DISCIPLINARY DIFFERENCES – Frameworks for better learning design

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Abstract

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This paper presents research into ways that e-learning can be integrated into conventional higher education teaching. It examines how appropriate techniques and technologies may be selected, adapted and combined for effectiveness, to accommodate the preferences or needs associated with disciplinary differences. The research reviews existing literature and surveys practice. Disciplinary differences are analyzed and examples of typical applications are presented with an analysis of those techniques which are most appropriate. It also analyses quantitative and qualitative data gathered from interviews with students across a number of academic disciplines. The conclusions have implications for the direction of future work on learning design

1. Introduction

The choice of effective of teaching method depends on several factors including the subject's culture, alongside the academic level and prior experience of the learner [1-4]. Understanding these issues can help when designing e-learning activities and materials. An analysis of the relative strengths and weaknesses of different e-learning approaches may also suggest whether a course should be supported through *'e-learning'* or through a *'blended'* approach. This paper analyses how appropriate e-learning techniques may be selected and designed. It evaluates the data in the context of quantitative and qualitative data gathered from interviews with students of a variety of academic disciplines

2. Approaches to e-learning

A range of e-learning practices exist. These include static and interactive tutorials, simulations, discussions, quizzes and practical exercises

2.1 Categories for Learning Design

Laurillard analysed the role of educational technology in higher education and its relationship with student learning in her seminal book "Rethinking University Education"[5]. Her conversational model has become a recurrent guiding model in analyses of the design of learning materials. However the application of models of e-learning such as Laurillard's are typically applied at the micro-level, detailing how a particular set of interactions might be designed.

An alternative, meta-level approach is offered if the system designer takes into account disciplinary differences. Typical e-learning approaches together with an indication of their educational style are shown below in figure 1.

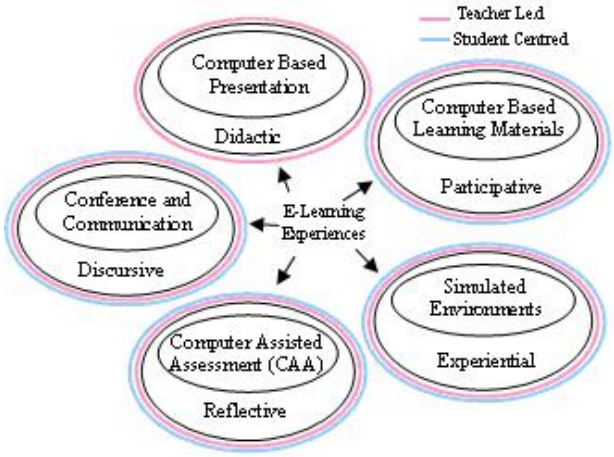

Figure 1: Typical approaches to e-learning

2.2 Integrated solutions

Virtual Learning Environments (VLEs) are typically used to encapsulate access to a range of e-learning applications with the addition of a standard user interface access via the World Wide Web. Registrations and student logins are used to provide additional student and class management. The software is designed to be easy to configure by those who do not have strong computer skills [6, 7]. Although VLEs can be used to provide complete online courses, particularly those which provide distance learning, in the UK Higher Education VLEs are predominantly used within specific teaching units or

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modules, see for example[8, 9]. While currently systems in widespread use are predominantly server based, we can expect the future development of widespread solutions based on a web services approach. The de-facto generic name of such services remains to be established but development is underway at the meta level focusing on establishing an e-learning framework [10].

At the micro level the ongoing development and use of learning objects and object repositories is indicative that when frameworks are established there will be content with which to populate these emergent distributed learning environments.

At a practical day to day level it is now common for e-learning materials to be used in a purposeful mix with traditional face-to-face methods referred to as *Blended Learning*. Programs combine technology based techniques with traditional learning techniques, while a strict definition of *e-learning* courses would be based exclusively around computer-based activities. Our survey was conducted at a traditional research intensive university where the majority of teaching is face-to-face, however increasing use is being made of technology based learning resources.

2.4 Analytical Perspectives

Our analysis explores five discrete application types, plus the integrated form of Virtual Learning Environments. Each application type is classified as either student-centred or teacher-led.

3. Conceptual Analysis

Biglan's categorized subjects matter in different scientific areas [11, 12]. Neumann Parry and Becher [2] carried out a conceptual analysis of teaching and learning activities based around Biglan's categorization. They identified ways in which teaching and the assimilation of knowledge is typically achieved. The subject categories they used are Hard Pure, Soft Pure, Hard Applied and Soft Applied. Table 1 summarizes key components of their mapping between curricular content and activities to discipline types. Section 4 below elaborates the target areas which come under of each of the subject categories.

