Mobile City and Language Guides - New Links Between Formal and Informal Learning Environments

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Abstract: One of the major challenges in second and foreign language education, is to create links between formal and informal learning environments. Mobile City and Language Guides present examples of theoretical and practical reflections on such links. This paper presents and discusses the first considerations of Mobile City and Language Guides in language centres, upper secondary schools and universities. The core concept of Mobile City and Language Guides is geotagging. Geographical locations can be geotagged either through GPS or by marking positions directly in, e.g., Google Earth or Google Maps. Students or teachers can add various kinds of information to geotags: Photos, audio, text, movies, links, vocabulary and various language tasks. This allows the student, in self-defined learning contexts, to down- and upload location-based materials with his or her mobile phone, for immediate or later processing. More and more students are able to afford mobile phones with multimedia and broadband Internet. The potentials of user-generated mobile- and web-based content are increasing. In these years, the internet is moving from the so-called Web 1.0 to the more user-centered Web 2.0, i.e. Weblogs, YouTube, Google Maps, MySpace, Flickr, etc. In an educational context, Web 2.0 represents an interesting development of the relatively monologue Web 1.0, where traditional homepages often only allow minimal interaction with the site content. This paper investigates the opportunities that Mobile City and Language Guides seem to give second and foreign language students to learn from informal, location-based, experience-based and authentic materials; and discusses how language centres, upper secondary education and universities can involve informal learning contexts through student use of mobiles with broadband and Internet technology supporting second and foreign learning. Mobile City and Language Guides is only of several possible mobile- and Internet-based language educational scenarios. The challenge for the future, therefore, is to develop and implement new, meaningful and exciting scenarios that strengthen the linkages between formal and informal learning environments.

Keywords: second and foreign language education, formal and informal learning, broadband mobile technology, Web 2.0, geotagging

1. Introduction

More and more teenage and adult language students own state-of-the-art mobile phones. These are phones with sound and video recording possibilities, usually with broadband access to the Internet. On the average, mobile phone users change telephone models every 18th month. This is also the average period it takes to effect improvements on the mobile phones’ function.

Language students use the mobile phone in their daily life – both as students and as ordinary citizens (Chen 2007). They use their mobile phones to they take photos of friends and the places they visit. They send photos as MMS to their contacts or send them to their own Internet site. They are able to download and play media files such as music or short films. They can access the Internet and check their emails. Moreover, they can search for a variety of services on the Internet. If they wish to locate a street, they can, for example use “Google maps” which can be downloaded in their phones. Aside from data transport, most of the popular mobile phone services are offered for free. In Denmark, many young people give up their stationary Internet connections, and prefer to send and receive data traffic solely on their mobile phones. In short, the Internet has moved from being “stationary” to being “mobile” (Alby 2008a).

At present, we see a movement from Web1.0 to the more user-oriented Web 2.0 (Alby 2008b). Here, one finds a large variety of ways to organise content and interaction, which breaks away from the...
one-way communicating Web 1.0. Instead of heavy websites, we now see an enormous proliferation of blogs, mobile blogs (moblogs) or video blogs (vidblogs). These represent a simpler way to develop websites, while opening up for two-way communication on the content. Web 2.0 provides new ways of commonly creating and sharing information and knowledge via the so-called "social software," such as Wikis, Flickr, FaceBook, YouTube, Google Earth, Google Maps and so on.

These Internet applications can be accessed both from a computer and a mobile phone, and thus offer fantastic possibilities to learn a foreign or a second language.

One of the big challenges for both foreign and second language learning is how IT can mediate or create connections between the teaching’s formal and daily (or “reality’s”) more informal learning environment (Bo-Kristensen 2004a). In foreign language learning, it is important to create a connection between, for example, the teaching of French and reality as reflected in the environment where French is being used. The same applies to second language learning. Luckily for the second language student, his/her environment outside the classroom provides language inputs and possibilities to use the language.

The challenge therefore in both foreign and second language learning is to identify effective ways of using IT to acquire relevant and authentic language in teaching and the student’s learning (Bo-Kristensen 2004b). In this connection, we pose the question:

How can the mobile phones’ and the Internet’s new developments create the link between formal and informal learning environments in language teaching?

2. Approach

To answer this question, we will first present a cognitive constructive view of foreign and second language acquisition. We will implement this view in a series of language activities, and discuss how these activities can be used in foreign and second language teaching, which continues to search for, and create better links between formal and informal learning environments.

We will also introduce the concept, geotagging, wherein one puts tags in Google Earth or Google Maps. With geotagging, one can mark or put visual representation on areas and landmarks in a given geographic area. These are the areas of the informal learning environment with which language learning would like to connect. Tags can contain everything from text over photos and film, to tasks. Language students can make their own tags and routes, or they can retrieve information, knowledge and tasks through the tags that the teacher or others have made.

In this paper, present our concept for mobile-based learning called “Mobile City and Language Guides”. This draws upon the experiences of, and the possibilities that the Web 2.0 offers. We present concrete examples of geotagging and the cognitive-based language activities that have been developed earlier. This gives us the possibility to show how the development of mobile phones and the Internet can be used to create exciting and useful links between formal and informal learning environments in foreign and second language teaching.

After the summary, present a perspective on how broadband Internet, mobile phones and Web 2.0 applications can become an everyday reality at language centers, upper secondary schools and universities. Finally, we conclude that “Mobile City and Language Guides” is only one among several possible mobile and Internet-based language educational scenarios.

3. Links between formal and informal learning environments

To find out how broadband mobiles and web 2.0-mediated links between the formal and informal foreign and second language learning environment can be presented and organized, we should first identify which language activities to focus on. We know that these language activities should be developed using the knowledge on how language is acquired as starting point (Bo-Kristensen 2006).

Language students learn alone. They also learn together with others, and they learn the knowledge and skills that are meaningful for them (Illeris 2008). This applies to language, and to all other possible subjects. The individual perspective is referred to in second and foreign language learning research as cognitive (Ellis 2008). Learning is collaborative and situational when adults learn together with others (Wenger 1999). Learning uses the existential perspective when the focus is on "meaning"
in learning (Jarvis 2004). It is an art to both separate and blend these three perspectives – so they demonstrate how adults learn.

For many teachers, the cognitive perspective is the flagship of educational reflections in second and foreign language learning. What are the cognitive processes that provide the foundation for language learning? The answer to this provides an insight on how learning activities and their possible organization in formal and informal settings should look like.

Second language learning research has different models in which to understand cognitive learning processes. Several models are offered: information- and system theory-based, hermeneutically- and phenomenologically-based models (Bo-Kristensen 2004c). These models have 3 central processes in common:
- Prior knowledge
- Attention
- Use

The concept of prior knowledge concerns the experiences, the knowledge and the accomplishments on which language students base their learning. The concept of attention is drawn from the research on perceptions and consciousness and is a prerequisite for language learning (Schmidt 2001). To learn a language requires that one notices the language’s phenomena, so one can store it in his/her short-term memory. Finally, use is a concept that also comes from memory research and shows that we know how to precisely use acquired language such that it would be possible to adapt and store it for later use – in long-term memory.

The question now is: how can these cognitive processes be implemented in concrete language activities. We will use the activities to create the necessary links between the formal and informal learning environment. We point out three types of activities:
- Pre-activities
- Main activities
- Post-activities

In “Pre-activities”, the language student’s experiences, knowledge and accomplishments are being mobilised. When a student becomes aware of what he/she already knows, it will be simpler and more rewarding to start with the main activity, which will give the student the possibility to acquire new knowledge. This new acquisition of knowledge occurs during an activity that focuses on drawing his/her attention to new phenomena in the language. It is only the student who can say what is new. However, lessons can be designed in a way that the student has the best possibility to notice the new aspects of the target language.

The main activity cannot be endless. There is a limit on how much new knowledge on language the student can absorb. Finally – to ensure that the new knowledge is stored – the student has to go through another activity. This activity, which will ensure that the new knowledge is stored in the student’s long-term memory, demands that the student uses this new knowledge. This “post-activity” may have many different forms and content. The important thing is that the student is able to use the new language phenomena so he/she acquires cognitive “ownership” of them.

We see these three types of activities often in formal learning, e.g., in language teaching’s listening and reading disciplines (Richards & Rodgers 2001). But how can these cognitive and constructivist-substantiated activities be used in organising good and affective links between the formal and informal learning environments?

We present as an example the teaching of a second language: We propose that pre-activities are introduced in the formal learning environment. With this approach, the teacher creates activities designed to utilise the student’s experiences, knowledge and accomplishments. If the example for a class is conversational grammar, the teacher should ensure that the student is aware of his/her prior knowledge about the conversation’s structure and special idiomatic expressions, while the student is allowed to acquire knowledge on how a specific conversation is carried out in the target language. This way, the student is able to prepare himself/herself to interact in the informal learning
environment, where he/she will be able to experience the language phenomena in a “real” conversation.

Activities that focus on authentic conversational grammar are addressed in the “main activities”. These activities are ideal in the informal learning environment, where newly acquired knowledge is tested in the student’s own conversations.

It is possible to introduce these activities’ post-processing or use of the new language in a more formal learning framework. For example, one can use in the classroom, specific phenomena, such as the conversation’s listening positions and phenomena in the activities, in the classroom.

In this chapter, we have shown both the language activities and the acquisition theory in order consider how language learning can create links between the students’ formal and informal learning environments. The following is a short presentation of the possibilities that geotagging offers.

4. Geotagging

Geotagging is described as the activity where one puts tags either via GPS or by marking directly in i.e., Google Earth (Fig. 1) or Google Maps (Fig. 2). What interests us in geotagging is the possibility it offers to mark or put visual representations in places and landmarks in a given geographic area. They can be areas that function as informal learning environment in which foreign and second language education wishes to create links.

Geotagging covers the following:

- A geotag describes longitude and latitude, which is connected to a specific object, e.g., text, a photo, a video clip or a language task (see e.g. Nunan 2004).
- Geotagging is a collective description that refers to the connection of information with a specific geographic point, such that the information can be searched in a map database system or via GPS.

Figure: 1: Google Earth

One can access maps and tags from his/her PC or mobile phone. It is also possible to make one’s own tags via the mobile or PC. This way, one can preserve and eventually share one’s experiences from the town and its language to others. Language students can make their own tags and routes, or they can get information, knowledge and tasks via tags from the teacher or others who have posted them. The purpose of connecting information with a geographic location is to provide the possibility to build a bridge between the virtual universe and the physical worlds. Thus, IT systems support and
promote interaction between the experiences and activities that one meets in the physical world. This can be used to seek support from the IT system, e.g., to focus attention to the language in the informal environment.

5. Mobile city and language guides

The Mobile City and Language Guides will enable the student to create learning connections between the classroom (formal environment) and the informal environment, where the language is spoken. How does one create these relationships?

The following is a classic model to organise activities in and outside the classroom:

- **Pre-activities:** The student prepares for the main activities in the classroom.
- **Main activities:** The student undertakes the given activities outside the classroom.
- **Post-activities:** The student goes back to the classroom and completes the assigned activities.

This model follows the cognitive approach (See Section 3) We use the model as basis in considering how the Mobile City and Language Guides can help the student create meaningful relations between the formal and informal learning processes. We use as an example, second language education. One of the greatest challenges here is how the student learns to adapt in his/her everyday conversations, e.g., with his/her neighbour, a caretaker in the children's day care centre or a shop assistant. It can also be everyday conversation at the workplace -- with colleagues at the cafeteria, with the boss, or with a customer. These conversations happen at different places in the geographic areas the student finds himself/herself. One can imagine where these areas can be found at a Google map an geotags with information on the specific conversational situation. Much of this later.

To make the example as concrete as possible, we will show how one expresses oneself and show that one is listening in the context of a Danish conversation.

The question is: How do Mobile City og Sprog Guides help the student to become a better listener in daily conversations in the target language? The listener expresses himself/herself in small comments, questions and nonverbal expressions on the subject that the speaker undertakes in the conversation. (Bo-Kristensen 2004c).

The knowledge that are taught in the pre-activities is how does one listenin a Danish everyday conversation. This can be done by presenting some short film clips of everyday conversation that illustrate what a listener can say and do in a conversation in Danish. The students are given a list of the listening expressions. They will be asked to, among others, compare the expressions with their own language. This way, the pre-activities give prior knowledge which can be used when the student is in his/her own informal learning environment in expressing the language phenomenon.

The teacher introduces Google Maps to the students, where some places in town are marked (geotagged), where conversations can, for example, occur. A link is provided, and when one clicks on the tags, one can watch an example of the conversation in YouTube. Likewise, there is also a summary of the conversation and a list of the listening expressions at the geotags.

In the tag, the students are asked to use their own mobile phones when they start a Danish conversation that they experience daily. They should focus their attention on and document at least two conversations they encounter. They can use their mobile phones for the following:

- Take a photo of the person/persons they converse with;
- Upload the photos at a system that enables them to put geotags on the photos (Some mobile phones have built-in GPS, wherein geotagging can be made directly from the phone);
- Audio record their conversation;
- Video record their conversation;
- Record – or get a native to record –listening expression/s that he/she has noticed.

The students are provided the following assistance:

- The mobile phone’s camera and sound/video recorder.
- Google Mobile Map with tags and relevant wordlists and links.

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Possible example videos (There is a link in the geotag that opens to the film in YouTube)

Fig. 2: A Google map geotag with an embedded conversation from a language student’s informal learning environment

The students can present their collection of their research of the target language during and after the exercise. This post-activity can be combined with other activities. After processing the experience at the classroom, the student can go back to the informal learning environment with new questions and research. They may be encouraged to make their own maps with tags containing conversation, expressions and relevant observations.

6. Conclusion and perspectives

Mobile City and Language Guides is a language learning concept that can help second and foreign language learning by creating a better link between the teaching’s formal and “reality’s” informal learning environment. In this paper, we have shown how new technological developments in mobile phones and the Internet can be used to create exciting and useful links between these environments. A question that one can ask right now is: How can broadband Internet mobile phones and Web 2.0 applications become a reality and the daily life at the language schools, upper secondary schools and universities?

The answer to the question is training for teachers. But we are not so sure that this is enough. Other supporting initiatives must be undertaken if a learning concept such as the Mobile City and Language Guides will be a reality in a practical everyday teaching and learning. Perhaps, the answer can be found, at a higher level, at the institutions’ own concrete IT culture and vision on how technology (in this case broadband mobile phones and Web 2.0) should be incorporated in teaching. In our
experience, this culture starts to seriously develop when it has the support of the institution’s Board, management and teaching staff.

Finally, *Mobile City and Language Guides* is only one among several possible mobile and Internet-based language educational scenarios. Therefore, a future challenge is to develop not only the concept of *Mobile City and Language Guides* but a great deal of other meaningful and exciting scenarios that can strengthen the linkages between formal and informal learning environments.

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Some Factors to Consider When Designing Semi-Autonomous Learning Environments

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Abstract: This research aims to answer the question, “in what ways do mediated learning environments support or hinder learner autonomy?”

Learner autonomy has been identified as one important factor in the success of mediated learning environments. The central aspect of learner autonomy is the control that the learner exercises over the various aspects of learning, beginning with the decision to learn or not to learn. But as Candy (1995) points out, there are several areas where learner-control can be exercised.

The first are the motivational-intentional forces that drive the learner to apply some determination (or “vigour”) to the act of learning. They are the conative functions of learning and include learner initiative, motivation and personal involvement. They are often associated with life goals that are independent of the actual learning goals pursued within the strict confines of the learning environment (Long, 1994).

The second area of learner-control is the one comprising the “nuts-and-bolts” of the act of learning, such as defining learning goals, deciding on a learning sequence, choosing a workable pacing of learning activities, and selecting learning resources (Hrimech & Bouchard, 1998). These are the algorithmic aspects of learning, and in traditional schooling, they are the sole responsibility of the teacher. In mediated learning environments, it can be shared between the platform and the actual learner.

Just a few years ago, learner control was necessarily limited to these two sets of features, conative and algorithmic. Today however, with the proliferation of educational offerings in both the private and public sector, as well as the developments in educational technology, two other aspects of the learning environment emerge as important areas where learner-control can be exercised.

The semiotic dimension of learner-control includes the symbolic platforms used to convey information and meaning, for example web “pages”, hypertext, video/audio multimedia, animation, each of these bringing with them their own specific set of possibilities and limitations for autonomy in learning.

And then again, all learning environments exist in their own distinct economic sphere where decisions about whether, what and how to learn are made on the basis of cost-benefit, opportunity cost, and extrinsic market value.

We will examine the implications of each of these areas of learner-control, and share our analysis of a series of interviews with cyber-learners, based on this framework of conative, algorithmic, semiotic and economic factors.

Keywords: self-directed learning, learner autonomy, educational policy, international development.

1. More or less autonomy?

Early attempts at defining features of Distance Education have stumbled upon an interesting conundrum. Some authors (Kegan, 1986; Perraton, 1983), pointed out that printed material mailed to a distant location increased pressure on the learners to set their own schedule and to work around deadlines imposed by the teaching institution. This feature, juxtaposed to the fact that distance education shows one of the highest drop-out rates among all educational environments, led to the supposition that distance learning requires some higher degree of learner autonomy than traditional classroom instruction. Indeed, lack of autonomy was considered the main reason why students failed or discontinued their programs.

