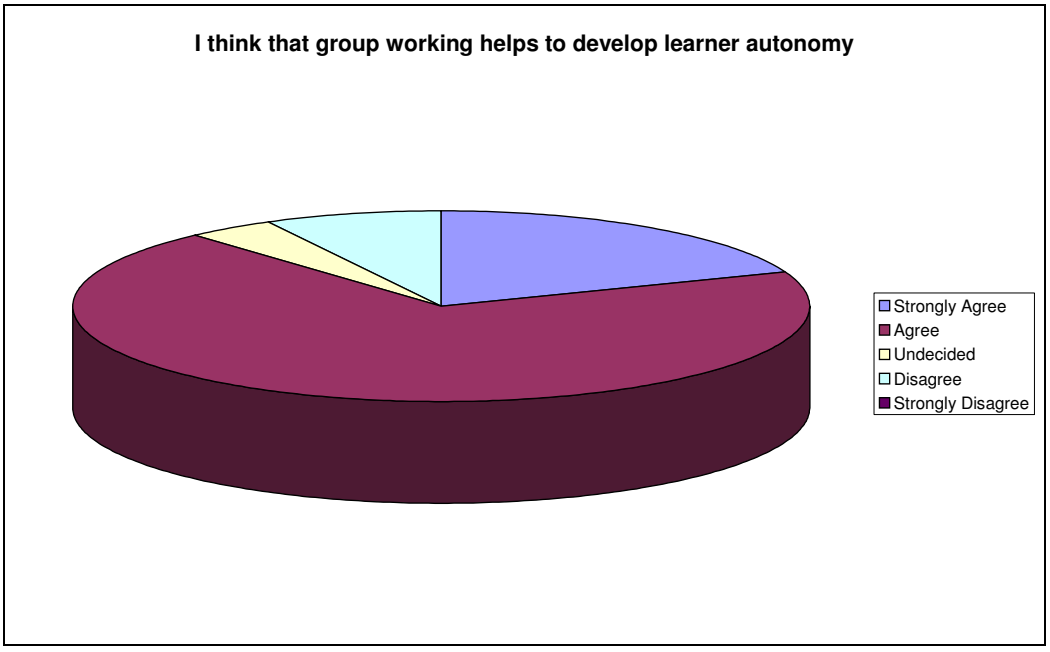

Figure 2 – Students views on group working

However, most students thought that the best way to develop learner autonomy was through independent study, figure 3:

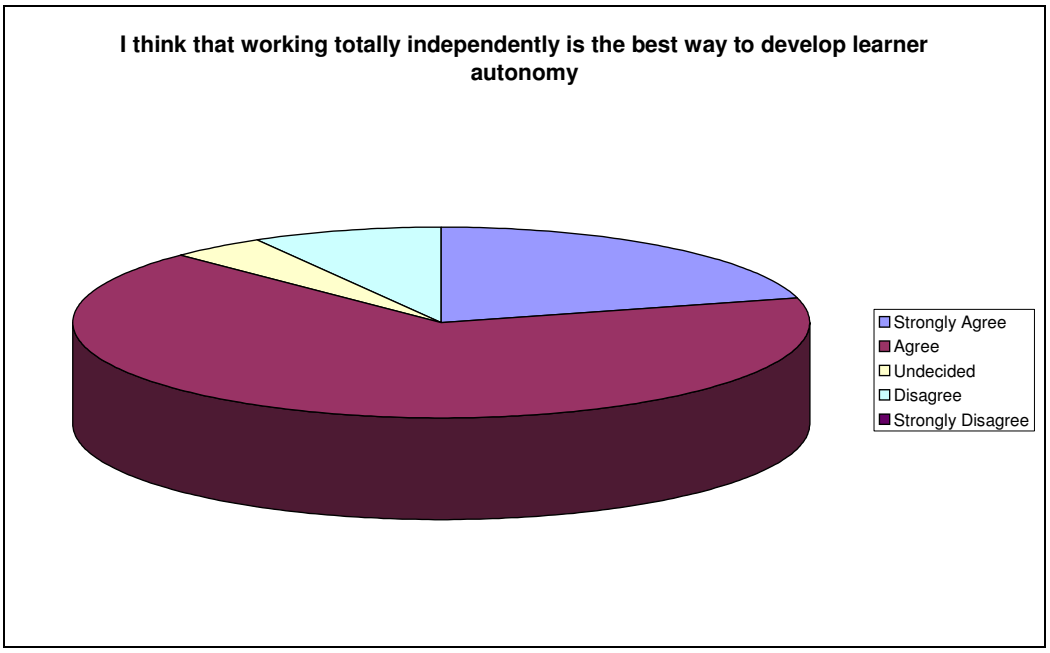

Figure 3 – Student views on independent study

Results showed that students were very strongly assessment driven, only researching and gathering information when undertaking an assignment, figure 4:

