ENHANCING TEACHING-LEARNING ENVIRONMENTS IN UNDERGRADUATE COURSES IN ELECTRONIC ENGINEERING: AN INTRODUCTION TO THE ETL PROJECT

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ABSTRACT

This paper introduces earlier research into the effects of teaching on the quality of student learning and describes a large-scale project within the Teaching and Learning Research Programme of the British Economic and Social Research Council, looking at contrasting university subject areas, including electronic engineering. Subsequent papers present preliminary findings.

KEYWORDS

Student learning, pedagogical research, university teaching, electronic engineering.

BACKGROUND TO THE RESEARCH

There has been a substantial amount of research carried out into how teaching affects learning in higher education but there has not been a ready take-up of the ideas in university departments. Part of the reason is that the research is generally reported in education journals and in social science jargon, and part is the realisation that the findings cannot be applied equally well to the wide variety of disciplines and professional areas. The current project represents an attempt to develop ideas about teaching and learning that are the result of collaboration with colleagues in several different subject areas and across varied institutional settings. In this way, it is hoped that the findings will be more readily applicable to those subject areas, and the experience of working in this way may generalise to other disciplines and professional areas.

RESEARCH INTO STUDENT LEARNING

In setting up the project, we started with certain ideas about teaching and learning in higher education based on an extensive research field described by Ramsden [1] and others as *student learning research*. It began with research into how students went about everyday study tasks, such as reading academic articles, and led Marton and Säljö [2] to the idea of *approaches to learning,* with a crucial distinction between *deep* and *surface* approaches. The key difference between these approaches is the students' intention – whether to understand the material for themselves or to pass the course with limited effort or engagement. Each intention then brings into play differing processes of learning that inevitably lead to different learning outcomes and levels of understanding. Subsequent research found that students also differed in terms of the extent to which they had adopted a strategic approach to studying [3] which, in the current study, has been sub-divided into monitoring studying, study organisation and time management, and effort and concentration.

The main conclusion of the research on student learning has been that the teaching provided for students affects not just what students learn (knowledge and skills), but also how they go about learning as well (the processes). It is possible markedly to affect the extent to which students adopt a deep or a surface approach by the kind of teaching and assessment procedures they experience [4]. Although the distinction between deep and surface approaches has been oversimplified here, the idea has proved extremely powerful in helping colleagues to think about their teaching in a more systematic conceptual way. The starting point is to decide what is meant by a deep outcome of learning in a particular discipline or degree course and then to consider what learning processes are necessary for students fully to carry out an intention to understand for themselves in that course. It is then possible to see which ways of teaching and assessing are most likely to encourage a deep approach in that subject.

When such reflection on current practice is carried out, however, it shows that teaching does not lead to learning in a direct or simple way. Rather we have to look at the whole *teaching-learning environment* provided for the students, including the various types of teaching, e-learning and other forms of support provided, assessment

criteria and procedures, assignments, feedback and workload. All these elements interact and together affect the quality of learning that students achieve. These effects were noted, among others, by Eisenberg [5]. He reported that changes his anatomy department had introduced as a result of reviewing their teaching and learning had proved effective only because these changes were treated as an interacting whole, designed to encourage a deep approach. Later, Biggs [6] also emphasised the importance of looking at teaching and learning as an interacting system through the idea of *constructive alignment* that describes a teaching-learning environment in which all the constituent parts of it pull together coherently to support high quality learning.

Although there are overall effects on the quality of learning attributable to the actual teaching-learning environment provided, the influences are still indirect. It is not the actual environment, but students' perceptions of the teaching and assessment procedures that most strongly affect their learning. And, of course, students differ markedly in their perceptions of the environment, depending on their abilities, reasons for studying and approaches to learning.