	Curriculum / Content	**Assessment**	**Cognitive Purpose**
HARD-PURE Eg: Natural Sciences	Concepts and principles are closely connected. Content typically fixed and cumulative. Quantitative.	Specific and focused exam questions. Objective tests relying on quantitative nature of knowledge	Logical reasoning Testing of ideas in linear form of argumentation Reliance on facts, principles, and concepts.
	Teaching and learning activities are focused and instructive.		
SOFT-PURE Eg: Social Sciences and Humanities	Non-linear, open and loose Content is free-ranging Qualitative Teaching and learning activities are constructive and interpretative	Essay questions, short answer questions, and oral presentations Ongoing assessment	Broad command of intellectual ideas Emphasis on creativity in thinking and fluency of expression
HARD APPLIED eg Engineering	Concerned with the mastery of the physical environment Focus is on products and techniques Content is linear in sequence, based on factual understanding	Preference for exam questions, especially problem-solving	Problem-solving and practical skills Emphasis on integration and application of existing knowledge
SOFT APPLIED eg Nursing, Education	Concerned with the enhancement of professional practice Knowledge is accumulated in a re-iterative process	Essays, project-based assignments Use of peer and self-assessment tasks	Emphasis on personal growth and intellectual breadth Development of reflective practice and lifelong learning skills

Table1 : Mapping Disciplinary Approaches
Matrix derived from Neumann, Parry, & Becher [1]

4. Classifying Discipline Areas

The categorization developed by Neumann Beecher and Parry looked at broad subject areas. If this perspective is to be used to analyze actual e-learning applications a further more detailed mapping of disciplines to the broad area needs to be identified. There are many different ways of classifying discipline areas. Governments and funding organizations devise systems to suit particular agendas, and wherever disciplinary lines are drawn there will be debate on the appropriateness of the classification.

In the UK support for teaching and learning in academic disciplines is provided on a subject basis through twenty four "subject centres" which are part of the Higher Education Academy (HEA). Other classification types were available (for example the UK Quality Assurance Agency's 'JACS' codes). However, for the purpose of this work, the Subject Centres were used. The advantage of this classification is that the centres themselves collect information about e-learning resources and approaches to teaching which were used to assist in the process of identifying example applications in each area. We accept that these classifications will inevitably overlap but think that they are sufficient to illustrate the objective of our argument.

For the purposes of our survey we worked from the groupings of subject areas used by the UK Higher Education Academy. The areas are show together in table 2 below. Titles are taken from Subject Centre names, and the areas are clustered together into the four areas around the soft/hard and pure/applied axis.

HARD	• Built Environments, • Engineering, • Health Science and Practice, • Computer Science, • Medicine, Dentistry and Veterinary Medicine, • Psychology.	• Bioscience, • Earth Environment Science, • Maths, Statistics, Operational Research • Physical Science
SOFT	• Art, Design and Media. • Business Management and Accountancy • Education • Hospitality, Leisure, Sport and Tourism, • Law • -Dance, Drama and Music • Social Policy and Social Work.	• Economics, • English, • History, Classic and Archaeology, • Language Linguistics and Area Studies, • Philosophical and Religious Studies, • Sociology, Anthropology and Politics.
	APPLIED	**PURE**

Table 2. Survey Areas
Applying the conceptual analysis
to the HEA subject centre discipline are**as**

A survey was conducted to discover the ways e-learning tools and techniques are used across a variety of subjects at the University of Southampton. A total of 286 students participated in this survey: 62 postgraduate and 224 undergraduates from different backgrounds and subject areas as detailed in table 3 below.

Subject category	**Student participants**	
	Under graduates	**Post graduates**
Hard Applied	93	23
Soft Applied	40	8
Hard Pure	43	15
Soft Pure	48	16
Total	224	62
Grand Total	286	

Table 3. Survey Participation

Among the 286 students interviewed, 87% considered themselves regular computer users able to install new packages and transfer data between packages.

5. Survey Responses

5.1 'Hard' Subjects

Of students studying **Hard Applied** subjects (113), 98% said they would like more online tests, while 26% identified the need for more online materials for their subject. They also expressed a desire for more interaction in the classroom for example via interactive tests, so that both teacher and student can see if the subject was fully understood. More than a quarter (27%) of all students expressed a desire to follow lectures from home. Some students even suggested recording lectures so that students can replay them for revision purposes or if a lecture was missed. There was no desire to entirely abandon the lecture system.

5.2 VLEs

In general, medical students found the use of VLEs useful as containers of online testing for exams and testing. Most (76%) the students in this study area wanted online electronic learning to be an integral part of their degree along with computer-based presentations and assessment materials. These results can be seen as supporting the use of VLEs in table 2. The results from medical students show this directly. Less directly, the desire for more online tests also shows that a VLE is appropriate, online tests being one of the e-learning techniques provided by a VLE.

5.3 Assessment

Students in **Hard Pure** subjects did not seem to prefer online tests. Only 15% of the 58 students who took the survey stated that it would have been useful for exams. 25% of the 21 physics and mathematics students interviewed also showed an interest in computer-aided assessment materials, as some subjects require solving exercises quickly and precisely, by visualising the problem.