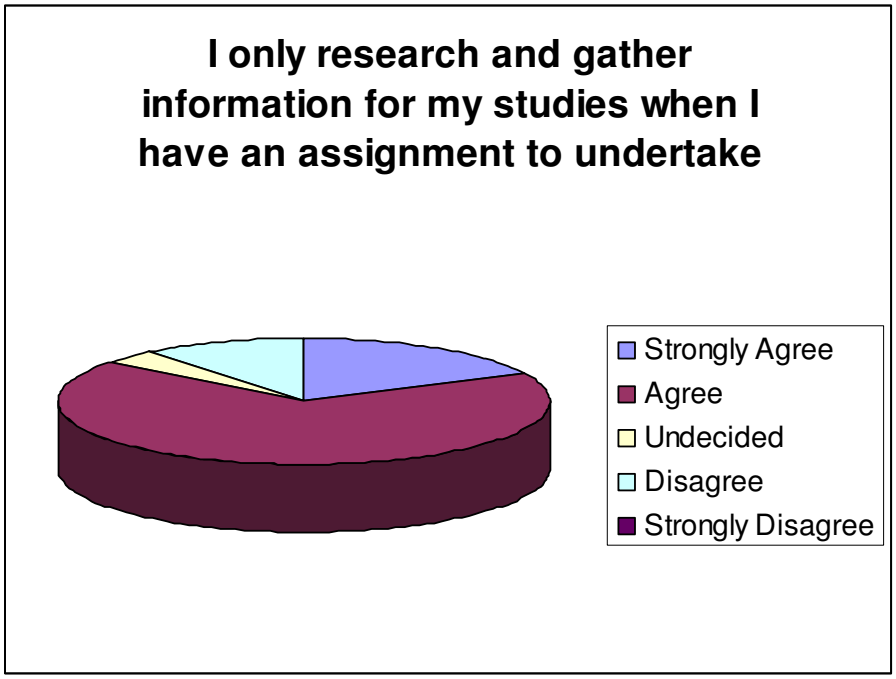

Figure 4 – Student views on researching and gathering information

Most students expected strong guidance from their tutors/ lecturers, figure 5:

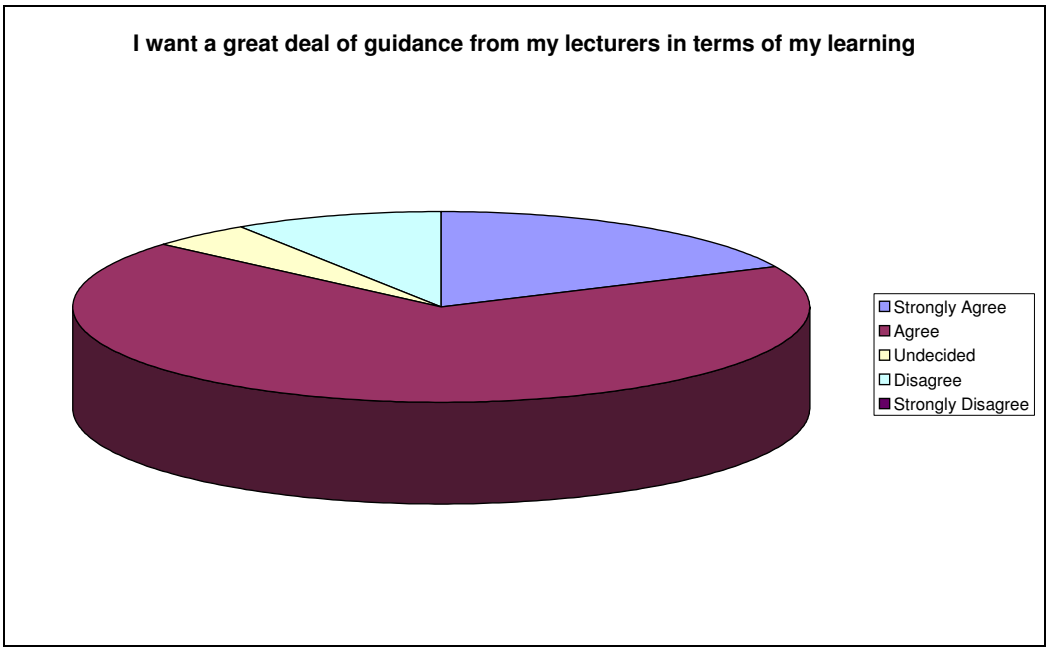

Figure 5 - Student views on guidance from their lecturers

Students were then asked a series of questions on the importance of various vocational skills and values that were important for a qualified engineer to able to perform his/her duties. A score of 0 was of 'no importance' with a score of 10 being 'very important'. An opinion of the level of these skills actually exhibited in their fellow students followed each question on a scale of 0 to 10, with 10 being very high.