As staff are all too well aware, they do not have a free hand in deciding how to teach a degree course. There is strong 'guidance' from various external sources. Subject benchmarks, external validation, employers' views, and conventions about teaching the discipline, all affect what can be provided for students. And the institution itself influences how teaching is carried out through its quality assurance procedures, the relative emphasis and resources given to teaching and research (RAE), the type of student intake, and the regulations affecting assessment and progression.

It is possible to look at all the various influences on student learning using what Checkland [7] called *soft systems analysis* – working out how the various components within an organisation interact to affect its efficiency. Figure 1 below provides one such analysis. The diagram separates out the various influences on learning. The top half covers the student characteristics, indicating how previous educational experience affects how students learn and study once in higher education. It also suggests the influence of the peer group on student habits and effort. The concepts included have all been shown from research to affect learning outcomes [8] .

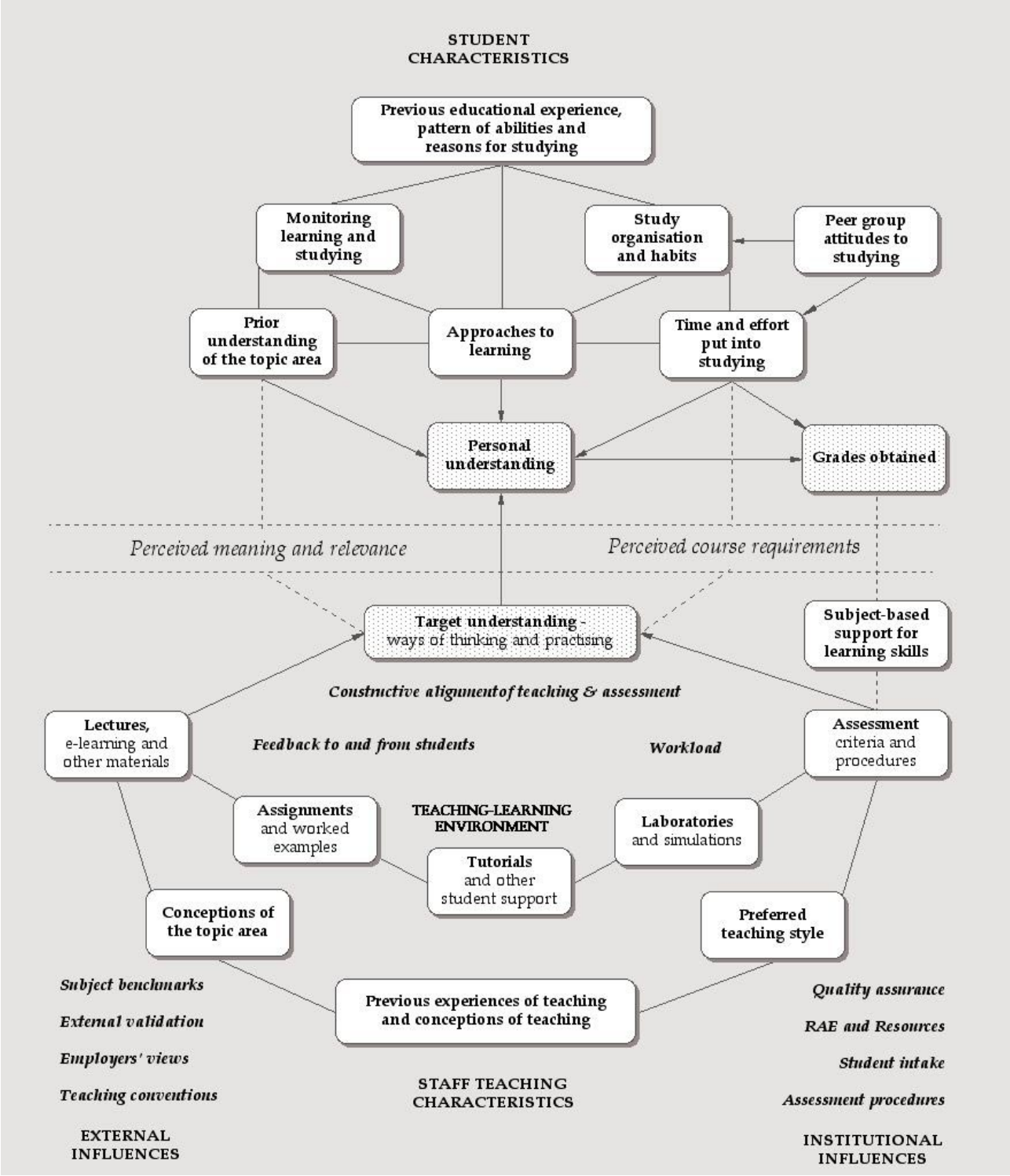
The bottom half of Figure 1 describes the learning environment and the characteristics of staff which affect how they go about teaching within the constraints of external and institutional influences. While there are distinctive ways in which staff in different subject areas think about teaching and learning, there are also differences in the same area in how topics are conceived and taught, arising from previous experience and preferences, as well as from contrasting teaching styles [9].