5.4 Visualizations

Most Hard Pure subjects (89%) replied that they would like more computer-based learning materials to help visualise problems. Half of the 21 bioscience and environmental science students believed that more computer-based presentations and simulated environments would be useful in their subject. Students in this subject area in general liked the idea of being able to follow lectures from home, although some commented that it would be good to be able to interact with the environment more directly, in opposition to a conventional lecture (in the jungle or under the sea were given as examples). The emphasis shown here on visualisation supports the suggestion that visualisation of problems is effective for Hard Pure subjects.

5.5 'Soft' Subjects

Students in **Soft Pure** subjects seemed to prefer online teaching in the form of discussion, simulated environments and online tests. 30% of the 64 students who took the questionnaire seemed to prefer to have the chance of having online tests in order to practise subject areas for their exams. They also found the idea of having lectures from home appealing as if they were learning a new language or history it would be useful to be able to watch documentaries.

5.6 Simulated Environments

It was noted that 12 economic students found simulated environments useful, and that it helped them to have a deeper or more practical approach to the subject. They pointed out that similar techniques were used in class, although with little success, as a it took a long time to understand. In students belonging to the **Soft Applied** subjects the response was unanimous: all preferred online simulation, in particular, role-playing games. 86% of the 48 students who responded said that they would not like the chance to attend lectures from home, as in some classes live discussion takes place. Possibly this could be replaced by online discussion but they did not seem enthusiastic about the idea. The 13 Law students expressed a desire for more online role-playing games.

This strong desire for online simulations and role-playing games clearly supports the categorisation theory, which recommends the use of such simulations as effective e-learning techniques for teaching these subjects.

5.7 Discussions Online

From the Philosophical and Religious Studies academic subject 5 students found online discussion useful as they could argue philosophical and religious topics with other students both from their own university and from other universities

From the 23 students belonging to the Linguistics and Area Studies, 89% wanted more online materials for their course as it is quite hard to find relevant information for their subject outside the university area. However, positive feedback was noted from the 8 English students who replied. They commented that online materials are used in many of their courses and that they found them very useful.

The categorisation theory suggests that effective e-learning techniques for teaching Soft Pure subjects should include online discussion and simulations. This is supported in the results of the survey, where a preference for online discussions and simulations have been shown.

6. Discussion

The earliest literature on the computer applications of technology has identified benefits of using learning technologies. The computer can host repositories of information. Interactive tutorials can pace students learning. Computer Assisted Assessment can be used to build up test banks of questions, and be used in a diagnostic, formative or summative manner. Simulations can provide safe experiments, "take" students to inaccessible locations, or provide realistic vehicles for role play and gaming.

Computer mediated communication has become part of the fabric of academic life, and it is common for academics to use emails, wikis and discussion boards with their students. The ubiquity of the World Wide Web has changed academic practice, and those changes too have made their way into the university classroom.

The web has become a common mechanism for teaching across all subject areas and categories. The flexibility of the web means that it is possible to deliver a wide range of content.

Web-based Virtual Learning Environments make it possible to implement a wide variety of different e-learning techniques, integrated into a single system. Additionally, the platform-independent nature of the web means that a web-based system can be used on any computer with a web browser and Internet connection. Previous systems were limited to running under specific platforms.

The development of more straightforward systems to design and implement computer systems has to some extent acted as a catalyst for more widespread use, although often, where face-to-face communication is a possibility, electronic solutions will exist side by side with traditional methods. Visionaries will talk about online education being "Just in Time and Just for You". But for the individual faculty member, or the departmental team deciding to introduce some standalone computerization, or introduce a more wide ranging set of blended learning modules, having

some guidance as to the best way forward can only be an advantage.

Educationalists have for some time bemoaned e-learning applications which are developed led by technology rather than pedagogy, but for the individual faculty member making sense of the pedagogy and applying it to e-learning is non trivial.

Developments on the technical side of e-learning are advancing. As our understanding of the applicability of web services in the learning environment increases, and work at the ground level of designing learning objects advances, there needs to be parallel development in our understanding of what can be done educationally with e-learning. The insights of those individual who began the work on disciplinary differences has a lot to offer the world of e-learning.

7. Concluding Remarks

This paper has categorised and reviewed e-learning considering ways it may be used to guide and pace student learning. It has also demonstrated how taking disciplinary differences into account may inform the selection of e-learning approaches.

The survey gave insight into students' experience of e-learning and their views of its potential to assist in their learning. The students' responses are well aligned with the categorisations of subject areas developed from the work by Neumann Beecher and Parry. It is clearly important to consider subject preferences and disciplinary approaches when seeking to identify the most appropriate e-learning components. E-learning materials may cost a large amount of time, money and effort to develop. Selection of an appropriate technique is therefore particularly important since the use of inappropriate e-learning approaches without regard for subject may be counter-productive. These observations have implications for individual academics as they plan and implement their university teaching, but they may also usefully be taken into account by those individuals developing systematic approaches to learning design.

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