Another feature of Distance Education was identified as the constraint imposed on institutions to produce a standard learning program that will be followed by all learners in the same sequence, usually within a set of prescribed deadlines (Holmberg, 1986). This institutional standardization, inevitably, is then passed on to the learner. In this respect, distance learning environments can be said to constrain the expression of autonomy among learners and instructors alike, at least when
compared with traditional environments where components of the program may be modified in response to learner feedback or other considerations.

The question of whether a specific learning environment will support or hinder the expression of autonomy is an important one for educators. Contemporary literature in adult education has focused on learner self-direction as a core value associated with the notion of facilitation, rather than the dispensation of learning (Knowles 1980; Long, 1992). The point here is not to retrace the steps that led to the emergence of learner-autonomy as a strongly held value among adult educators, but merely to situate our study within its context. It is our view that the quality of any learning environment is to a significant extent dependent on the degree to which that environment acknowledges the need to support learner self-direction.

Several authors have attempted, with varying results, to define self-direction in learning. One of the most influential works in this area, Candy (1991) summarizes self-direction in these terms:

*Being able to pursue a learning goal with equal vigour and determination without being adversely affected by external factors including the increase or decrease of rewards for pursuing or attaining the goal (…)*

Conceiving of goals, policies and plans independently of pressures to do so, or not do so.

(p. 41)

And further:

*Being aware of alternative choices, both as to learning strategies and to interpretations or value positions being expressed, and making reasoned choices about the route to follow in accordance with personally significant ideas and purposes.*

(p. 62)

Interestingly, these quotes point to very different aspects of learner autonomy, the central one being the control that the learner exercises over the various aspects of learning, beginning with the decision to learn or not to learn. But as Candy points out, there are other specific areas where learner-control can be exercised.

2. Pedagogical vs. psychological

The question, then, is to investigate the “areas” of learner control. How many are there? How do they intersect with the specific features of D. E. environments? What are their implications for adult learning?

According to Long (1982), the first area includes the motivational-intentional forces that drive the learner to apply some determination (or “vigour”) to the act of learning. What Huey Long called the ‘psychological’ aspects of learner autonomy will be referred to here as the conative functions of learning. They are the foundation of learner initiative, motivation and personal involvement. Most often, adult learners harbour life-goals that are related, but distinct from the actual learning goals (e.g. career advancement, good parenting or better health), as part of the conative baggage they carry. Other possible drives include the pleasure one derives from the act of learning in itself, and the satisfaction obtained from becoming part of a particular culture of knowledge (Houle, 1961).

The second set of elements identified by Long (1982) as a subset of learner autonomy were the “pedagogical” aspects of learning. These involve the control over the “nuts-and-bolts” of the act of learning, such as defining learning goals, deciding on a learning sequence, choosing a workable pacing of learning activities, and selecting learning resources (Hrimech & Bouchard, 1998). These elements can be grouped under the more precise heading of algorithmic aspects of learning. In traditional learning environments, most of the algorithms are the responsibility of a teacher or a teaching institution. Learning goals, student workload and methods of evaluation are usually stipulated at the outset and little participation in their formulation is expected from the learner. Any derogation from this approach entails devolving to the learner, on top of the expected “learning tasks”, at least some of the “teaching tasks” normally reserved for the instructor. In this sense, we can say that autonomy is directly related to the number and magnitude of the “teaching tasks” that are appropriated by the learner (Tough, 1965). Most mediated learning environments require such
participation from learners, albeit to different degrees and with varying results as will be described below.

2.1 Emerging dimensions

Just a few years ago, learner control was necessarily limited to these two sets of features, conative and algorithmic. After deciding whether, what, and how to learn, one had covered all areas where it was conceivably possible to exercise some degree of learner autonomy. Now with the proliferation of learning environments that include mediated instruction materials, exponentially available learning resources, new means of communication, and a marketplace literally exploding with learning opportunities, two other components of learning emerge as possible areas where learner control may be exercised – or impeded. We have namely identified the *semiotic* dimension of learning, and the emerging *economics* of the knowledge marketplace.

Until recently, the prevalent medium for encoding, storing and disseminating knowledge was to provide access to print materials through libraries, mail-order programs, or custom-printed resources. Today, learning materials include rather diverse media which may share very few features with printed text. For example, hypertext, asynchronous messaging, and electronic whiteboards each possess their own set of codes and behaviors that are inconsistent with the linear quality of print. Furthermore, the manner in which each new medium is utilized by instructors and learners varies to some extent, leading to further diversification in the perception of their semantic possibilities (Garrison, 2000). For example, hypertext can be used as a way to link course materials to outside resources, or as an inherent part of the material to be learned, or then again as non-compulsory enrichment to the basic text such as illustrations or diagrams to be viewed when needed. From the learner’s perspective, hypertext can be perceived as a convenient way to store and retrieve information, or as a bothersome irritant leading to feelings of frustration in the presence of overwhelming amounts of poorly organized data. Because each environment offers its own set of communication pragmatics and its own approach to using them, we can say that the semiotic choices made by designers and instructors are an integral part of the learner’s experience, and as such offer opportunities to enhance or deter learner autonomy.

Learning is no longer the reserved province of traditional institutions such as schools or colleges. Indeed, it is now acknowledged that universities find themselves in direct competition not only with each other, but with a multitude of offerings from a thriving marketplace (Moore & Kearsley, 1996). Today an important component of any learning environment is the perceived economic value of its knowledge in the marketplace, either as an asset for finding employment or as a means of production in the knowledge economy. Based on this consideration, learners must not only decide why and what to learn, but also where to learn it and who to learn it from. This decision will surely be based on factors like individual preference for a proposed learning environment, but ultimately the choice will rest on the perceived cost-benefit and opportunity cost which are generated by each alternative. In this context, we can observe that the *economics* of learning are emerging as an important component of learning environments.

The diagram in Figure 1 illustrates how learner autonomy can be divided in four areas of learner control: conative, algorithmic, semantic and economic. One useful feature of this representation is that it makes it possible to explore learner perceptions within different learning environments, while retaining a constant framework for analysis.
3. Methodology

Open-ended interviews were conducted with 13 adult students registered in on-line courses in Psychology, Finance, Education, and Political Science. Questions were formulated to explore the four areas of learner autonomy, using everyday terminology familiar to the students. The research question to be explored using this method was, more specifically,

“In what ways do mediated learning environments hinder or support the emergence and expression of learner autonomy?”

The questions asked the informants were not as formally worded. We conducted semi-guided interviews generally purported to get some feedback from the students on their learning experience in on-line university courses. Interviews were taped, transcribed, coded and analysed using standard content analysis techniques. Coding was done by grouping units of meaning under tentative
headings, and then combining the headings under generic titles using an emergent design method. The factors that determined the students’ perception of each learning environment were categorized as: Interaction; Structure; Value; Context; and Media.

4. Findings

One of the first things that became apparent during the interviews was the diversity in the likes and dislikes of individuals concerning the various components of the learning environments. All courses were designed using online course materials, a messaging device and a textbook. Some used hyperlinks to other web-based resources, and none included classroom or face-to-face meetings. The individual preferences were polarized around the use of media, the course structure and the value of course content. Predictably, about half of the students said it took some effort to prevent inertia when facing the prospect of doing tasks online, in the absence of an imposed schedule.

4.1 Interaction

The portion of the course grade allotted for participation in on-line discussion groups varied between 0% and 40%. In the groups where there was less pressure to ‘participate’, students felt that the interaction was more meaningful and that they were more in ‘control’ of the environment. From the students’ responses, it appears that instructors did not attach any weighting to the quality or tone of the interactions. Some students felt that the imposition of online discussion was superfluous, but nevertheless felt their learning was validated when read by others. Some students felt uncomfortable at the idea that the instructor had access to the messages, which prompted the use of alternative means of communication between students – private email and telephone conversations. In one instance, the instructor’s failure to moderate a somewhat incendiary discussion on Middle-East politics dissuaded other students from participating. Interaction also occurred between students and TAs, technicians and, more rarely, professors. Students enrolled in a full-year course reported the growth of a sense of learning community around the 4th month of interaction, while single-term students did not. Posting messages to a discussion group was perceived as less threatening, and therefore more accessible, than voicing comments in a classroom. One student complained that there is no real connection to others when talking on-line – “you never get to ‘know’ anyone”. This finding supports the notion that the conative aspects of learner autonomy in D. E. environments need to be further analyzed to include the subsets that are specifically linked to the characteristics of the environment itself. For example, while social interaction has been found to be one important factor in the motivation of learners, the type of interaction provided by chat-groups, e-mail and moodles need to be further explored.

4.2 Structure

A few students who had a personal interest in their course topic spontaneously searched for alternative learning resources but overall, this was not a prevalent practice. All courses except one had set very specific objectives, thereby circumventing student participation in their formulation. When a learning goal was stated in general terms, mature students more readily established links with their own experiences and interests. Evaluation was done in much the same way as in classroom environments, participation in discussion groups being graded in lieu of attendance. Overall, students had difficulty evaluating their own learning, stating instead that they earned their grade simply by conforming to the course-work requirements. Students with poor performance tended to blame the “lack of clarity” of the course objectives.

Students admitted readily that they chose an on-line course because of the flexibility it afforded in their schedule. However, some found the prescribed pacing too slow, while others found it somewhat daunting, especially when assigned weekly readings – thus, scheduling became more of a problem than anticipated. The requirement to participate in online discussions was perceived as additional workload that would have been less demanding in classroom interaction. The detailed program structure found in all but one of the on-line courses was perceived to make the learning tasks more manageable, as they were relieved of any ambiguity.

This finding points to the importance of some important algorithmic features that are inextricably woven into the design of each D. E. learning environment. In most cases, we found that design features tended to reduce learner autonomy in very serious ways. Setting unalterable objectives, leaving all evaluation activities to the instructor, setting the same sequence of learning for all students independently of their individual needs or characteristics, all of the have detrimental effects on learner
autonomy. In fact, this is the area where the most severe weaknesses were found in the designs we studied. Since there is no inherent reason why D. E. packages should limit autonomy so much, we need to ask ourselves why designers tend to appropriate for themselves such excessive control over the environment.

4.3 Value

Students can be placed in two groups according to the criteria they used to establish the value of their learning. The first group derived their estimation from the potential usefulness of their newly acquired knowledge in some immediate area of their lives, either by providing tools for better understanding world issues or financial matters, or by developing skills that apply to family relationships or the workplace. The second group was typically concerned with completing a university degree and selecting eligible courses for their anticipated convenience or easy workload. Interestingly, several students admitted opting for on-line courses assuming – wrongly they soon discovered – that they would entail a flexible schedule and a less demanding productivity. Some of the derived benefits were discovered as learning occurred throughout the course. Others were identified as unanticipated spin-offs, such as developing better writing or computer skills. One student pointed out that his workplace offered a similar course package, featuring a better design and a lower cost, but that it could not be credited towards his university degree.

As in many institutions, the actual per-credit cost to the student is considerably higher for the on-line version of a course. Students generally accepted this fact with some resignation, but could not explain the disparity. One student realized too late that he could have learned independently, at a much lower cost, everything that he learned in his course. Two other students acknowledged that they had chosen the institutional avenue in order to access the university’s sophisticated computer labs. In light of these findings, we can say that the economics of D. E. are often poorly understood by institutional designers. In some instances, the cost associated with learning is in reality the hidden cost of giving institutional credit for learning that could have occurred anywhere. This gives rise to unnecessary duplication of courses that are offered in non-credit organizations (e.g. the workplace), or to the practice of granting dubious legitimacy for learning that otherwise could have been entirely self-directed, and therefore considerably less costly.

4.4 Context

Students were asked about the reasons they decided to enrol in their course, and why they chose the on-line version of the course. Factors such as desire to understand family issues, or the wish to improve work performance were mentioned by mature and non-degree students only. Reasons for choosing the on-line version of the course were mostly linked to personal, family and work situations. Somewhat ironically, the same factors were identified as barriers to achievement in the on-line course. The institutional context also was perceived to play a role, beginning with the fact that two versions of the course were offered by the institution, that the on-line version was higher priced but available, and that the absence of in-class meetings seem to motivate the instructors to increase student workload.

4.5 Media

In a previous study (Bouchard & Kalman, 1998), low computer literacy was identified as a barrier to distance learning. Here, students all had achieved reasonable competency at using computers. Some difficulties were encountered however with the consistency of access to the online environment. There were frequent system crashes and technical help was not always available. From the delivery point of view, the emphasis was placed on completing course assignments and little attention was paid to students’ efforts to learn how to navigate within the system and outside. Some features of the courseware were used routinely, such as messaging and on-line exams, while others were rarely or not used (file transfer, self-corrected testing, live chat, transfer of images or animated gif files, etc).

This particular finding points to another area of concern for D. E. designers. There is a tendency to use technology and systems that are available, rather than those that are appropriate. This is attributable to a common management error that consists of making decisions based on past investments rather than future returns. As often happens with adult learners, they end up making their own decisions, and choosing for themselves how they will learn. This is the self-appropriation of the semiotic aspect of learning that is made possible when more than one technology is available.
5. Discussion

The purpose of this study was to obtain from the learner's perspective some indication of the factors that encourage or deter from the development of self-direction in mediated learning environments. In light of the data collected, it is possible to make some recommendations that relate to the conative, algorithmic, semantic and economic dimensions of learner autonomy. Further analysis will allow us to produce a more detailed classification, but for now we will limit ourselves to a number of recommendations that are supported by our data. This information should be useful for planners who value, beyond the conformity to academic standards, the capacity for self-direction as a central goal of education.

First, it should be noted that students embark in on-line courses with various expectations, ranging from fairly reasonable to confused. Efforts should be made towards correcting the most common misunderstandings, such as the expectation that on-line courses are easy, require less time and demand less participation – before enrolment. Some allowance should be made at the beginning of a session for learning the navigation and software tools that will be used during the term. Whenever possible, face-to-face meetings or other devices seeking to personalize the learning environment should be planned in order to reduce feelings of alienation (an important conative aspect of learning).

Online discussions should be structured around guidelines and clear criteria should be set to evaluate the quality, rather than quantity, of participation. Instructors should attend to online discussions but refrain from acting as one of the participants. Students’ work can be validated by peers through feedback given on short warm-up assignments. Students can be encouraged to explore alternative sources of documentation outside the confines of the on-line device, and to establish links with their own personal areas of interest. Reasons for pricing on-line courses in a higher bracket should be made public by the institution, or that practice should be discontinued. Opportunities to learn similar contents in other, less costly venues, should be made available to learners (thereby improving economic flexibility). Planners should be aware of the added time constraints imposed by on-line participation in discussion groups, testing and other interactions. Students can be encouraged to explore the possibilities offered by the institutional and other software packages, and not limit themselves to those functions used by the instructor.

On-line and other mediated learning environments offer much potential for supporting the development of self-directed learning skills, and can also be powerful deterrents. Realizing the potential – and reducing the deterrents – are possible if educational planners consider the importance of these two criteria when making instructional design decisions.

6. References


Game Inspired Tool Support for e-Learning Processes

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Abstract: Student engagement is crucial to the success of e-learning but is often difficult to achieve in practice. One significant factor is the quality of the learning content; also important, however, is the suitability of the process through which that material is studied. In recent years much research has been devoted to improving e-learning content but considerably less attention given to enhancing the associated e-learning process. This paper focuses on that process, considering in particular how student engagement might be improved using techniques common in digital games. The work is motivated by a belief that, with careful design, e-learning systems may be able to achieve the levels of engagement expected of digital games. In general, such games succeed by entertaining players, building on their natural curiosity and competitiveness to encourage them to continue to play. This paper supports a belief that by adopting some of the engagement techniques used in games, e-learning can become equally successful. In particular, the paper considers how the learning process might become a form of game that helps sustain continued study. Factors affecting engagement and elements of digital games that make them engaging are identified. A proposal for improving engagement is then outlined. The approach is to encourage student involvement by rewarding desirable behaviour, including the completion of optional challenges, and giving regular feedback on performance, measured against others in the same class. Feedback is provided through a web-based tool. The paper describes an exploratory assessment of both the tool and approach through action research. Results for two linked university modules teaching software development are presented. The results so far are very encouraging in that student engagement and performance have increased, especially at the weaker end of the class. Limitations of the approach are also outlined, together with an indication of future research plans.

Keywords: e-learning, digital games, engagement, feedback, action research

1. Introduction

In essence, engagement is the measure of a student’s participation in a learning task. Skinner and Belmont (1993) explain this more fully by suggesting that those engaged “…show sustained behavioural involvement in learning activities accompanied by a positive emotional tone. They select tasks at the border of their competencies, initiate action when given the opportunity, and exert intense effort and concentration in the implementation of learning tasks; they show generally positive emotions during ongoing action, including enthusiasm, optimism, curiosity, and interest”.

As might be expected, engagement is strongly related to achievement and dropout rates (Astin 1993, Harrison 2006, Trotter and Roberts 2006). Dropouts in e-learning are a particular concern, involving many complex issues (Martinez 2003, Tyler-Smith 2006). With a growing use of technology at all levels of education, leading to a blended approach to learning, the importance of improving engagement in e-learning has increased. The purpose of this paper is to consider how techniques used in computer games might be used to improve such engagement.