Each of the different forms of teaching shown as constituting a learning environment can be carried out in ways which encourage either a deep or a surface approach in students, but to differing degrees, depending on the individual student. The extent to which all the elements are constructively aligned to support deep learning can be judged through feedback from students [6]. Other important influences on the quality of learning are also shown in the diagram, namely the workload that students experience and, as Hounsell [10] has shown, the type and extent of feedback provided to students on how their learning is progressing.

Across the centre of Figure 1, the dotted lines enclose perceptions of meaning and relevance on the left, and perceptions of course requirements on the right. Perceptions are included as a reminder that the effects of teaching on learning depend on those perceptions. The distinction between the two forms of perception has been introduced to suggest an important difference in how students view their experiences. Perceptions of meaning and relevance come mainly from the teaching itself which, if appropriately carried out, will help to encourage a deep approach. Perceptions of course requirements relate to the syllabus and assessment procedures and may induce either a deep or a surface approach, depending on what type of learning is seen to be required.

The final concepts included in the diagram follow the work of Entwistle and Smith [11] to distinguish between the target understanding in the teachers' minds – what they hope the best students will acquire in terms of their *ways of thinking and practising in the subject* – and the personal understanding actually achieved by individual students. There is also a separation between these personal understandings and the grades awarded through the formal assessment procedures, which generally focus on 'intended learning outcomes' and will, although to varying extents, tap personal and target understandings.

FIGURE 1 A systems framework for analysing teaching and learning in higher education



Promoting a deep approach to learning

The general influence of the teaching-learning environment is indicated in Figure 1, but it is also important to be able to suggest what types of teaching and assessment are most likely to encourage students to seek meaning in what they are learning.

Previous research has already suggested that students see 'good lecturing' as depending on four basic aspects – *clarity* (clear speaking and illustrations), *level* matched to students' prior knowledge, *pace* appropriate to ability level, and clear logical *structure*. But the three aspects that are linked most closely to a deep approach are the accessibility and thoroughness of *explanations*, the *enthusiasm* shown for the subject, and the *empathy* that is shown for students' difficulties and the quality of support that follows. Previous research has also suggested that multiple-choice questions (MCQs) that focus on knowledge encourage surface approaches, while more open forms of assessment, like essays or authentic problems, evoke deep approaches [7].

Although the previous research can provide general guidance, rather little is known yet about how to promote the specific types of learning that staff expect students to carry out within their specific disciplines and professional areas. That is one of the main focuses of our current project.

THE ETL PROJECT

The ETL project is part of the UK-wide Teaching and Learning Research Programme of the ESRC, and is now one of four projects (out of 31) focusing on teaching and learning in higher education. The programme is trying to strengthen the impact of educational research by requiring that each project is carried out in collaboration with 'users' of the research findings. In our project, these users are academic staff, staff developers, institutional managers, and policy makers. Previous research on student learning, as we have seen, has mainly tried to establish generic relationships between teaching and learning. The ETL project is now exploring differences across four contrasting subject areas – biological sciences, economics, electronic engineering, and history. Within each subject area, staff in six or more course units across distinctively different institutional settings have agreed to participate collaboratively in our study over a two year period.