The following data shows the mean results:

Communication skills	**Importance**	**Perception of fellow students ability**
Present and defend points of view and outcomes of their own work in writing to colleagues, clients and superiors	6.8	4.1
Present and defend points of view and outcomes of their own work verbally to colleagues, clients and superiors	7.1	4.8
Critically read written works, making judgements on their relevance and value	7.1	4.9
Use visual aids in presentations	7.2	5.8

This data shows that the students perceive the need to develop their writing and presentation skills, rating these highly important, but with a low perception of fellow student's abilities in these areas.

Ability to work in groups	Importance	Perception of fellow students ability
Work with others in teams adopting a relevant role	7.9	6.4
Organise and delegate tasks	7.6	6.0
Assume leadership positions when necessary	7.4	5.7

This shows that the students understand the relevance and importance of working in teams, and that their fellow students have reasonable abilities in this area.

Problem solving skills	Importance	Perception of fellow students ability
Identify and solve unstructured problems	7.6	5.6
Find creative solutions	7.3	6.1
Integrate multidisciplinary knowledge to solve problems	6.9	5.0
Perform critical analysis	7.3	5.6
Work independently	7.8	6.7

Students recognise the importance of problem solving skills and the need to therefore develop these skills, especially in a multidisciplinary environment.

Stress management skills	Importance	Perception of fellow students ability
Organise the workloads to meet conflicting demands and unexpected requirements	7.5	6.1
Organise the workloads to recognise and meet tight, strict and coinciding deadlines	7.9	6.3
Organise the workloads to select and assign priorities within time constraints	7.8	6.2

Students were consistent in ranking this area of high importance, especially the need to organise workloads to meet deadlines, rating this 7.9. This ranking was equal highest of all questions together with ‘working in groups’, which was also 7.9.

Information technology skills	Importance	Perception of fellow students ability
Use relevant software, e.g. databases, spreadsheets, word processors	7.7	7.2
Use electronic information sources	7.2	7.1

Not surprisingly, as shown above, the students rated IT skills important, but recognising that they already have these skills.

Overall, the questionnaire's results raises the importance of developing the student's communication, teamwork and leadership skills and to critically solve problems in multidisciplinary environments.

The new case study work, as described earlier, using group work, video and engineering disaster management should fulfil these needs. This was borne out in interviews with students following the case studies. Below are some of the student comments:

" ….Communication in the actual presentations……I felt we learnt from it…..and communication between us in the group we also benefited from….the experience of doing something like this [student conference]…it's the first time I've done something like this…."

"…by doing this it has boosted my confidence…don't mind doing it again and again…."

"….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…."

"…presenting information and ideas to an audience helps with employers…"

"…working as a group is the best option as you get to know who they are and how other people work, what is their strengths plus their weaknesses…"

"…the analysis skills, the communication, the teamworking works…..gave me skills to apply in any situation in the future…."

These comments show that this type of project work benefits the students, adds realism, aids communication and analysis skills and hence helps with their employability. From the questionnaire results it is clear that the areas that needed development were addressed to a great extent. The student motivation and hence achievement was improved, as demonstrated by the improved pass rate for the module.

Future work of the CETL

It is planned to use three main outputs within the CETL project:

Output 1: taking level 4 courses with high student numbers, developing our learner autonomy model across such courses, including inquiry-based learning (IBL), use of personal development plans (PDPs); the activity is then developed across a network of UK Higher Education Academy Subject Centres before 'returning' to the University for further development on other courses. The resulting university-wide output will gain from this broadening process.

Output 2: developing the model across subject pairings, e.g. History and Languages, Engineering and Art & Design, expanding discipline-based learner autonomy, using already established good practice in the university.

Output 3: transferring the model from one level to another, e.g. from postgraduate to undergraduate levels in the same subject area.

Taken together the three outputs provide a cascade model of mentoring to support innovation and achieve staff 'buy in'. CPLA creates linkages between disciplines, a key requirement of Sheffield Hallam University's Corporate Review (2003-2008).

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