The overall situation is summarised graphically in Figure 1 as a rich picture (Lewis 1992). Rich pictures, often used in Soft Systems Methodology (Checkland 1999), help build and document a shared understanding of a situation of concern. The diagram in this case shows a class of students studying material through engagement in a structured teaching and learning process—which typically has to be covered to a schedule to meet assessment constraints. The process is supported formally by one or more teachers and/or tutors, together with computers connected to the internet. There is also informal support for the learning process from others in the same class group. The ticks emphasise the positive benefits to the process from these sources of support. On the negative side, the crossed swords identify two areas of concern: one is the limited availability of teachers/tutors and the other is the difficulty that students experience in engaging with the learning process. In the bottom section of the diagram it is suggested that the difficulty with engagement might be helped by adopting ideas from computer games.
Computer games are known to be highly engaging. The inherent rule-bound structure of a game immerses a player in a temporary world in which challenges build up skills and knowledge to help achieve specific goals. As this is essentially a learning process (Gee 2005, Prensky 2006), many believe that games ideas could be used in e-learning to improve engagement (Cordova and Lepper 1996, Jonassen and Land 2000, Ricci et al. 1996, Squire and Jenkins 2004). That is the motivation for the work described in this paper.

Games ideas can be used in both the learning process and the design of learning materials. Work in this area has tended to focus on learning content (McFarlane et al. 2002) but the learning process is equally important. Indeed, improvements to the process can be more influential because, by being largely independent of content, such ideas can be used in a wide range of contexts. Section 2 of this paper examines engagement in the teaching and learning process in more detail and identifies the engaging aspects of games that might support that process. Section 3 then outlines the design of a process game. Experiences with using this process and associated tool are discussed in Section 4. Plans for further development of the approach are indicated in the conclusions.

2. Supporting engagement with games techniques

This section examines the factors associated with engagement as a first step towards identifying improvement. One well established model of the constituent elements of engagement is that developed for the National Survey of Student Engagement (NSSE), which began in 2000. The purpose of the survey is to gather information annually on engagement across four-year colleges and universities in the USA and Canada. In 2000, 276 institutions were involved, rising each year to 774 in 2008. The rationale for their work (NSSE 2008) is that “...the time and energy students devote to educationally purposeful activities is the single best predictor of their learning and personal development... [so] those institutions that more fully engage their students in the variety of activities that contribute to valued outcomes of college can claim to be of higher quality compared with other colleges and universities where students are less engaged”.

NSSE currently bases its engagement benchmark on five main indicators, assessed through 42 questions. The indicators are:

- Level of Academic Challenge, as “challenging intellectual and creative work is central to student learning and collegiate quality. Colleges and universities promote high levels of student
achievement by emphasizing the importance of academic effort and setting high expectations for student performance”.

- **Active and Collaborative Learning**, as “students learn more when they are intensely involved in their education and are asked to think about and apply what they are learning in different settings. Collaborating with others in solving problems or mastering difficult material prepares students to deal with the messy, unscripted problems they will encounter daily during and after college”.

- **Student Interaction with Faculty**, as “students see first-hand how experts think about and solve practical problems by interacting with faculty members inside and outside the classroom. As a result, their teachers become role models, mentors, and guides for continuous, life-long learning”.

- **Enriching Educational Experiences**, as “complimentary learning opportunities inside and outside the classroom augment the academic program”.

- **Supportive Campus Environment**, as “students perform better and are more satisfied at colleges that are committed to their success and cultivate positive working and social relations among different groups on campus”.

These factors cover both technical and personal development, across a full educational programme, and include wide interaction with the environment. Other researchers have identified more detailed factors, some of which elaborate or complement the points above, including:

- **Challenging tasks**: tasks should continually and appropriately challenge students to stimulate engaged learning. If a task is too simple it becomes boring and if too difficult, can be frustrating. Tasks must increase in difficulty as students improve to ensure they stay engaged in the process (Quinn 2005, Wang and Kang 2006).


- **Identity and roles**: being a member of a community has a strong motivational influence on an individual’s identity with their peers, and much research emphasises the importance of the social factors of learning engagement (Rosenberg 2001).

- **Focused goals**: students should be aware of or discover which outcomes they need to achieve. This can be accomplished by defining a clear set of compelling goals that relate to the learning objectives (Quinn 2005). Also, allowing students to set their own goals could help increase motivation and further immerse them in the learning process (Wang and Kang 2006).

- **Protection from adverse consequences**: students should receive feedback on their work throughout the process, which informs them of their progress towards the learning goals (Allen 2003, Schlechty 1997, Wang and Kang 2006).

- **Clear and compelling standards**: the standards for assessing performance should be clear and are important to students (Schlechty 1997).

- **Authenticity**: the work should be significant and relevant to the lives of students and something with which they can identify (Allen 2003, Rosenberg 2001, Wang and Kang 2006).

- **Affirmation of progress**: student performance should be observed by persons other than the teacher as this public review helps add meaning to the completed tasks (Schlechty 1997).

- **Choice**: students should be provided with choice in the ways of doing the work and the methods of presentation. Choice increases engagement by giving the student control over their learning experiences (Wang and Kang 2006).

This list can be further refined by identifying key elements of game design that promote an effective learning experience (Cordova 1996, Garris et al. 2002, Malone and Lepper 1987, Rieber 1996). A significant overlap is to be expected but considering the factors from a different perspective helps clarify their meaning and give insights into how improved engagement might be achieved.

- **Fun**: This is an essential engagement factor in games but isn’t typically given much prominence in education. Anyone directly involved, however, knows of the positive impact that ‘fun’ can have on engagement. Koster (2004) goes further and argues that “fun is just another word for learning”, implying that effective learning is inherently enjoyable.

- **Conflict**: This is an alternative way to think about ‘challenge’ in education. Conflict is an intrinsic element in game systems and occurs routinely as a player pursues goals. Some goals may be
achieved with ease while others require a higher level of skill that has to be developed (Salen and Zimmerman 2003). The struggle of players to complete these goals, either in opposition or collaboratively, encourages engagement by building on their natural competitive drive.

- **Structure**: The ‘rule bound’, ‘goal oriented’ structure of games contributes to an engaging experience (Bjork and Holopainen 2005, Gee 2005, Rabin 2005, diSessa 2000). As in education, goals, sub-goals and required levels of achievement need to be clear, relevant and appropriate.

- **Identity**: A player usually has a visual representation of themselves within a game system. Gee (2003) describes this as a “projective visual identity”. This may be selected by the player or personally developed by them. Gee (2003) suggests this identity deepens personal investment in the game and encourages players to interact and engage to a greater extent through the projected character. Currently, there is no directly equivalent mechanism in education but students do develop specific role within a peer group.

- **Feedback**: As in education, feedback in games is important in providing players with timely and relevant information on their progress towards goals and identifying their level of achievement so far. Progress within the game will often be summarised in a map, and achievement indicated through ongoing game statistics, measuring attributes such as player skill, strength and health.

- **Social**: When players interact within a game environment there is social interaction at two levels: (i) internally, though interaction of game characters; and (ii) externally, as the players communicate to exchange information, share experiences, or compete to make progress with the game (Salen and Zimmerman 2003). Much educational and social research highlights the importance of such social interactions in the learning process (Rudd et al. 2006).

The next section, building on these aspects of game design that promote engagement, outlines an approach to the development of a process game that is intended to improve engagement in a programme of study. In principle, the approach should be relevant to study at any academic level but the initial focus and subsequent experimental work described is in third level education.

### 3. The teaching and learning process game

The most obvious difference between the list of relevant engagement factors in education and the one for games, as outlined in Section 2, is the absence of ‘fun’ in the education list. One obvious way to improve engagement, therefore, is to introduce a game into the general teaching and learning process. What is less obvious, however, is the form that such a game should take to ensure that it is played with sufficient enthusiasm to enhance student performance. Potentially, for example, the game might be resented by the students, and ignored. Because of this concern, it was decided to approach the design of the game cautiously, in stages. In the first stage, the focus was on group work, with the expectation that groups would be more likely than individuals to take part in a game. As a further safeguard, the game was presented as an ‘experiment’, with participation made optional and ample opportunity given for critical feedback.

The general strategy was to create a game in which points were offered for desirable behaviour, which would include, for example, attendance at lectures, lab classes and tutorials. Desirable behaviour is obviously important for student success but interesting optional challenges are also necessary. Examples here include answering questions in tutorials, asking questions in lectures and making a presentation to the class on a relevant technical topic.

Groups were allowed to give themselves names to establish a game identity, and feedback was provided each week through an update of group scores. As an ‘affirmation of progress’ these scores were displayed openly on a plasma display in a public area.

The group approach was sufficiently successful to move confidently to the second stage of introducing engagement strategies from games, namely to encourage students individually. For this stage, a feedback tool was developed to present each student with an ongoing report of their performance. The results from these experiments are described in the next section.

### 4. Experience with the teaching and learning engagement game

Experimental use of the engagement game focused on two consecutive first year Java programming modules: **Software Development 1** (COM158C1) and **Software Development 2** (COM164C2). Both ran for 12 weeks, in consecutive seminars from September to December 2007 and January to May 2008, respectively. The modules operated identically in 2006-07, without the game, so direct
comparisons of student behaviour and performance could be made. Students were briefed about the game at the beginning of the year and all chose to participate.

4.1 Semester 1: the process game with groups

In the first semester, the experiment was designed around relatively large groups of students. Specifically, 64 students were allocated to 8 groups, selected to have a reasonably even distribution of ability, based on entry level qualifications. The main objective of the first experiment was to see if the students would participate in the game and, if so, determine the impact on both their behaviour and academic performance. The semester was divided into two halves: a simple introductory game ran from weeks 1-5, which helped familiarise the students with the various elements of the game, as summarised in Table 1. These were introduced as the rules of the game. The game leader board was reset during week 6 and the game continued throughout the remaining 5 weeks of the semester.

Table 1: Rules for game 1

<table>
<thead>
<tr>
<th>Element</th>
<th>Score</th>
<th>Possible Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance</td>
<td>10 Points for each of the lectures, lab class and tutorial</td>
<td>200</td>
</tr>
<tr>
<td>Contribution to tutorial</td>
<td>10 Points for every question answered correctly (Maximum of 10 points per student per tutorial)</td>
<td>50</td>
</tr>
<tr>
<td>Outstanding work</td>
<td>10 Points awarded at lecturer’s discretion</td>
<td>50</td>
</tr>
<tr>
<td>Online Revision Quizzes</td>
<td>10 Points awarded for each quiz a student completes successfully; further attempts not rewarded with points but the student who obtains the highest score on their first attempt awarded a further 20 points</td>
<td>210</td>
</tr>
<tr>
<td>Group Assignment</td>
<td>25 Points group mark</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>15 Points individual mark</td>
<td></td>
</tr>
<tr>
<td>Exam Questions</td>
<td>10 Points awarded to each question completed by group, max of 2 questions per group</td>
<td>20</td>
</tr>
<tr>
<td>Group Presentations</td>
<td>20 Points awarded for a presentation, max of 2 presentations per group</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>590</td>
</tr>
</tbody>
</table>

Different levels of challenge were identified, closely linked to keys skills that would benefit the students. Students could chose to do nothing beyond normal module activity and still earn some points, or select more demanding tasks, which might enhance their skills while gaining higher points for their group. For this experiment, feedback was presented weekly, showing the breakdown of group points, as indicted in Figures 2. This information was accessible through each student’s virtual learning environment and was also displayed publicly.

Figure 2: Graph of gamer points and the breakdown

The groups and their interaction with the game were observed in class. Some groups, like the Radioactive Squadron, were slow to engage but as the game neared the end of the semester put in
additional effort. In general, the groups would discuss their performance regularly and make strategic decisions about what tasks to tackle and who would tackle them. Attendance increased by 5% over the previous year, with completion of revision quizzes up by 70%. One unfortunate side effect was that the number of questions asked in lectures became unmanageable, showing that the rules needed to be fine tuned. Most significantly, the examination average for the module increased, and everyone passed at the first attempt (40%), as shown in the scatter graphs in Figure 3. This had never happened before and was both surprising and encouraging.

![Figure 3: Comparative module results for COM158C1 for 2006/07 and 2007/08](image)

Overall, student feedback was very positive and the game seemed to have been an enjoyable and worthwhile experience for them. With respect to the objectives of the experiment, the students clearly accepted the game and benefitted accordingly. The main criticism was in relation to feedback, with most students wanting points to be updated more frequently and many seeking information on their individual performance. These issues and the lessons learned in the first semester were used in designing the experiment on individual process game play implemented in Semester 2.

### 4.2 Semester 2: the process game with individuals

The second stage of the experiment involved the same group of students, with similar challenges but with some adjustment to the scoring scheme, as shown in Table 2.

#### Table 2: Rules for game 2

<table>
<thead>
<tr>
<th>Element</th>
<th>Score</th>
<th>Possible Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 CV</td>
<td>Create CV and Submit to study Supervisor</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Polished finish</td>
<td>25</td>
</tr>
<tr>
<td>2 Group Dynamics</td>
<td>Weeks 1-5</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Weeks 7-11</td>
<td>25</td>
</tr>
<tr>
<td>3 Outstanding Work</td>
<td>Assignment Week 2</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Assignment Week 4</td>
<td>30</td>
</tr>
<tr>
<td>4 Answering Questions in Tutorial</td>
<td>10 points/week * 8 weeks</td>
<td>80</td>
</tr>
<tr>
<td>5 Coursework</td>
<td>Assignment Week 2</td>
<td>15</td>
</tr>
<tr>
<td>6</td>
<td>Assignment Week 4</td>
<td>15</td>
</tr>
<tr>
<td>7</td>
<td>Week 6 Test</td>
<td>30</td>
</tr>
<tr>
<td>8</td>
<td>Group Assignment</td>
<td>35</td>
</tr>
<tr>
<td>9</td>
<td>Personal Development System Use</td>
<td>5</td>
</tr>
<tr>
<td>10 Attendance</td>
<td>L1 = 2 points/week * 12 weeks</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Lab = 4 points/week * 12 weeks</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>L2 = 2 points/week * 12 weeks</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Tutorial = 2 points/week * 12 weeks</td>
<td>24</td>
</tr>
<tr>
<td>11 Asking Questions in Lectures</td>
<td>7points/Lecture * 2 Lectures/week * 10 weeks</td>
<td>140</td>
</tr>
<tr>
<td>12 Quiz &amp; Presentations</td>
<td>Quiz (additional reading) weeks 2-5 (25*4)</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>1 presentation within weeks (7-11)</td>
<td>100</td>
</tr>
<tr>
<td>13 Revision Quizzes</td>
<td>10 points per quiz</td>
<td>200</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>1000</td>
</tr>
</tbody>
</table>
The scoring scheme was based on the Xbox Live game system model, in which players compete for up to 1000 achievement points, which was a rounder target. Not all points were available immediately, so a weekly release plan of the gamer points was produced, as shown in Table 3.

**Table 3:** Weekly release plan of gamer points

<table>
<thead>
<tr>
<th>Week</th>
<th>Attendance</th>
<th>Ask questions in Lectures</th>
<th>Answering Questions in Tutorials</th>
<th>Assignment (1,2)</th>
<th>Outstanding Work</th>
<th>Group Dynamics</th>
<th>Class Test</th>
<th>PDP</th>
<th>Group Assignment</th>
<th>Quiz &amp; Presentation</th>
<th>CV</th>
<th>Revision Quizzes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>From Wk 3</td>
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<tr>
<td>2</td>
<td>10</td>
<td>14</td>
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Student feedback was given individually and updated daily. A tool was developed to display this feedback graphically. The user interface is shown in Figure 4. There are four main sections on the screen: basic student details are on the left hand side, information on gamer points is in the middle and attendance information is on the right. At the top, is a slider allowing students to give basic feedback on the perceived value of the performance display tool.

The gamer point section shows: the total points available at any stage, the score the student has obtained, their position in class and the highest and lowest scores within that class. The lower graph gives the mark breakdown, with further details displayed as the mouse pointer is moved over the bars.

Attendance was believed to be a key indicator of engagement so it was given a section to itself. This shows the percentage of overall attendance and a week by week breakdown. On reflection, this rather negative emphasis on attendance seems disproportionate to other aspects of the game and so is currently under review.

Comparing the 2007-08 class with the equivalent cohort in 2006-07, again showed significant improvements. Attendance was up by 4% and examination performance had also improved significantly as shown in Figure 5. In this traditionally demanding module, initial failure rates of the order of 25% had been common over many years but dropped to less than 10% in 2007-08. As in the first semester, there was a clear improvement in performance at the lower end of the class but there was also improvement across the class, suggesting that the game approach was bringing benefits to those with a range of abilities. Most significantly, Figure 5 shows a smooth distribution of marks for 2007-08, whereas the 2006-07 results suggested that a group at the bottom end had largely given up.
As in the first semester, the students again rose to the challenges offered, engaged in the game and enjoyed the experience. The additional use of the graphical feedback tool also had a favourable response, with a satisfaction rating of over 80%. The experiment in the first semester made clear that students wanted to be aware of their own performance even if they work in groups. It was, however, unclear to what extent engagement and performance were dependent on peer pressure within the groups. More careful experimentation is needed here, but the results in the second semester suggested that the process game could run successfully without groups and so be relevant to individual e-learning.

5. Conclusions and future work

This paper has described some initial exploratory research into the use of games techniques to improve student engagement in e-learning. The overall objective is to help students reach their potential, which, as a side effect, includes reducing the student dropout rate. The work is being
approached as a series of investigative experiments moving from a labour intensive face-to-face form of teaching to full e-learning, involving minimum tutor contact. The paper describes the first two stages in this sequence. The first stage introduced a group game to a traditional first year programming module and the second extended that approach to individual students. The results have been well beyond expectations in several respects though there are also reservations in each case.