In the first year, baseline data are collected. Staff are interviewed to allow the researchers to discover more about teaching and learning within each subject area, as well as the details of the particular unit. The interviews are supplemented by the documentation provided for the students. Two questionnaires are completed by students - one at the beginning and one at the end of the course unit. The first looks at students' reasons for taking the degree course and the course unit, and explores students' general approaches to learning and studying in the subject area. The second concentrates on the approaches used in the specific unit and about experiences of teaching and learning. Groups of students are also interviewed to explore those experiences in more depth.

These baseline data are then analysed and confidential reports are provided for the staff teaching the unit. Discussions are then held to establish whether the feedback from students suggests there being any value in developing a *collaborative initiative,* designed to enhance certain aspects of the teaching-learning environment. Where such an initiative is agreed, the second year of collaboration involves the same data collection from the following year group to evaluate what changes in teaching and learning have occurred, and the extent to which these can be attributed to the collaborative initiative. Further details about the project can be found on our web site – http:/www.ed.ac.uk/etl

CONCEPTS AND MEASUREMENTS

Analyses of the feedback from students provided in the baseline data have been considered in the light of the notion of *constructive alignment* [6]. From the interviews with staff teaching the various units, the quality of learning outcomes has been considered in terms of the *ways of thinking and practising in the discipline* [9] that departmental partners suggested were most important in their course unit. We were then able to explore how the various teaching-learning activities were expected to fulfil those aims and expectations for student learning. The questionnaires and interviews with students helped us to build up a detailed picture of how students had experienced the teaching-learning environment. The items in the questionnaires were carefully selected and developed to create a series of scales (groups of related items) designed to measure specific aspects of students' approaches to studying and perceptions of the teaching-learning environment, and so simplify the analyses. These scales are shown in Table 1.

TABLE 1 Questionnaire scales used in the ETL project

Attitudes to taking the degree course	***Experiences of teaching and learning***
Interested in the content of the course	Clear aims, organisation, alignment & integration
Concerned mainly with qualifications	Teaching for understanding and student choice
Wondering about the value of studying at all	Staff support and enthusiasm
Approaches to learning and studying	Assessment for understanding and feedback
Deep approach to learning	Interest, enjoyment and perceived relevance
Surface approach to learning	Support from other students
Monitoring studying and skill development	***Self-ratings on learning outcomes***
Study organisation and time management	Knowledge and understanding
Effort and concentration	Ability to think about ideas and solve problems
Relative easiness of the demands made	Skills or technical procedures specific to the subject
Prior knowledge expected	Overall academic progress
Rate material introduced	
Amount of work expected	***End-of-unit summative assessment grade***

As a result, we had a great deal of detailed information about students' attitudes, ways of studying and reactions to the course unit which could be filled out through analyses of the group interviews with students. The scores on approaches to learning indicated the relative balance between deep and surface approaches adopted by students in the course as a whole prior to the unit, and also any changes in that balance in the target unit. Taking that evidence along with the questionnaire responses on students' experiences of teaching in the unit (both as scales and as individual items), and with the comments made in the group interviews, we were able to see if any aspects of the teaching-learning environment seemed to be out of line with the aims specified. Previous findings from student learning research could then be used in conjunction with an understanding of the course aims to suggest possible changes for the following year, which could then be discussed with staff.

Preliminary findings from the project, specific to electronic engineering, are presented in the subsequent papers. The first two papers look at the teaching of analogue in four different course units and three contrasting institutional university settings, while the final paper investigates an 'Introduction to microprocessors' course taught within an HNC course for day-release students.

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