Fundamentally, the game approach to the teaching and learning process seems to be successful in that the students responded well, with all agreeing to participate and many rising to the challenges involved. One key question here, however, is the contribution to success from other factors, such as presenting the idea as an ‘experiment’ and the resulting increased personal contact from the lecturer and support staff. The approach needs to be repeated more routinely to remove the Hawthorne Effect (Cook 1967) and perhaps use greater automation to reduce the personal contact involved.

As well as embracing the game, the students also achieved significantly improved results. Again, the experimental factor is a concern but so also is the nature of the group of students involved. This group could have been particularly studious, through that is not reflected in their entry results, or they could have been particularly sociable and so well suited to playing this type of game. The experiments therefore need to be repeated again with another cohort.

A third, unexpected benefit was that the performance of the students improved in the other modules they studied, suggesting that there had been a beneficial change in their approach and study skills. It could be argued again, however, that this was in some sense an ‘exceptional year’ so more experimentation is needed before definite conclusions can be drawn.

At a detailed level, there are also many more issues to be explored, such as gaining a better understanding of the contribution of the individual challenges and determining the appropriate level of complexity in the game. The timeliness and appropriateness of the feedback is also crucial, as is the variations in level of challenge across the tasks to encourage full participation. Students will select these tasks strategically, based on preference and ability.

It was fortunate to have started with a group experiment as that seemed particularly successful. In particular, it was a gentle introduction to the game and gave the groups a clear social identity. Group cohesion and peer support were stronger as a result, ever if the main motivation was to achieve a good group mark. The transition to individualised feedback was sufficiently different to avoid the risk of the students becoming bored though that could be a factor if this were repeated for students in successive years.

Overall, this research has raised more questions than it has answered, suggesting the need for many more experiments. The results achieved so far, however, provide a very strong incentive to pursue that work.

References

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Web 2.0-Mediated Competence – Implicit Educational Demands on Learners

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Abstract: The employment of Web 2.0 within higher educational settings has become increasingly popular. Reasons for doing so include student motivation, didactic considerations of facilitating individual and collaborative knowledge construction, and the support Web 2.0 gives the learner in transgressing and resituation content and practices between the formal and informal learning settings in which s/he participates. However, introducing Web 2.0-practices into educational settings leads to tensions and challenges in practice because of conceptual tensions between the views of knowledge and learning inherent in Web 2.0-practices and in the educational system: Implicit in Web 2.0-practices is a conception of ‘knowledge’ as, on the one side, process and activity, i.e., as use, evaluation, transformation and reuse of material, and, on the other, the product side, as a distributed attribute of a whole system (such as Wikipedia) or community of practice (such as the community of practice of Wikipedia contributors). In contrast, ‘knowledge’ within the educational system is traditionally viewed as a state possessed by the individual, and learning as the acquisition of this state. This paper is an analysis of the challenges which these tensions lead to for the learners. The argument is that Web 2.0-mediated learning activities within an educational setting place implicit competence demands on the students, along with the more explicit ones of reflexivity, participation and knowledge construction. These demands are to some extent in conflict with each other as well as with the more explicit ones. A simple example of such conflicting competence demands is experienced when students develop a course wiki: The Web 2.0-competence demands here concern the doing something with the material. The copy-pasting of e.g. a Wikipedia-article without referencing it from this point of view is a legitimate contribution to the knowledge building of the course wiki. In contrast, educational competence demands require the student to participate actively in the formulation of the course wiki-articles. Copy-pasting without reference from this point of view is cheating. Here, the student is met with the incoherent requirement of authoring entries that display the acquisition of a knowledge state in a context where authorship is renounced and knowledge is understood dynamically and distributively. More generally, in Web 2.0-mediated educational learning activities, the student is required to manoeuvre in a field of interacting, yet conflicting, demands, and the assessment of his/her competence stands the risk of being more of an evaluation of the skill to so manoeuvre than of skills and knowledge explicitly pursued in the course.

Keywords: Web 2.0 in education, wikis, second life, competence, concepts of knowledge, concepts of learning

1. Introduction

Communication on the World Wide Web (WWW) is currently evolving from the one-to-many display of information on homepages to the ‘bottom-up’ many-with-many interaction of numerous participants in the construction of social networks, communities of practice, user-driven encyclopaedias like Wikipedia (http://www.wikipedia.org/), and collaborative content sharing systems like Connexions (http://cnx.rice.edu). This shift in the role of the WWW, and of communication on it, is characterized as the shift from Web 1.0 to Web 2.0 (Downes 2005; O’Reilly 2005), and, correspondingly, the technological tools that enable the shift are designated Web 2.0-technologies.

In this paper, the phenomenon of Web 2.0 is approached from a practice perspective (Dohn 2009), i.e. is seen as a set of activities or practices for which most or all of the following attributes apply:
- collaboration and/or distributed authorship
- active, open-access, ‘bottom-up’ participation and interactive multi-way communication
- continuous production, reproduction, and transformation of material in use and reuse across contexts
- openness of content, renunciation of copyright, distributed ownership
- lack of finality, ‘awareness-in-practice’ of the ‘open-endedness’ of the activity
- taking place on the WWW, or to a large extent utilising web-mediated resources and activities

From this perspective, being ‘Web 2.0’ is not a binary function, but a question of degree, as any given concrete activity may be characterized to a greater or lesser extent by the attributes on the list, and by more or less of them. Further, according to the practice perspective, Web 2.0-activities do not
necessarily take place exclusively in a virtual environment. As long as web-mediated resources and activities are utilized in ways describable by the characteristics on the list, some of the contexts in which this is done may well be physical.

In many upper tertiary educational programmes, Web 2.0-practices are being introduced into the teaching and learning activities. To give just a few examples, it is done at Georgia Institute of Technology, USA (Rick and Guzdial 2006), the Open University, Great Britain (Jones 2008), the University of Birmingham, Great Britain (Pilkington et al. 2007), Queensland University of Technology, Australia (Bruns and Humphreys 2005), and the University of Southern Denmark (where the author of this paper teaches). There are many good motivational, didactic, and learning theoretical reasons for doing so (e.g. Cress & Kimmerle 2008; Rick and Guzdial 2006; Yukawa 2008; Bruns & Humphreys 2005; Boulos et al. 2006; Lund & Smørdal 2006; Dalsgaard 2006; Fountain 2005): Since students engage voluntarily in Web 2.0-mediated communication in their spare time, employing these same communication practices in the service of learning ought to help them enter the learning practices of the university, both in respect of their motivation and of the skills required of them. At the same time, the user-centred focus of Web 2.0-activities will in itself support them in transgressing and resituting content and practices between the formal and informal learning settings in which they participate. Furthermore, because of the centrality of participation, production, dialogue and collaboration in Web 2.0-practices, such practices seemingly are ideal ways of facilitating individual and collaborative knowledge construction. Finally, competence in the use of Web 2.0 – e.g. skills in navigation, communication, and critical evaluation – appears to be a reasonable learning objective in its own right, since the future working life may well demand such competence of the students.

However, introducing Web 2.0-practices into educational settings is not a straightforward matter because of conceptual discrepancies between the views of knowledge and learning inherent in Web 2.0-practices on the one hand and in the educational system on the other. These discrepancies lead to challenges in practice, not least for the learners, because of the inconsistent competence demands which they result in. The aim of this paper is to give a theoretical analysis of these inconsistent competence demands and the challenges they in practice pose for learners. The analysis will be supplemented with considerations of two examples: learning activities with wikis and Second Life. These examples draw on experiences from five courses using wikis and two courses using Second Life. They are introduced, not as empirical evidence, but for illustrative purposes only; to concretize the theoretical claims.

The structure of the paper is as follows: First, the conceptual divergence in the views of knowledge and learning of Web 2.0-practices and educational ones are shown to exist. Second, the implicit and explicit competence demands placed on students are analysed, as are the tensions between them. Thirdly, ‘web 2.0-mediated competence’ is argued to consist in the complex ability to respond adequately to the way the conflicting demands actualize in specific learning situations.

### 2. Conceptual discrepancies between Web 2.0- and educational practices

Inherent in educational practices is the view of knowledge and competence as ‘a something’ – an entity, state, disposition, ability or the like – which is possessed by the individual in abstraction from the concrete situation. This view, of course, does not have to be endorsed theoretically by the individual participants in the educational practices (the teachers and learners). However, it is part of the underlying rationale of an educational system where the practices of learning (aimed at the acquisition of knowledge and competence) are separated from the practices of acting (where the ‘acquired knowledge and competence’ allegedly is exercised). Without the implicit view of knowledge and competence as objects to be acquired, possessed, transferred and exercised with no major loss or transformation in new contexts, education as separated from professional life would not make sense. Given this view, on the other hand, it seems very reasonable to establish separate practices focusing on the acquisition of the object, so that the learner will not be met with the demands of professional life, before s/he is qualified to do so – in the sense of possessing the full knowledge and competence ‘object’ judged necessary to participate in this life.

As argued by Sfard, in contemporary educational research this objectivistic and individualistic view of knowledge is being challenged by another view according to which learning is participation and knowledge is situated doing (Sfard 1998). In Sfard’s article, however, the two views are presented as metaphorical frameworks (Lakoff & Johnson 1980) with which one in principle can regard any learning practice. In contrast, the argument in this paper is that educational practices intrinsically build upon...
the acquisition metaphor, whereas Web 2.0-practices incorporate the participation metaphor to a very
high degree. The question of a possible reconciliation between the metaphors is therefore not just the
theoretical one of upholding two divergent perspectives, but the very practical one of bridging or
integrating practices.

The claim that Web 2.0-practices instantiate a view of knowledge and competence as situated doing
is motivated by noting the dynamicity, open-endedness and flexibility of the practices, concerned as
they are with the continuous 'bottom-up' production, use and reuse of material across contexts, and
by the centrality in these practices of open-ended knowledge construction, knowledge transformation,
and communication: These characteristics show the practices to incorporate a view of knowledge and
competence as dynamic, transitory, and situated phenomena, i.e. phenomena of participation. They
are, on this view, only fully realized, ontologically speaking, in the acting in concrete situations. In the
words of Wenger, who together with Lave (Lave & Wenger, 1991) has been one of the primary
articulators and advocates of the participation metaphor "Knowing is a matter of participating in the
pursuit of [valued] enterprises, that is, of active engagement in the world" (Wenger 1998, p. 4).

This view of knowledge is the one implicit in Web 2.0-practices, when these are regarded from the
perspective of ongoing activity. For some Web 2.0-practices this is the only really meaningful
perspective to take, since these practices aim primarily or solely at the activities themselves, not at
any specific outcome of the activity. Cases in question are social friendship sites, where the aim of the
communication is the communication itself, not the specific subject matter of the communication, and
the type of blog which is constructed along the lines of a diary; expressing views, experiences etc.,
with the wider aim of presenting and negotiating personal identity. For other practices, however, there
is another perspective from which the question of knowledge must be viewed as well. Wikis like
Wikipedia and open content sharing systems like Connexions are relevant examples: Given that
participation in the production of entries in Wikipedia or content in Connexions is not undertaken for
the sake of the participation itself, but rather aims at qualifying the material available in these
systems, it is appropriate to adopt an 'outcome' perspective, too. And viewed from this perspective,
Web 2.0-practices such as these must be said to also implicitly involve an objectivistic ontology of
knowledge, since the point of the participation is precisely the production, editing and transformation
of entry-objects, stored in the system, available for later consultation by oneself and others.
Furthermore, viewing such content systems as reified products of Web 2.0-practices, it seems
reasonable to ascribe the concept of knowledge not just to the individual entries, but to the system as
a whole. Far from being an individual mental possession, knowledge from this perspective is a
distributive attribute of a whole system.

In general, therefore, inherent in Web 2.0-practices are two different views of knowledge, related to
the activity and the product side of the practices, respectively. The first is a dynamic view of
knowledge and competence as doing, the second is an objectivistic view of knowledge as an attribute
of a system produced by the practices. Both of these differ from the view implicit in educational
practices, according to which knowledge and competence is an individually possessed object which
can be transferred between practices.

3. Implicit and explicit competence demands in Web 2.0-mediated educational
activities

3.1 Three analytic levels of demand characteristics

Analysing the complex of competence demands placed on students in Web 2.0-mediated educational
activities, it is helpful to distinguish three different levels at which any situation poses requirements,
possibilities and restrictions (henceforth demand characteristics) for adequate acting. The distinction
is inspired by the schematic proposed by (Dohn 2007), but is somewhat adapted to fit the learning-
theoretical focus of this paper. Importantly, the distinction of levels is an analytical one. The point is
not that demand characteristics at different levels exist unrelated to each other. On the contrary, the
whole point of distinguishing the three levels is to be able to discuss the way the demand
characteristics at the different levels interact, interfere and contradict each other when Web 2.0-
practices are utilized as educational activities. With this comment, the following levels of demand
characteristics can be distinguished:

- The domain-internal level determined by the domain which communication is about, i.e. the focus
area of the learning activities, for example literary novels, organic chemistry, set theory, and
philosophy of education. Demand characteristics at this level include domain-specific traits, facts and perspectives such as that magical happenings are appropriate in fairy tales, that in set theory $A \cup B$ only equals the number of elements in $A$ plus the number of elements in $B$ if $A \cap B = 0$, and that within the philosophy of education propositions about different senses of ‘constructivism’ include ontological, epistemological, pedagogical and methodological perspectives.

- **The activity-internal context level** determined by the context of the activity itself. This is the level of demands placed by Web 2.0-practices like wiki construction, blog participation, and Facebook interaction. Likewise, it is the level of demand characteristics of collaborative problem solving; individual oral presentation; scripted or 'free' group discussions (oral or written); role play scenarios; lecture attending etc. Demand characteristics at this level include that students sit relatively quietly whilst attending lectures; that scripts be perceived and acted upon as ‘scaffolds’ for discussion; that certain implicit rules of cordiality be followed in group discussions; and that Web 2.0-activities usually involve renunciation of copyright and requires a 'use-and-reuse'- and ‘lack of finality’-perspective on the material.

- **The activity-framing context level** determined by the actual ‘real life’ context in which the activity is taking place. Among such contexts are ‘using one’s spare time’, ‘shopping for necessary groceries’, ‘carrying out a task for one’s boss’ and ‘participating (physically or virtually) in a class within an educational programme’. Demand characteristics at this level include tackling disagreements in ‘group discussions’ between invited guests at home in a way that is in accordance with the duties of the host; acting in a socially acceptable way towards one’s boss in receiving and carrying out one’s task; and not handing in as one’s own a class assignment written by someone else.

It should be noted that ‘domains of communication’ are exactly that: they are what is actually being (or should be) talked about in the given situation. No claim is being made that ‘domains’ exist in the abstract, nor do ‘domains’ have a definite level of generality. In the context of a literature course in an English program, ‘postmodern American literature’ might be a domain, whereas in the context of a primary school course on basic genre theory this topic would most probably be just a part of the domain of ‘literary novels’. Similarly, precisely which level of generality an ‘activity’ has may vary between situations: In the context of collaborative problem solving, group discussion is obviously a part of carrying out the activity, whereas in other situations the discussion may itself be the activity which students are asked to undertake.

### 3.2 Demand characteristics of Web 2.0-mediated educational activities

In accordance with the analysis given above, competence demands of Web 2.0 at the activity-internal context level centre on participation and production. Some of the demand characteristics at this level are explicitly acknowledged and constitute the very reason for employing Web 2.0-activities. This is the case for the demand characteristics of active engagement, bottom-up sense-making, multi-way communication, collaborative knowledge construction, and reflexivity concerning quality and trustworthiness of material. However, the way these demand characteristics present themselves as requirements, possibilities and restrictions at the activity internal context level is not with the focus of the educational practice: At the activity-internal context level, the enumerated demand characteristics are structured and made sense of through the further implicit demand characteristics of continuous use, dynamicity, open-endedness, and distributivity. Competence demands therefore centre on the communicative interaction, the usefulness of material, and the perspectives for its further use, more than on the individual person communicating and using the material. For those Web 2.0-practices where the perspective of ongoing activity is the only really meaningful one to take (cf. above), competence demands primarily, perhaps even solely, concern ways of participating and negotiating identity, and only secondarily, if at all, does it matter what more specifically is being communicated about. When interacting with strangers in a virtual café in Second Life, for example, what counts is your ‘style’ of interaction, your communicative attitude, and the identity you signal by your appearance and by what you say and do, much more than the content of what you actually communicate about. The stylishness of the café interior hardly matters in itself to the Second Life participants; what matters is the mutual identity construction and negotiation which is brought about through discussing, applauding, or ridiculing the design of the café; as well as the friendliness you show in communicating about this matter at all with a stranger. In other words, the demand characteristics at the activity-internal context level of Second Life tend in practice to counteract the demand characteristics of the domain-internal level since the domain itself may be of little significance for the participants. In general, for this kind of Web 2.0-practicities, the reasonableness of what is said may matter only to the
extent that seemingly false claims can make a conversation partner unsure s/he has understood at all (Wittgenstein 1984).

For Web 2.0-practices, such as the distributive construction of a wiki, where the ‘outcome’ perspective is appropriate along with the perspective of ongoing activity, the demand characteristics of participation are co-defined with demand characteristics concerning the adequacy of the ‘entry objects’. Significantly, the ‘outcome’-related demand characteristics concretize as demands relating to ongoing participation and possibilities of doing something with the material. Copy-pasting a Wikipedia-article without referencing it therefore is a legitimate contribution to the knowledge building of a wiki. The evaluative focus is on future use, reuse and transformative possibilities, not on origins. For this type of Web 2.0-practice, the demand characteristics at the activity-internal context level do not directly counteract those at the domain-internal level. The adequacy – truth, reasonableness, usefulness – of what is said or written counts. Nonetheless, demands of future usefulness and transformative potential delimit relevancy of domains and restrict and structure significance of aspects within domains. As such, though there is no inherent contradiction between demand characteristics at these two first levels, in practice there may still be tensions between what is relevant from the domain-internal point of view and what is relevant from the Web 2.0-activity-internal level.

Proceeding to the level of the activity-framing context, the implicit view of knowledge in educational practices leads to quite different demand characteristics, which centre on the acquisition and demonstration of individual knowledge and competence states. The origin of production of e.g. a written assignment is very important: From a learning perspective, writing is a learner-centred way of facilitating the acquisition of ‘understanding’ of the domain in question as well as of the ‘style of academic documentation’. From an assessment perspective, written assignments are evidence of the ‘possession’ of the necessary knowledge and competence ‘objects’. Utilizing material produced by others at most displays competence in finding relevant information, which does not suffice to demonstrate possession of ‘understanding’. On the contrary, ‘possessing understanding’ is taken as involving the ability to ‘show’ the ‘object of understanding’ by ‘formulating it in one’s own words’. Material from others must be referenced. Not complying with this is cheating – and stealing – since one takes the ‘knowledge possession’ of someone else and presents it as one’s own.

When introducing Web 2.0 as learning activities within educational practices, these demand characteristics are superimposed on the ones adhering to the activity-internal context level of Web 2.0. This imposition is not a simple addition of demands. Rather, it radically changes the overall complex of demand characteristics which the situation presents to the learner. Activities involving Second Life, for example, are imposed with the demand characteristics of competence ‘acquisition’ and ‘possession’, so that participation in Second Life, far from being a goal in itself, becomes a means for acquiring ‘knowledge objects’ in certain domains. The underlying presupposition is that the domain of communication is important in itself. This is in direct contradiction to the demand characteristics at the activity-internal context level where the significance of domain-internal demand characteristics are reduced because focus is on ways of participating and negotiating identity. Alternatively, Second Life may be employed as a means for acquiring and practicing ‘interaction skills’. Still, although the focus then is on ‘ways of participating’, this is understood not as a dynamic situated happening but as a ‘skills entity’ which the educational practice is to facilitate the acquisition of. Thus, even with this focus, the demand characteristics of the situation changes fundamentally.

As for wiki construction in a course context, the demand characteristics at the activity-framing context level are at variance with the dynamicity, open-endedness, and distributivity of the wiki production. The explicaded primary aim of the wiki may well be the possibility of future use of course content in new situations, in seeming correspondence with demand characteristics at the activity-internal context level, but the implicit demand characteristics of the activity-framing context level counteract this aim in practice. The wiki, employed as a pedagogical tool in the course, is primarily an artefact for student production and competence demonstration, i.e. for the acquisition and display of knowledge states. Though the material may be put to future use, the demand that it should is not a defining characteristic of the activity. Instead, a basic requirement is that the students themselves participate actively in the formulation of wiki entries. Copy-pasting a Wikipedia-article into the wiki without referencing it therefore is condemned as cheating and is considered detrimental to the very idea of
learning through knowledge construction: It involves no ‘acquisition’ of a ‘knowledge object’, but only a
more or less mechanical ‘passing-on’ of the ‘knowledge object’ possessed by someone else.

4. Web 2.0-mediated competence

Exercising competence in any situation consists in acting adequately in relation to the complex of
demand characteristics of the situation. The point of the analysis given above has been to show that
in practice the demand characteristics of Web 2.0-mediated educational practices are incoherent,
because demand characteristics at the three different analytical levels counteract and contradict each
other. The consequence, of course, is that students in practice are met with incoherent competence
demands. In the examples discussed, the student is required in Second Life at once to participate
according to participation-internal evaluation criteria and to do so against the educational evaluative
structuring of the domain-internal demands. Alternatively, s/he is required to participate in the sense
of partaking in ongoing situated activity in a context where participation is understood as a skill to be
possessed. In the case of the course wiki, the student must balance between the demands of
participation and collaborative knowledge sharing posed at the activity-internal context level and the
demands of individual knowledge possession inflicted at the activity-framing context level. Concretely,
s/he is met with the incoherent requirement of authoring entries that display the acquisition of a
knowledge state in a context where authorship is renounced and knowledge is understood
dynamically and distributively. Contributions to the wiki must be adjusted accordingly, to match at
once the conflicting foci of future transformative possibilities and the here-and-now demonstration of
‘understanding’ of course content for the sake e.g. of passing exams.

More generally, in Web 2.0-mediated educational learning activities, the student is required to
manoeuvre in a field of interacting, yet conflicting, demands. Put sharply, ‘web 2.0-mediated
competence’ corresponds to the complex ability to respond adequately to the way these conflicting
demands actualize in specific learning situations. Aspects of this ‘complex ability’ are constituted by
the explicitly formulated learning objectives of reflexivity, communication, collaboration and knowledge
construction. But these explicitly acknowledged aspects are framed, delimited and to some extent
curtailed by other, inherently contradictory, aspects posed implicitly at the activity-internal context
level and the activity-framing one. In the words of Biggs (2003), the problem is that because of these
inherent contradictions, alignment between learning objectives, learning activities and assessment
criteria (implicit and explicit) is not adequately realised in practice.

Web 2.0-mediated competence in this view is not so much the ability to reflect, communicate,
collaborate, and construct knowledge in itself – since this ‘in itself’ is never realized in practice – but
rather is the ability to frame and actualize one’s network of reflective, communicative, collaborative,
and knowledge constructive skills to situational demands set by conflicting views of knowledge and
learning and divergent foci of activity. Not the least important aspect of this framing or manoeuvring
ability is the skill of attuning oneself to the way the teacher (or assignment assessor) in practice
incorporates and enacts the incoherent demand characteristics of the situation. I.e. to attune oneself
to and comply with the expectations, which the teacher has to how a distributive participation-focused,
use-oriented, yet individual knowledge state-demonstrating Web 2.0-contribution is to be realized.
This attuning oneself becomes all the more complex by the fact that the teacher will not in general
have explicated his/her expectations, since the conflicting demands are not explicitly acknowledged,
but are posed implicitly in practice.

5. Final remarks

A few final points should be stressed. First, the question may be raised whether it is not the
introduction of the Web as such into educational practices, rather than just Web 2.0, which leads to
the problems described. After all, as the inventor of the internet, Berners-Lee, has said “the idea of
the Web as interaction between people is really what the Web is. That was what it was designed to be
as a collaborative space where people can interact” (developerWorks Interviews, 2006). The
technology, he claims, still basically builds on the so-called Web 1.0. And, one might add, the
information overload on the internet, the ease with which material of varying quality can be copy-
pasted, and the need for students to develop skills in critical assessment and transformative use are
all aspects pertaining to the Web as such, not just to Web 2.0. However, the point in this paper is that
practices have changed and, intertwined herewith, the understandings of knowledge and competence
implicit in these practices. And that the incoherent competence demands placed on learners when
Web 2.0 is introduced into educational settings result from the tensions between these implicit
understandings and the ones inherent in the educational system. This means that even if the
technologies are fundamentally the same and the design visions of the inventors of the Web match what is happening now (which could be contested, cf. Dohn 2009), people are actually acting differently: sharing, collaborating, and negotiating meaning on the net in more bottom-up ways than before. In other words, the dynamicity and flexibility of knowledge construction, the renunciation of ownership, the acceptability of appropriation and reuse of material produced by others, and the collaborative/distributive production of material are all central characteristics of Web 2.0-practices in a way which was not actually the case on the Web before, no matter what the inventors envisioned it to be in the then future. Former Web-practices simply did not embody the dynamic, participatory view of knowledge and practice-internal teleology to the extent that Web 2.0-practices do. And for this reason, though problems of information overload and the need for critical assessment skills were present with the internet from the beginning, there was not a comparable clash of concepts and therefore not the same conflicting competence demands placed on learners. Alignment between learning objectives, learning activities and assessment criteria were in other words not to the same degree fraught with inconsistencies by the very introduction of the activities themselves.

Second, the aim of this paper has been to call attention to implicit and incoherent competence demands which we as teachers in practice place on our students when we integrate Web 2.0 in learning activities. As such, the focus has been on problems we give the students without intending to. However, the upshot of this analysis is not that we should abandon attempts at utilizing Web 2.0 for educational purposes. That would be throwing the baby out with the bathwater, since the motivational, didactic, and learning theoretical potentials of Web 2.0 sketched at the outset of the paper are not negated by the problems raised here. They have, though, been shown to be somewhat complex to realize. The wider implication of the paper should instead be two-fold: Firstly, we as teachers should acknowledge the conceptual discrepancies between Web 2.0- and educational practices and the incoherent demand characteristics they lead to. This would be a first step towards alignment, in that we thereby explicate the expectations we have, thus not leaving the students blindfolded as to the complex network of competences we expect them to exercise in concrete situations. And secondly, the explication of the incoherent demand characteristics of Web 2.0-mediated learning activities might help us raise the question of whether the educational practices of today are really up-to-date with the flexible, globalized world in which we live. Perhaps the demand characteristics at the activity-framing context level are a consequence of an out-dated view of knowledge and a too narrow focus of activity?

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Listening to the Learners’ Voices in HE: how do Students Reflect on their use of Technology for Learning?

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Abstract: The importance of the Learner’s Voice and thus of listening to students’ views has been evidenced in various high profile initiatives in the UK. The work presented here is from the JISC Learners’ Experiences of E-Learning Phase 2 Learners’ Journeys STROLL project. The seven JISC funded projects were set up in 2007 to investigate inter alia the changing views of students in their use of technology to support their learning. The STROLL (STudent Reflections on Lifelong e-Learning) project has recruited a diverse range of students from both Higher and Further Education backgrounds with the aim of researching the students’ experiences of learning in a technology rich environment and their progression in their use of learning technologies over the two years of the project’s timescale. STROLL is a largely qualitative study with students participating from across the University of Hertfordshire (UH) and Hertford Regional College (HRC) by recording their own video and audio diaries of their learning experiences. Using the students’ choice of camcorder, web camera, or digital voice recorder they recorded their daily learning experiences of using technology, including a range of e-learning tools and the University’s own MLE (Study Net). The project started in March 2007 and completed in March 2009 with the final round of student diaries collected in October 2008.

The project’s aim was to research and document the students’ answers to the following questions:

How do learners experience change through their learning journey?

How do students use and make choices about their time?

How do students use e-learning tools to support their learning?

How do students use their personal technologies?

The qualitative data from the students’ reflective diaries collected was first transcribed, then the transcripts were analysed and colour coded according to the research themes. Concept maps were created for each student’s diary detailing their reflections on learning. Further concept maps of quotations relating to the research questions above were developed to identify comments which were particularly relevant to the themes. Finally Nvivo™ was used to support and track the large quantities of data. This paper presents some of the early findings in terms of the ease with which students interact with technology and the choices they make about what they use and when and where. The discussion includes consideration of the research methodologies, since the use of personal video diaries to record reflections on learning, is to date a rarely used method of capturing data on students’ reflections.

Keywords: student experience, e-learning, social uses of technology

1. Introduction

"Regardless of how institutions or individual teachers choose to use networked technologies learning takes place in an environment saturated with information and communication. Learners are increasingly networked." (Beetham, 2008)

Following an investigation of the literature in 2005, Sharpe and her co-investigators revealed that very little research had sought to include learners’ views of their experiences in e-learning (Sharpe et al,2005). This was in spite of a major increase in funding across the United Kingdom as Higher Education (HE) institutions sought to provide high quality e-learning support in universities and colleges for their students and the publication of the DfES of its plans for e-learning strategy in Harnessing Technology (2005) where it stated:

“We need to listen to people’s views and ensure that technology meets their needs.”

Since publication of these reports various institutions have sought to fill this gap and there have been a number of funded projects into the Learners’ Experiences of E-Learning. In 2006 Glasgow Caledonian University and the Open University in the UK developed innovative methods for researching into e-learners practice and experiences, through the JISC funded Learners’ Experiences
of E-Learning Phase 1. Results from these projects have been widely reported (e.g. Creanor et al., 2006) and pointed to a general enthusiasm among students to use a variety of e-learning opportunities to support their study behaviours. These students exhibited increasing confidence in their use of technology for learning and could be defined as part of the ‘Net generation’ as described by the Oblingers in their research across a similar age group in the U.S. (Oblinger et al., 2006). The research described below is from one of the JISC Phase 2 Learners’ Experiences of E-Learning projects which began in March 2007. The STROLL project sought to build a picture of the Learners’ Journeys across a study period of 18 months. An important part of this research was to gather data from the student volunteers through personal reflective diaries constructed at approximately 6 monthly intervals, showing their changing uses of technology and their growing maturity in both learning and using technology.

2. The methodology of the STROLL project – Student participation and diary completion

The STROLL project methodology consisted of a series of up to four reflective diaries constructed by the participating student volunteers at roughly six monthly intervals as well as a set of focus groups and some telephone interviews. In addition to the qualitative data gathered, students were invited to complete an online profile which returned a set of quantitative data for separate analysis. Students were invited to participate in the project through tutors based in each faculty as well as an open invitation via the university’s MLE (Study Net); the project team were concerned to have as broad a set of participants as possible and did not want to have participation concentrated in a handful of programmes.

The STROLL project enrolled a total of 54 students, (34 female, 20 male), from a broad age range which was between 18 and 52 years at the start of the project. The volunteers were studying on programmes based at one of the university’s campuses or a local FE associate college and were drawn from a total of 18 different programmes of study. In terms of the students’ ethnic diversity, this was an optional question on the profile but at least 8 different ethnic groups were included in the project. The majority of students came almost equally from White (British) or Black/Black British (African) backgrounds. 23 students based in FE but following HE programmes that would progress to University of Hertfordshire (UH) degree programmes were included, with the majority of these studying at HRC. 31 students were enrolled on programmes based at UH and would be studying as a minimum from May 2007 to October 2008. Three students had a disability that they declared to the project team, two were dyslexic and one was wheelchair based.

Students were invited to launch events at UH and HRC for a presentation on the project prior to them enrolling for the first set of diaries in May 2007. The pattern of the diary completion is now described. The diaries were typically recorded over a five day period. The students collected their diary questions and the technology of their choice to record their diary (camcorder, web camera, and digital voice recorder) from the project office. Each day’s diary included a brief recording in the morning to state the student’s plan for the day and a five to ten minute recording in the evening stating what they achieved, how they studied, the number of hours they spent studying, the technology they used to aid learning and answers to a set of supplementary questions based on the project’s research aims. In May 2007, 28 students completed a diary, in Oct 2007, more students were recruited to the project and 47 students completed a diary. In May 2008, 45 students completed reflective diaries. By the end of October 2008 40 students had completed three or more diaries providing a valuable longitudinal view to the project’s findings.

In the summer of 2007 telephone interviews were carried out with the students who had participated in the first set of diaries. These used Beetham’s ‘Interview Plus’ methodology (referred to by Creanor et al., 2006) itself a development from Bloom’s stimulated recall methodology (Bloom,1953) using details which students had mentioned in their diaries as the artefacts. This gave a deeper insight to specific points made in their diaries. The contact was further beneficial in keeping the students interested and engaged in the project over the long summer vacation. To maintain a project identity and encourage further reflection a closed group was set up on the MLE (StudyNet) for the STROLL project, where the students were updated on project news, discussions, and an area was made available for blogging. This also acted as a contact point between students and the project team.

Following the second set of reflective diaries in October 2007 four focus groups were conducted between January and March 2008 by a researcher independent of the STROLL project. Twenty
students chose to participate in these. This activity further supported the project findings by picking up on specific points from the diaries, and encouraging group interaction on specific areas where clarification was needed about the students’ voices.

The majority of the data which the project team collected was derived from the students’ diaries and the project therefore generated large amounts of qualitative data to be analysed. The data was first transcribed and then colour coded according to the main project themes. Concept maps were created for each student’s diary detailing their reflections on learning from the transcripts; further colour coded concept maps of quotes relating to the research questions above were then created from the transcripts. The benefit of concept maps to the project team has been the quick visual guide to each student’s reflections. Finally Nvivo™ was used to support and track the large quantities of data and as a means of ensuring that data could be checked by another researcher to ensure it had been reviewed thoroughly.

2.1 Using video and audio diaries, the choices of who used what and when

The project team had originally intended that all STROLL participants would use a web camera to complete their diary, with the opportunity once the project had completed that they would be able to keep their web camera. However, not all the STROLL students wanted to use a web camera. The team also had access to a small number of camcorders loaned from the Blended Learning Unit and a number of digital voice recorders. This enabled a choice of technologies to be made available for the students to feel confident and comfortable recording themselves. Figures 1 and 2 show how students changed in their choice and the use of the diary capture technologies.

![Figure 1](image1.png)

**Figure 1**: How students changed in their choice and the use of the diary capture technologies in May and October 2007

In October 2007 more students chose to use web camera, and digital voice recognition (Audio), students using the camcorders increased by one and the number of blogs decreased to just one.

It is clear that for the first three reflective diaries the digital voice recorder and web cameras were the favourite technology for recording. The project team discovered that the camcorder proved to have the best quality of recording, followed by the web cameras and then the handheld digital voice recorders. The number of camcorders used by the students over the three diaries decreased. This is probably due to the reduced number of camcorders available for the STROLL project to use and the extra responsibility for borrowing them. The project team found that students were keen users of the digital voice recorders as these were seen as simple to use and there were no compatibility issues. The team ascertained that some students preferred to use the digital voice recorders so their facial expressions were not seen by other people. The wheelchair student with cerebral palsy found the fine motor skills required to use the web camera and camcorder meant that these were difficult to use with accuracy and for her the digital voice recorder was a better choice as she was ‘more in control of it’. The reason a few students had to resort to blogging was due to problems with recording with digital technology, it was not their first choice of diary recording. This is in contrast with some of the students recording diaries of their first year undergraduate experiences for the LEAD project at University of Edinburgh (LEAD, 2008) who deliberately chose to handwrite or word process their reflections. A handful of students have struggled with using the web camera technology in spite of the availability of
technical support at both UH and HRC. Some of the STROLL participants also claimed to be unable to use the integral webcams on their personal PCs.

Figure 2: Student choice in the use of the diary capture technologies, May 2008

3. Developing the reflective questions and eliciting the student responses – reporting initial findings

Each diary session invited students to describe their daily routine and their use of technology for learning. Supplementary questions were asked to uncover students' maturing use of technologies and their attitudes.

3.1 How do learners experience change through their learning journey?

The supplementary questions around this area included the following: How has your use of technology to support learning changed in the last year to October 2007 and what is your favourite technology? In subsequent diaries students were invited to reflect on how their favourite technologies had changed and why. Students were asked to reflect on how their learning had changed over the last three years as they came to study at HE level and whether the technologies that they used had changed during the last three years. Three years was chosen as a time period since it would cover all project participants who had started their HE experience within three years of the start of the STROLL project.

There appeared to be a change in the learners' journey though their time in FE and HE and some students reported sharp changes, such as the student below who went from using physical to digital media.

'I've gone from using pencils to do my drawings, to different mediums like digital media like Photoshop™ and Flash™ and other programs like that. I'm using my pen tablet as well so it has really been quite a big change.' Male, 2D Designs, HE

As students progressed through their university degree it has been a common theme that their use of technology also increased.

'I would say that I am getting to use more and more technology, and I am relying more and more on technology in this past year...I'm getting inseparable without technology.' Female, Psychology, HE

'I also am on the StudyNet e-mail service a lot more. Always always on it. Which was kind of different I guess because last year I hardly ever used it ever, ever... But this year it seems like if I don't I'm going to miss something serious, I'm going to fail or a lot worse.' Male, Music Technology, HE

There has also been a recurring theme that for each year of the students' course they are maturing in their learning and are adapting and using the available technology more.
3.2 How do students use and make choices about their time?

The supplementary questions around this area asked students how they divided out their studying and personal time, whether they had a daily routine with regard to using technology in their learning e.g. checking the MLE every day plus their university and personal emails and their use of social networks.

There were a few students who only worked a standard 9am-5pm Monday to Friday but in general as they progressed through university, they reported that they matured and realised the need to prioritise studying over personal time and flexibility in study time becomes more highly prized.

‘The way I divide my studying and personal time is as opposed to all the other years, I guess, this year it is study first and then friends and personal time second.’
Male, Music Technology, HE

‘My general plan is that I work nine in the morning until five, Monday to Friday.’
Male, Humanities Modular, HE

Students with families had to fit in learning around their home lives. These students reported being heavily dependent on technology to aid their learning, benefitting from course information that was available 24/7.

‘I do divide my studying time [and personal time]. I worked late at night when the children have gone to bed.’
Male, Modular Extended Degree, FE

Other students deemed it important to enjoy life as a student as well as studying and put a priority on personal time.

‘I think all work and no play makes a good girl cry...So I divide my time, roughly equally.’
Female, Nursing, HE

Time was often seen to be a precious commodity in today's busy life, and many students liked to make the most of their time wherever they were:

‘I will be doing studying on the bus and the train’. Female, Combined Modular, HE

3.3 How do students use e-learning tools to support their learning?

The supplementary questions around this area asked whether students had any difficulties using technology in every day life and in their studying. The project wanted to investigate what would make e-learning technology easier to use for these students and how their lecturers could use technology (including StudyNet) better to improve learning. In terms of investigating students’ own rates of confidence the project asked them to reflect on how confident they felt using technology and what extra support would be useful.

This university now uses podcasts extensively, these being posted on module sites via StudyNet. Students reported using the technology to aid their learning on the move, like the student below who listened to her podcasts as she drove home at the weekend.

‘Pod casts...[I] just bought [a] car over the summer and I’ve got a radio which rigs up to my MP4 player so I am able to ... play it when I’m driving’ Female, Combined Modular, HE

StudyNet was widely used throughout the university by lecturers and students. This has become an essential part of their learning experience for many students. The student below typically expressed how useful StudyNet is in their learning, although one or two students have recorded being less keen to use it.

‘StudyNet, it is my favourite just because of how useful it is really...all my course notes are put on [it], and any assignments ...and class discussions, with your own little e-mail account, private messages as well...It has lots of features for my course and just fully supports me when I’m not in class.’ Male, Computer Science, HE
Voice recognition software was described as a favorite technology by some participating students;

‘My favourite piece of technology that aids my learning is possibly voice recognition software and the reason I would like to say that is because I have a physical disability … I have an awful lot of reading to do, so rather than reading and making notes, I am reading and speaking my thoughts about what I’m reading and then I save it and print it’. Female, Computer Science, HE

As technology evolves, so has the method to input images, from a pencil, to a mouse to a pen tablet.

‘My favourite piece of technology is my pen tablet because it basically does away with the need to use a mouse to draw images onto a computer, and this helps me mainly because I can input images to a computer with analogue pressure, and very efficient accuracy rather than using a mouse’ Male 2D Design, HE

3.4 How do students use their personal technologies?

The supplementary questions which the project team asked the students in this area were about their own rating of enjoyment about using technology as opposed to their confidence ratings. As well as their use of their own technologies such as mp3 players, students commented on their use of social networks for social and academic purposes. One project student used her mobile phone to video record her lectures, she claimed she was familiar with it and thus preferred to use it rather than to download the lecturer’s video of the lecture.

‘I am more likely to watch what I have recorded [on my mobile] than to log on to StudyNet and to go through the long procedure of finding something that could have easily been put in [by] a simple method.’ Female, Extended Degree, FE-HE

Social networks have grown hugely in the last couple of years especially with the introduction of Facebook and some students reported using it to aid their learning in addition to the discussion groups on StudyNet.

‘We have a Facebook group [for our] course which is really useful in posting things up to see when everybody is in, and keeping in contact with each other, and put our websites out there so we can get feedback up from each other. I think it works a lot better than StudyNet which can be difficult to find things on sometime.’ Female, Digital & Lens Media, FE-HE

3.5 Findings from the student focus groups

Following the first two set of diaries a researcher external to the STROLL team conducted a series of focus groups, picking up on general points noted by the researchers from the diary transcripts for group discussion. It was clear that student learning has changed over the years from college through to university, many claimed that they have matured with their use of technology, and also that they were becoming more dependent on technology for their learning as the years passed.

‘When I first came here I was using books a lot more, but as I’ve gone along I’ve started using more journals, and database’ Male, Humanities Student, HE

‘I’ve become more dependent on StudyNet as the years have gone on, and have found it more and more useful, and as time has gone on I can’t imagine life without StudyNet’ (All agreed) Female, Combined modular, FE-HE

Students reported using personal technologies including social technologies (MSN /Facebook /Mobile Phone) to communicate with other students and to aid their learning. A few students also used their own Dictaphones to record lectures.

‘MSN and Facebook can be useful for learning by linking with other students. You can find ideas off each other like being in the same room.’ Female, Modular Extended Degree, FE

‘I’ve bought a Dictaphone, so I can do that myself, if I know I’ve got a lecturer who’s going to talk quickly or if there is an important lecture that I don’t want to miss and I want to be able to revisit it. I can record it myself and take it home and use that.’ Female, Humanities, FE-HE

In terms of benefitting from the flexibility that studying online offers, students in the focus group were less categorical about the benefits of StudyNet as an MLE to support their time management
Amanda Jefferies and Ruth Hyde

‘In general, I don’t think it can really help with your time management, I always think that’s down to the individual the only thing that differs with e-learning is that you can receive something if you have a day off.’ Male, 2D Design, HE

‘It could save you time, in that if you don’t want to make the effort to go to uni because you can access it all and the reports that you get from professional bodies and access to Athens [the online databases] so that can save you time and might help manage your time.’ Male, Business Studies, HE

4. Discussion and conclusions

The STROLL project investigated students’ uses of technology to aid their learning over an eighteen month period, by listening to these ‘learners’ voices’ as they reflected via their video and audio diaries on the various questions posed by the research team. Students have on the whole shown great enthusiasm for the MLE platform (StudyNet) at the University of Hertfordshire with the materials uploaded by their lecturers, and the range of facilities to support their learning. StudyNet is available both to the FE students on programmes leading to a UH award and to the HE students registered on campus based undergraduate programmes.

The ‘21st century student’ or the ‘Net generation’ learner increasingly slots studying into their lives alongside family and work commitments so that learning and information to support studying is sought and used 24/7. The use of an MLE enables the student to work and communicate asynchronously from the rest of their cohort. Lecture podcasts and videos, lecture notes, presentations and personal blogs are all accessed on the MLE. Students are also able to use SMIRK boards, discussion areas, check their rooms and timetable, download journals, check for books in the library, renew books currently on loan, and check email, personal messages and view the news area. As students are often on the move, some of them download lectures onto their MP3/4 players and listen to them on the go as they drive or cook or sit in the bus. Word documents are downloaded onto students’ mobiles so they can catch up wherever they are. Students use social networks like Facebook and MSN to catch up at anytime of the day or night in addition to those facilities provided through the MLE. Voice recognition software is used to save time when writing essays or when reading text books. More recently Google Docs are reported as being used to aid group work on an assignment from different physical locations. There is an increasing reliance on the internet for researching background material on essay topics. There has definitely been a demonstration of this type of the ‘Google generation’ student, characterised in this research group of over 50 participants by widespread use of multiple types of software and internet use accessed throughout the day and night and throughout the week, both at home and on campus. Within the time span of the project the researchers have seen a huge initial growth in the use of social networks such as Facebook for social and learning purposes. Facebook was just appearing on the UK HE horizon when the original work was proposed in October 2006. By November 2008 there had been a levelling off for some students’ enthusiasm in its use.

An important part of the students’ reflections of carrying out the project diaries has been their personal realisations of the extent to which they now depend on technology. This is not just to aid their learning, and while many report that they are happy with the self-confessed high dependence on technology, others fear they may have become too dependent on technology.

‘…this week it has really enlightened me [sic] that I am very, very highly dependent on the Internet and networks that the university runs.’ Male, Business, HE

One of the project’s music students used his web cam to show all the technology that he uses in his room for learning and social use. This included a PC, MAC, Keyboard, Mini Keyboard, Mixers, Microphone, and Nintendo Wii™, which had been linked together by his own network.

These early findings from the STROLL project indicate that students will use both university provided technology and their own personal technologies for supporting their academic and social lives. There appears to be little separation out between the time spent learning and time spent in ‘social activity’, students report both activities happening in parallel for much of the week. Technology has become for most of these students an integral and ubiquitous part of their lives regardless of the programme of study for which they are registered. Reflecting on their use of technology has shown them in turn how much they have become dependent on it and thus reliant on being part of a ‘connected world’. 
The last stages of the STROLL project included a final reflective diary in October 2008 to review students’ continuing and changing uses of technology in their learning and these are now the subject of further analysis, discussion and debate. Future papers will present an overview of the major lessons learnt through the investigation into the learners’ reflections on their experiences and where the STROLL project’s outcomes are also reflected in those of the wider JISC community’s research into e-learning.

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Learning Objects and Virtual Learning Environments
Technical Evaluation Criteria

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Abstract: The main scientific problems investigated in this article deal with technical evaluation of quality attributes of the main components of e-Learning systems (referred here as DLEs – Digital Libraries of Educational Resources and Services), i.e., Learning Objects (LOs) and Virtual Learning Environments (VLEs). The main research object of the work is the effectiveness of methods of DLE components quality evaluation. The aim of the article is to analyse popular existing LO and VLE technical evaluation tools, and to formulate new more complex tools for technical quality evaluation of LOs and VLEs based on requirements for flexible DLE, as well as to evaluate most popular open source VLEs against new more complex criteria. Complex tools have been created for the evaluation of DLE components, based on a flexible approach. The authors have analysed existing tools for technical evaluation of LOs, and it was investigated that these tools have a number of limitations. Some of these tools do not examine different LO life cycle stages, and other insufficiently examine technical evaluation criteria before LO inclusion in the repository. All these tools insufficiently examine LO reusability criteria. Therefore more complex LO technical evaluation tool is needed. It was investigated that this new more complex LO technical evaluation tool should include LO technical evaluation criteria suitable for different LO life cycle stages, including criteria before, during and after LO inclusion in the repository as well as LO reusability criteria. The authors have also examined several VLE technical evaluation tools suitable for flexible DLE, and it was investigated that these tools have a number of limitations. Several tools practically do not examine VLE adaptation capabilities criteria, and the other insufficiently examines general technical criteria. More complex VLE technical evaluation tool is needed. Therefore the authors have proposed an original more complex set of VLE technical evaluation criteria combining (1) General (Overall architecture and implementation; Interoperability; Internationalisation and Localisation; Accessibility) and (2) Adaptation (Adaptability; Personalisation; Extensibility and Adaptivity) VLE technical evaluation criteria. The authors have also selected and proposed to use the universal, clear and convenient DLE components' evaluation rating tool, and have evaluated three most popular open source VLEs against technical (both general and adaptation) criteria in conformity with this rating tool.

Keywords: managing quality in e-learning, technical evaluation, virtual learning environments, learning objects, repositories

1. Technical evaluation of learning objects

1.1 Different approaches to learning objects technical evaluation

The various approaches to LOs attempt to meet two common objectives:

- To reduce the overall costs of LOs.
- To obtain better LOs (Wiley 2003).

It can be argued that the provision of LOs provides better access to quality LOs and supports enhanced learning outcomes. The purpose of LOs is to increase the effectiveness of learning by making content more readily available, by reducing the cost and effort to produce quality content, and by allowing content to be more easily shared. These two purposes, effectiveness and efficiency, receive differing emphases from different sectors (Haughey and Muirhead 2005).

The evaluation of LOs is a comparatively new concern as the quantity of LOs has grown and the development of LO repositories has come about to allow for greater ease in finding and using LOs for both classroom and online instruction. The growth in the number of LOs, the multiplicity of authors, their increasing diversity of design and their availability to trained and untrained educators has generated interest in how to evaluate them and which criteria to use to make judgments about their quality and usefulness (Haughey and Muirhead 2005).
1.2 LORI quality criteria

The need to evaluate LOs requires the development of criteria to be used in judging them. (Vargo et al. 2003) developed a Learning Object Review Instrument or LORI to evaluate LOs. The LORI approach uses the following ten criteria when examining LOs:

- Presentation: Aesthetics.
- Presentation: Design for learning.
- Accuracy of content.
- Support for learning goals.
- Motivation.
- Interaction: Usability.
- Interaction: Feedback and adaptation.
- Reusability (*technical criterion – authors’ comment).
- Metadata and interoperability compliance (*technical criterion – authors’ comment).
- Accessibility (*technical criterion – authors’ comment).

The criteria were drawn from a review of pertinent literature on instructional design, computer science, multimedia development and educational psychology. Each measure was weighted equally and was rated on a four point scale from “weak” to “moderate” to “strong” to “perfect”. The LORI process involved both individual and group rating of LOs (Vargo et al. 2003).

1.3 Paulsson and Naeve quality criteria

Six action areas for establishing LO technical quality criteria are suggested by Paulsson and Naeve (2006):

- A narrow definition.
- A mapping taxonomy.
- More extensive standards.
- Best practise for use of existing standards.
- Architecture models.
- The separation of pedagogy from the supporting technology of LOs.

Most LO implementations do not by far meet this vision. For those reasons it is essential to establish common criteria of quality for LOs. Technical quality criteria are specific characteristics and properties that LOs must (or in some cases ought to) adhere to – including best practice, guidelines and standard specifications – in order to be regarded as LOs.

The focus in (Paulsson and Naeve 2006) is on technical quality criteria for LOs. Other quality criteria, such as pedagogical quality, usability or functional quality are out of scope. Such aspects of quality are addressed by Van Assche and Vourikari (2006), where they suggest a quality framework for the whole life cycle of LOs.

The (Paulsson and Naeve 2006) evaluation focused on: (1) architecture – in terms of separation of data, logics, presentation, and implementation of interaction interfaces; (2) pedagogical contextualisation; (3) the use of standards and the extent to which they are decomposable/composable. Many of those issues are directly or indirectly related to the lack of explicit definitions and clear architectural models, together with technical (as well as other) quality criteria that are directly related to technical architecture. Many of the pedagogical dependencies and shortcomings seem to be caused by technical bindings of content to presentation and application logics as well as built in instructional design elements.

The (Paulsson and Naeve 2006) study has shown that there is a huge discrepancy between different definitions of the LO concept. This makes it hard (if not impossible) to author LOs that have the qualities that LOs are often ascribed in terms of reusability, interoperability, and context independence. Definitions really range from “anything to everything” (McGreal 2004). However, the
real problem lies in that there is no separation of “anything to everything” from a technological perspective and “anything to everything” from a “content” perspective. “Anything to everything” from a “content” perspective is a good thing as this makes it easier to support different pedagogical directions and methods, but “anything to everything” from a technological perspective becomes unmanageable. Paulsson and Naeve (2006) suggest the technical and pedagogical definitions of LOs to be separated – within a common definition of LOs.

The lack of common low-level definitions and models is a threat to interoperability, technical quality as well as for the acceptance of the LO concept itself. The Paulsson and Naeve (2006) study shows that the pedagogical content is often of good quality and that the ambitions are set high, but that LOs still do not live up to the expectations that would make them context independent, reusable objects. One important reason is that little consideration is given to fundamental software design principles, such as layering, principles from object orientation, structuring of data etc., which could enhance such properties that are usually ascribed to LOs. As most implementations do not deliver what they promise, the vision has yet to be fulfilled. There is a need to move on from just describing properties and characteristics, to determine how those can be realised.

To address the identified problems Paulsson and Naeve (2006) suggest six areas for action in order to establish technical quality criteria for LOs:

- There is a need for a common (more narrow) definition of what is, and what is not a LO.
- In connection to narrowing down the definitions, there is a need for a taxonomy that maps on to the definition and where granularities as well as special properties are regarded.
- Standards used for LOs should be extended to go beyond descriptive information, such as metadata, sequencing, and packaging to also embrace standards for interfaces, “machine readable” descriptions of technical properties and interaction interfaces.
- There is a need to establish standards and recommendations that address the internal use of data formats and data structure. Such general technology standards exist, but seem to be rarely used in the LO community.
- It should be prescribed for the architecture of LOs to be layered as a part of best practise, in order to separate data, presentation and application logics. This would enhance the level of decomposability and context independence, as is also pointed out by Pinkwart et al. (2005). Layering (or multi-tier architectures) is used frequently in many other areas of application/system development for the very same reasons.
- Pedagogy should preferably be kept outside the LO in order to facilitate pedagogical context independence. It is suggested that the pedagogical model is added as LOs are assembled to form learning modules. Using such methodology, it becomes possible to do pedagogical contextualisation at a later stage in the authoring process, and enhance reusability of different components as well as components mutual pedagogical context independence. In some cases there might be a need to add such “instructional properties” inside LOs, but in such cases this should be handled in a separate layer, using standard specifications for that purpose, and not by hard coded implementations (Paulsson and Naeve 2006).

1.4 MELT project quality criteria

The MELT content audit included an in-depth examination of project partners’ existing content quality guidelines and produced a checklist to help them decide what content from their repositories should be made available in the project for enrichment. This checklist is divided into five categories – pedagogical, usability, reusability, accessibility and production (MELT 2007).

The list is by no means prescriptive and not all of the criteria can always be applied to all LOs. For example, some LOs may score strongly in terms of reusability because they include open source code that facilitates adaptation to different learning scenarios than the one originally intended. However, the same LOs might actually score poorly in terms of its interactivity. The checklist, therefore, needs to be seen more as a minimum framework that should be used in a flexible way.

In MELT the partners want to be able to provide access to learning content that meets nationally recognised quality criteria. However, it is also important to appreciate that some very high-quality LOs may meet the specific needs of a national curriculum but may not always have the ability to be used
as effectively (or maybe at all) by schools in other countries. For example, a text-heavy lesson plan in a minority European language may work splendidly in a national context but may simply be unusable by teachers in other countries.

With this in mind during the content audit, MELT partners have begun to develop quality criteria that are defined in terms of the extent to which learning content has the potential to “travel well”; i.e. the extent to which LOs/assets can be easily used across national borders and in different curricula frameworks. At a commonsense level, some MELT content will obviously travel better than others. Learning assets such as pictures and sounds, for example, are obviously more reusable than a complex, Spanish language LO designed to convey facts about the Spanish War of Independence.

Beyond this, an initial assumption in MELT is that content is more likely to “travel well” if it is:

- Modular: the parts of a content item are fully functional on their own.
- Adaptable: the LO can be modified, for instance from a configuration file, from a plain text file or because it is provided along with its source code or an authoring tool.

Further discussions among partners also suggest that cross-border reuse of content will be more likely if LOs:

- Have a strong visual element and users can broadly understand what is the intended learning objective or topic (e.g. LOs may have little or no text; and include animations and simulations that are self-explanatory or have just a few text labels or icons/buttons for start, stop, etc.).
- Have been designed to be language customisable (“choose a language option”) and are already offered in more than one language.
- Address curriculum topics that could be considered trans-national (e.g. teaching “geometric shapes” or “the parts of the cell” are usually covered in every national curriculum but teaching the folklore of a very specific region is not).
- Are adaptable from a technical (e.g. LOs are supplied along with an authoring environment or tools) or IPR perspective (e.g. they are not made available under a “No derivatives” Creative Commons license which would prevent users from even translating the resource) (MELT 2007).

1.5 Quality for Reuse project criteria

A quality assurance strategy was implemented in “Quality for Reuse” (Q4R 2007) scientific project initiated by Tele-University of Quebec to improve effectiveness, efficiency and flexibility of LOs as well as proper storing and retrieval strategies. They have organised these strategies into four main groups, namely organisational strategies, and then three strategies inspired by the life-cycle of a LO, that is from its conception to its use / reuse (adaptations). Q4R quality assurance strategy is presented in Fig. 1:

![Quality assurance strategy (Q4R 2007)](http://www.ejel.org)
1.6 Lithuanian learning objects’ evaluation tool approved by the Ministry of Education and Science

The last “Computer Teaching Aids Methodical and Technological Evaluation Criteria” for certification of educational software and content were approved in Lithuania in June 2008.

These criteria are:
- Methodical aspects.
- User interface (incl. personalisation) (*suitable for technical evaluation – authors’ comment).
- LOs arrangement possibilities (*suitable for technical evaluation – authors’ comment).
- Communication and collaboration possibilities and tools (*suitable for technical evaluation – authors’ comment).
- Technical features (incl. working stability) (*suitable for technical evaluation – authors’ comment).
- Documentation.
- Implementation and maintenance expenditure (Computer… 2008).

1.7 Conclusions of literature analysis and problems to solve

It is obvious that all analysed LO technical evaluation tools have a number of limitations:
- LORI (Vargo et al. 2003), (Paulsson and Naeve 2006) and (MELT 2007) do not examine different LO life cycle stages.
- (Q4R 2007) insufficiently examines technical evaluation criteria before LO inclusion in the LO repository (LOR).
- All tools insufficiently examine LO reusability (incl. Interoperability) criteria.

The approved Lithuanian set of evaluation criteria (see (Computer… 2008)) also has a number of limitations, e.g.:
- All LOs and services (e.g., LOs, LORs, VLEs) are evaluated against the same criteria.
- No metadata-related criteria are included.
- Approved technical evaluation criteria for e-content and activities do not reflect their reusability aspects overall (Kurilovas 2007, Kubilinskiene and Kurilovas 2008).

Therefore this set of evaluation criteria is not suitable for technical quality evaluation of LOs and VLEs. It is obvious that more complex LO technical evaluation tool is needed. This tool should include LO technical evaluation criteria suitable for different LO life cycle stages, including criteria before, during and after LO inclusion in the repository as well as LO reusability criteria. LO reusability criteria should have the same weight as the other criteria.

The authors’ research results show that Lithuanian education system needs a rapid growth of adapted LOs available for the teachers. It is obvious that this growth due to the limited financial and human resources is impossible without large scale adaptation, localisation, and reuse of LOs available in European Learning Resource Exchange system and other suitable repositories around the world. It is also clear that Lithuanian LO repositories should include a big number of teachers created LOs.

Therefore Lithuanian education system needs high quality simple to use and clear enough LO technical evaluation tool based on scientific research in the area.

1.8 Recommended learning objects technical evaluation tool

The authors propose the original set of LO evaluation criteria based on flexible DLE model (i.e., reusability of DLE components, see (Dagiene and Kurilovas 2007)) as well as on conclusions of the analysis of LO technical evaluation criteria presented in Sections 1.1 – 1.6. This tool includes LO technical evaluation criteria suitable for different LO life cycle stages, including criteria before, during and after LO inclusion in the LOR, as well as LO reusability criteria. The tool combines (MELT 2007), (Paulsson and Naeve 2006), (Q4R 2007), (Vargo et al. 2003) and the authors’ own research results (e.g., (Kurilovas 2007)). The complex original LO technical quality evaluation tool is presented in Fig. 2.
Figure 2: Technical criteria for evaluation of LOs

Additional LO evaluation criteria interconnected with technical criteria are:

- Licensing (clear rules, e.g., compliance with Creative Commons).
- Economic efficiency (taking into account the number of probable users in conformity with LO reusability level) (Kurilovas 2007)

2. Technical evaluation of virtual learning environments

The flexibility of DLE and learning personalisation possibilities for its users is achieved by separating 'content' learning objects from 'activity' ones, separating LO metadata from LO repositories which can be on different servers, usage of highly adaptable open source tools to create/reuse LOs and provide online learning environments etc. (Dagiene and Kurilovas 2007, Kurilovas and Kubiliuskiene 2008).

The authors base their set of VLE evaluation criteria on flexible personalised approach to creation of DLE (Dagiene and Kurilovas 2007, Kurilovas and Kubiliuskiene 2008) as well as mainly on two well-known VLE evaluation methods suitable for flexible personalised DLE:

- Methodology of technical evaluation of learning management systems (LMSs) (Technical... 2004).
- Method of evaluation of open source e-learning platforms with the main focus is on adaptation issues (Graf and List 2005).
2.1 Methodology of technical evaluation of learning management systems

Methodology of Technical Evaluation of LMSs (or VLEs) is a part of the Evaluation of Learning Management Software activity undertaken as part of the New Zealand Open Source VLE project (Technical... 2004).

The evaluation criteria expand on a subset of the criteria, focusing on the technical aspects of VLEs:

- Overall architecture and implementation (*suitable for technical evaluation – authors’ comment): Scalability of the system; System modularity and extensibility; Possibility of multiple installations on a single platform; Reasonable performance optimisations; Look and feel is configurable; Security; Modular authentication; Robustness and stability; Installation, dependencies and portability.
- Interoperability (*suitable for technical evaluation – authors’ comment): Integration is straightforward; LMS/VLE standards support.
- Cost of ownership.
- Strength of the development community: Installed base and longevity; Documentation; End-user community; Developer community; Open development process; Commercial support community.
- Licensing.
- Internationalisation and localisation (*suitable for technical evaluation – authors’ comment): Localisable user interface; Localisation to relevant languages; Unicode text editing and storage; Time zones and date localisation; Alternative language support.
- Accessibility (*suitable for technical evaluation – authors’ comment): Text-only navigation support; Scalable fonts and graphics.

2.2 Virtual learning environments adaptation evaluation instrument

(Graf and List 2005) paper presents an evaluation of open source e-learning platforms / VLEs with the main focus is on adaptation issues.

Adaptation received very little coverage in e-learning platforms. An e-learning course should not be designed in a vacuum; rather, it should match students’ needs and desires as closely as possible, and adapt during course progression. The extended platform will be utilised in an operational teaching environment. Therefore, the overall functionality of the platform is as important as the adaptation capabilities, and the evaluation treats both issues. (Graf and List 2005) evaluation is also based on the qualitative weight and sum approach. After a pre-evaluation phase, nine platforms were analysed in detail. The detailed evaluation approach is focused on the adaptation category and its results.

2.2.1 Adaptation capabilities

This section is focused on adaptability, personalisation, extensibility, and adaptivity capabilities of the platforms. (Graf and List 2005) research is focused on customisable adaptation only, which can be done without programming skills.

- Adaptability includes all facilities to customise the platform for the educational institution’s needs (e.g. the language or the design).
- Personalisation aspects indicate the facilities of each individual user to customise his/her own view of the platform.
- Extensibility is, in principle, possible for all open source products. Nevertheless, there can be big differences. For example, a good programming style or the availability of a documented application programming interfaces (API) are helpful.
- Adaptivity indicates all kinds of automatic adaptation to the individual user’s needs (e.g. personal annotations of learning objects or automatically adapted content).

2.3 Conclusions of literature analysis and problems to solve

Both analysed VLE technical evaluation tools have a number of limitations:
(Technical... 2004) tool practically does not examine adaptation capabilities criteria. (Graf and List 2005) tool insufficiently examines general technical criteria. Therefore more complex VLE technical evaluation tool is needed. It should include general technical evaluation criteria based on modular approach and interoperability, as well as adaptation capabilities criteria.

2.4 Recommended virtual learning environments technical evaluation tool

As it was assessed earlier, both analysed tools have a number of limitations. Therefore the authors propose the original complex set of VLE technical evaluation criteria combining general and adaptation criteria (see Fig. 3).

![Figure 3: Technical criteria for evaluation of VLEs](image)

This tool includes general technical evaluation criteria based on modular approach and interoperability, as well as adaptation capabilities criteria. VLE adaptation capabilities criteria should have the same weight as the other criteria.

2.5 Virtual learning environments experimental technical evaluation results

The authors propose universal DLE components' evaluation rating tool for evaluation of all main DLE components: LOs, their repositories and VLEs. It is clearer in comparison with (Technical... 2004) rating tool and more convenient in comparison with (Graf and List 2005) rating tool. This tool is based
Eugenijus Kurilovas and Valentina Dagiene

on analysis of the level of feature’s support and the level of modification needed to reach the desired level of support (see Table 1).

Table 1: Evaluation importance rating (Technical… 2006)

<table>
<thead>
<tr>
<th>Rating</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Failed or feature does not exist</td>
</tr>
<tr>
<td>1</td>
<td>Has poor support and / or it can be done but with significant effort</td>
</tr>
<tr>
<td>2</td>
<td>Fair support but needs modification to reach the desired level of support</td>
</tr>
<tr>
<td>3</td>
<td>Good support and needs a minimal amount of effort</td>
</tr>
<tr>
<td>4</td>
<td>Excellent support and meets the criteria out of the box, minimal effort</td>
</tr>
</tbody>
</table>

Each selected criterion is proposed to be given an importance rating to be used when evaluating LOs, repositories and VLEs. Major criteria have to be broken down into sub-criteria with each sub-criterion also having an importance rating. The importance rating range is 0–4, with 0 being the lowest and 4 being of the highest importance. Each sub-criterion has then to be rated using a range of 0–4. The authors propose to weight each LO evaluation criteria equally and to use this simple and clear criteria rating system for evaluation of all components of DLE: LOs, LO repositories and VLEs.

This universal DLE components’ evaluation rating tool was used by the authors (Kurilovas 2007) to evaluate three most popular open source VLEs against technical (both general and adaptation) criteria. The results of this evaluation are presented in Table 2.

Table 2: VLE technical evaluation summary

<table>
<thead>
<tr>
<th>Technical evaluation criteria</th>
<th>ATutor</th>
<th>Ilias</th>
<th>Moodle</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General criteria</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Architecture and implementation</td>
<td>Rating 2</td>
<td>Rating 1</td>
<td>Rating 4</td>
</tr>
<tr>
<td>Interoperability</td>
<td>Rating 3</td>
<td>Rating 3</td>
<td>Rating 2</td>
</tr>
<tr>
<td>Internationalisation and localisation</td>
<td>Rating 1</td>
<td>Rating 2</td>
<td>Rating 3</td>
</tr>
<tr>
<td>Accessibility</td>
<td>Rating 4</td>
<td>Rating 1</td>
<td>Rating 2</td>
</tr>
<tr>
<td><strong>Interim evaluation rating:</strong></td>
<td>10</td>
<td>7</td>
<td>11</td>
</tr>
<tr>
<td><strong>Adaptation criteria</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adaptability</td>
<td>Rating 1</td>
<td>Rating 2</td>
<td>Rating 3</td>
</tr>
<tr>
<td>Personalisation</td>
<td>Rating 3</td>
<td>Rating 3</td>
<td>Rating 2</td>
</tr>
<tr>
<td>Extensibility</td>
<td>Rating 3</td>
<td>Rating 4</td>
<td>Rating 4</td>
</tr>
<tr>
<td>Adaptivity</td>
<td>Rating 1</td>
<td>Rating 0</td>
<td>Rating 1</td>
</tr>
<tr>
<td><strong>Interim evaluation rating:</strong></td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total evaluation rating:</strong></td>
<td>18</td>
<td>16</td>
<td>21</td>
</tr>
</tbody>
</table>

In conformity with this practical evaluation results, Moodle is the best VLE from technical point of view.

3. Conclusions

3.1 Conclusions on learning objects technical evaluation

The authors have analysed existing criteria for technical quality evaluation of LOs in Section 1. It was investigated that these criteria have a number of limitations, e.g., (1) LORI, (Paulsson and Naeve 2006) and (MELT 2007) do not examine different LO life cycle stages, and (2) (Q4R 2007) insufficiently examines technical evaluation criteria before LO inclusion in the repository. All tools insufficiently examine LO reusability criteria. The approved Lithuanian set of evaluation criteria has many limitations, e.g. (1) in conformity with this tool all LOs and services (e.g., LOs, LORs, VLEs) have to be evaluated against the same criteria, (2) no metadata-related criteria are evaluated, and (3) these criteria do not reflect e-content and activities reusability aspects overall. Therefore more complex LO technical quality evaluation tool is needed.

The authors propose an original more complex set of LOs technical quality evaluation criteria based on flexible DLE approach as well as on foreign LO technical evaluation criteria analysed in Sections 1.2 – 1.5. These criteria were presented in Fig. 2. They are: (1) Before LO inclusion in the LOR: Narrow definition compliance; Reusability level: Interoperability, Pedagogical decontextualisation level, Cultural/learning diversity principles, and Accessibility; as well as Architecture; Working stability; Design and usability; (2) During LO inclusion in the LOR: Membership or Contribution Control...
Strategies and Technical interoperability; (3) After LO inclusion in the LOR: Retrieval and Information quality. LO reusability (incl. Interoperability) criteria should have the same weight as the other criteria.

3.2 Conclusions on virtual learning environments technical evaluation

The authors have examined several VLE technical evaluation tools suitable for flexible DLE in Sections 2.1 – 2.2. It was investigated that these tools have a number of limitations, e.g. (1) (Technical… 2004) tool practically does not examine adaptation capabilities criteria, and (2) (Graf and List 2005) tool insufficiently examines general technical quality criteria. Therefore more complex VLE technical quality evaluation tool is needed.

The authors propose an original more complex set of VLE technical evaluation criteria combining (1) General (Overall architecture and implementation; Interoperability; Internationalisation and localisation; Accessibility) and (2) Adaptation (Adaptability; Personalisation; Extensibility; Adaptivity) technical evaluation criteria (see Fig. 3). VLE adaptation capabilities criteria should have the same weight as the other criteria.

The authors have also selected and propose to use the universal DLE components’ evaluation rating tool which is clearer and more convenient than investigated other foreign tools, and has evaluated three most popular open source VLEs against technical (both general and adaptation) criteria in conformity with this rating tool (see Table 2).

References


MELT (2007) Metadata Ecology for Learning and Teaching project web site, [online], http://melt-project.eun.org


Q4R (2007) Quality for Reuse project web site, [online], http://www.q4r.org


The Enhancement of Reusability of Course Content and Scenarios in Unified e-Learning Environment for Schools

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Abstract: With the expansion of e-learning, the understanding and evaluation of already created e-learning environments is becoming an extremely important issue. One way to dealing with the problem is analysis of case studies, i.e. already created environments, from the reuse perspective. The paper presents a general framework and model to assess UNITE, the unified e-learning environment for schools, from the reuse perspective. UNITE is the e-learning environment of the ongoing EU project (FP6 IST-26964, 2006-2008, http://www.unite-ist.org/). UNITE assets are described using feature diagrams (FDs) telling us about the internal structure of UNITE; representing relationships among the compound and atomic features, thus enhancing better transparency of UNITE and in this way empowering reuse. The factors of UNITE influential to reuse with some concrete results are also presented. We provide analysis aiming to extract from the model the relevant information of two kinds: (1) which is influential to reuse in a positive sense, i.e., enhancing reuse (e.g., application of meta-design methodology for the scenarios description, classification of subjects in metadata, use of content management tools (e.g., Course editor, Metadata editor), multi-linguistic approach, international and local collaboration between teachers and students in e-learning scenario implementation and delivery, and methodological support, etc.) and (2) which is hindering reuse (e.g., age of the students, differences in national syllabus and national educational programmes, language, cultural and communication problems). Despite of some limitations of FDs, we found this notation useful because it allows the explicit representation of various aspects of the complex system (i.e., UNITE) focusing on variability of features and possible relationships and constraints. We focus on the aspects such as evaluation of the UNITE platform including tools, scenarios and content variability.

Keywords: Computer supported learning, e-learning environment development, meta-design, mobile learning, reusability

1. Introduction

Today e-learning is a normal practice in a variety of corporative and governmental organizations, including universities and secondary schools world-wide. With the expansion of e-learning, the understanding and evaluation of already created e-learning environments is becoming an extremely important issue. As e-learning environments relate not only to technology but also relate to many other factors (e.g., pedagogical, organizational, social, etc.), the evaluation of efficiency of such environments is indeed a very complex problem. One way to dealing with the problem is analysis and evaluation of case studies (i.e., the already created environments or their constituents) from the reuse perspective. A motivation of the reuse-based approach is as follows: if created e-learning assets within an environment are reusable and we can in somewhat way to measure the extent of their reusability, either quantitatively or qualitatively, then one can reason about efficiency of the environment per se.

The aim of this paper is, using the introduced general framework and a model, to assess UNITE, the unified e-learning environment for schools, from the reuse perspective. UNITE is the e-learning environment of the EU project (FP6 IST-26964, 2006-2008, http://www.unite-ist.org/) based on three technologies: Microcosmos (e-learning management, Extreme Media Solutions Ltd.), MTS-Infopool (content management of SCORM-compliant courses, Fraunhofer-Institut für Graphische Datenverarbeitung) and m-learning (Cambridge Training and Development). The distinction of the project is the evaluation of sustainability and degree of deployment of project’s results through the creation of the UNITE network of schools (NoS). Physically, the NoS consists of 14 schools from 10 European countries with 46 teachers and 512 pupils involved in the project. The NoS provides a social and environmental basis for the investigation and validation of the UNITE framework, i.e., the technological platform, the pedagogical models (Granič 2007, Cukusic 2008), and the e-learning scenarios (Zoakou 2007) that are created, integrated, populated and used in the UNITE schools. Thus the above stated features are enough to provide the evaluation for reusability.
In this paper, we describe: 1) a framework reuse-based analysis and evaluation of e-learning environments, which is independent of the environment; 2) a feature-based model that describes dependences of reusable assets within the given e-learning environment and 3) with the help of the model, evaluation of reusability of the assets by analyzing critical factors which enhance and those which hinder reuse.

The paper is organized as follows. Section 2 analyzes related works and reusability issues in e-learning. Section 3 presents a general framework for reuse-based analysis of e-learning environments. Section 4 describes a model based on using feature diagrams for representing reusable assets in the UNITE e-learning framework. Section 5 delivers a case study of the implementation of the model and analysis of factors influential to reuse. Section 6 presents the evaluation and discussion on the topics. Finally, Section 7 ends with conclusions.

2. Related works and reusability in e-learning domain

We categorize basic related works into three research streams: 1) approaches that deal with e-learning environments at schools; 2) analysis of reuse-based strategies for e-learning within the meta-design approach; 3) reusability of e-learning content and scenarios.

Stream 1 There are many announcements on tools and systems that are dedicated for e-learning at schools. Examples are Blackboard (http://www.blackboard.com), Moodle (http://moodle.com), ILIAS (http://www.ilias.uni-koeln.de/ios/index-e.html), Atutor (http://www.atutor.ca), Claroline (http://www.claroline.net). As the development of the large software system is a complex process that, in general, requires several iterations until the produced system fulfils requirements of the intended user community, social aspects are as important as technical ones (Nikolova et al. 2007).

Stream 2 For supporting a wide variety of e-learning systems a flexible framework is required, which is adaptable to the learning content and knowledge processes that are not static, but evolve dynamically over time. Such a framework has to describe a wide range of evolutionary changes that can be supported in the system itself by empowering the users to participate in setup, customization, and evolution of the system, thus bringing users domain expertise into the system. In this context, G. Fischer and E. Giaccardi propose the idea of meta-design, where social creativity can be supported by innovative computer systems that allow all users to contribute to framing and solving design problems collaboratively and act as designers (Fischer and Giaccardi 2004). For socio-technical systems to effectively support collaborative design, they must adequately address not only the problem situations, but also the collaborative activity surrounding the problem (Fischer 2007).

Niederée et al. describe taxonomies that are a well-established instrument for organizing and accessing resources in Information, Content and Knowledge Management (ICKM) systems. Taxonomies contribute to a common understanding and an improved communication in the user community by fostering the development and usage of a shared vocabulary. Authors present a meta-design framework for systematically supporting the user in the setup, customization and evolution of Web-based ICKM system instances, which is based on a model-based domain construction approach (Niederée et al. 2002).

The need for effective methods to capture, represent and communicate design knowledge remains pressing. High level principles, such as those provided by constructivism, are not sufficient in themselves. T. Boyle provides the concept of Patterns for Learning (PALs) (Boyle 2000). These are re-usable design patterns that can be applied in the development of computer supported learning environments. The paper discusses how PALs may be extracted to capture and represent design knowledge. It is argued that these re-usable design patterns provide a productive currency for meta-design, the theoretical discourse about design.

D. Kaplan, J.Youm & D. Shaenfield describe the design for a meta-authoring tool capable of generating domain-specific learning activity across a variety of instructional designs. MetaTool supports a collaborative authoring of instructional technology and facilitate research into how, when and why certain sets of instructional design components are educationally effective in particular contexts. The end result is an open architecture developed using an object-oriented methodology and participatory design that is modifiable and extendable (Kaplan, Youm & Shaenfield 2003).
The use of metadata is an instrument enhancing reuse. R. Or-Bach discusses considerable efforts in the computer-mediated learning field towards standardization of metadata elements to facilitate a common method for identifying, searching and retrieving learning objects. There are ongoing debates regarding the issues of granularity of learning objects and the vocabulary in learning object metadata schemas (Or-Bach 2004).

Maule, R. (2001) presents a conceptual model and content framework to aid in the linkage of cognitive variables, to the meta-cognitive attributes of those variables, and related metadata for the design of the presentation media. Instructional designers seeking to provide mediated instruction to target specific learning strategies, in specific target markets, or for specific individuals, may use the framework to help align the design elements comprising the instructional presentation, with the meta-cognitive learning styles of the target population, with the cognitive variables governing the subject matter presentation.

Stream 3 Sommaruga proposes an approach to the creation of re-usable and adaptable learning content objects. The RUC prototype demonstrates how starting from the same basic content it is possible to produce three different results: a synthetic presentation in the form of slides, a detailed presentation in the form of scientific report, and an assessment presentation in the form of test. The use of the XML technology allows content structures to be defined at different levels of abstraction and content to be separated from presentation. Therefore the same content can be adapted to different pedagogical contexts. By focusing on the definition of structures for learning content objects, the RUC prototype can give a significant contribution to the SCORM standard to further increase reusability and adaptability at a lower level of granularity (Sommaruga 2004).

Pferdt, F. & Dilger, B. focus upon the concept of the reusability of learning objects. In their point of view a dilemma occurs through the different perspectives of the technological and educational discipline involved. The paper offers ideas from an educational perspective and shows three approaches which allow get out of the dilemma situation (Pferdt & Dilger 2006).

Strijker analyses the use of databases assigning resources to users with changing access rights and raises the following issues: How will the information be presented to the right users? How can resources be reused for different audiences and how should access rights be provided? Who has the right to change? Who can read it and who is owner of the objects in a resource base (Strijker 2000).

This short study shows that reusability in e-learning has many aspects and they should be thoroughly studied in some well-established manner. In the further discussion, we provide a framework and a model to evaluate reusability aspects in e-learning environments.

3. A framework for reuse-based analysis of e-learning environments

The need for such a framework is motivated by the fact that 1) reusability and e-learning are two sides of the same coin; 2) any project and its results (e.g., e-learning environment) should be founded on a well-defined framework (i.e., integration and use of technology, pedagogy, and e-learning scenarios within some network of organizational structure (e.g., departments, schools, etc.). The framework we suggest includes the following items:

- A1) Identification of the scope (boundaries) of reusability and levels within the scope;
- A2) Identification of reusability aspects to be considered; and
- A3) Introduction of some measures to evaluate reusability for each aspect.

A1. Boundaries of reuse is pre-specified by the scope of the organizational structure within which the e-learning environment is exploited (in our case by NoS). There are three levels within the network: internal for each school; national and international.

A2. Three aspects are important to deal with reusability in e-learning: technical, non-technical and pedagogy-related ones. The latter includes content, scenarios and pedagogical approaches used to deliver the content. Of course, pedagogy-related aspects are non-technical aspects, but we suggest considering them separately because of their importance for learning (e-learning). By doing so, we see a difference between reuse in software engineering (where only technical and non-technical aspects are under consideration (Lim 1997) and reuse in e-learning.
By technical reusability in e-learning we mean a) various kinds of tools used to support e-learning, which may include documentation (e.g., guidelines, instructions, etc.) saved in a repository, repositories per se and their managing software, software that support compositional, representative and generative aspects (e.g., editors, composers, generators, etc.), conventional tools integrated into e-learning environment (including HW, OS and Web); b) mode of the use of tools and devices (e.g., computers, internet, mobile devices, etc.).

By non-technical reusability in e-learning domain we mean standardization initiatives, Intellectual property protection, dissemination (knowledge transferring), organizational, managerial, economical, financial, social aspects (e.g., teachers and students motivation, communication between various shareholders, etc.).

We hope that this framework describes the general understanding of reusability in the e-learning and it can be used in various e-learning environments. The most crucial part of the framework is of how to measure and evaluate the extent of reusability. The measures should be considered separately for each aspect and can be expressed either quantitatively or qualitatively. However, some measures may be common for different reusability aspects e.g., number of users, frequency of usage (scenarios, tools, and software), scope of the content, scope of the scenarios used, scope of usages (scenarios, content) in the mode ‘use-as-is’, scope of usage with modification, etc.

As reusability has many dimensions, it is very difficult to encounter the possible measures in general. Below we present those that were applied to evaluate reusability within the UNITE environment.

A3. Measures are subdivided into three categories as follows.

Measures for pedagogy-based reusability include the following items:
- Scope of the content (scenarios) used without changes (except translation to other language)
- Scope of content adaptation
- Scope of the use of scenarios and content for m-learning
- Teachers’, students’, experts’ opinion about scenarios and content
- Number of different languages used to deliver the content
- Number of places (outside classrooms) where scenarios were used
- Measures and procedures applied to validation of content and scenarios.

Measures for technical reusability of UNITE tools include:
- Reusability of documents (guidelines, quality measured by degree of structuring, completeness, conciseness, use of templates);
- Reusability of software (easiness of use (how much integration of helps, prompts), intuitive interfaces, level of automation, quality of software)
- Reusability of information pool (UNITE repository, how separation of concerns are implemented, how easily a user can storage items, of how effective search of information is, etc.)
- Size of the repository for one user
- Number of eLearning standards applied (SCORM)
- Complexity, taxonomy of content and metadata
- Number, quality of features that are supported by the developed tools
- Representation formalism for knowledge sharing and dissemination
- Of how integration of various aspects are supported by the UNITE editor (course editor)

Measures for non-technical reusability. Though for this kind of reusability can be applied various measures, we restrict ourselves by providing specific measures used in UNITE for social-economics evaluation such as:
- Readiness index of a school to be involved in the project (at the beginning of the project)
- Teachers courses (in the 18 month of the project)
- Readiness index of a school to use the environment (after the end of UNITE).
In general, the scope of usability of UNITE is the integration of various reusability aspects.

4. Model for description of reusability in UNITE e-learning framework

We analyze the e-learning from the perspective of engineering, therefore we composed the common model of the UNITE framework. This model can be viewed as a specialization and instantiation of the framework described in Section 3. To represent the model, we used Feature Diagrams (FDs) (see Figure 1) for representing results of analysis, i.e. UNITE e-learning environment, because FDs are simple and allow expressing non-functional aspects too. Our goal is to take into account variability of features (e.g., web-based and mobile tools, scenarios, content etc.) Our efforts have concentrated on the evaluation of the UNITE platform including scenarios and content variability.

**Figure 1:** Feature diagram as a model for representing UNITE reusable assets and their relationships

A conventional FD [Kang et al, 1998; Schobbens et al, 2006] is a tree-like directed acyclic graph, in which the root represents the initial concept (also referred to as domain), intermediate nodes represent compound features, and leaves represent non-decomposable atomic features that may have values (aka variants); branches represent the parent-child relationships among compound features or among compound features and atomic features. Furthermore, some additional relationships such as constraints (e.g., <require>, <mutual exclusion>, etc.) between leaves derived from different parents are identified.

FDs are a graphical notation. Features are denoted by boxes. Features differ in types. There are mandatory, optional and alternative feature types. Mandatory feature is the one which always is selected (it is marked by a black circle above its box). Optional feature is the one which may be selected or not. Alternative feature is the one which is selected depending on some alternative (condition). Both are marked by a white circle above its box (see Figure1). The white arc means that only one optional feature can be selected while interpreting the model. The dark arc means that any number of optional features can be selected.

The following features such as web-based tools (abstractly denoted as T_1,..., T_r), mobile-based tools (denoted as M_1,...,M_p), scenario instances developed by experts (Instance_1, Instance_2 and Instance_3), scenario instances developed by teachers (Instance_1, Instance_2,...,Instance_m), Subjects (Subject_1,...,Subject_n), student ages (age_1,...,age_k) are atomic features.

The most crucial part of the model is relationships among atomic features. They are specified as R1 (teacher uses Guidelines and Content manual developed by UNITE experts), R2 (scenarios instances & scenario content created using tools are stored in the public or private repository), R3 (teacher has relationships such as constraints (e.g., <require>, <mutual exclusion>, etc.) between leaves derived from different parents are identified.

FDs are a graphical notation. Features are denoted by boxes. Features differ in types. There are mandatory, optional and alternative feature types. Mandatory feature is the one which always is selected (it is marked by a black circle above its box). Optional feature is the one which may be selected or not. Alternative feature is the one which is selected depending on some alternative (condition). Both are marked by a white circle above its box (see Figure1). The white arc means that only one optional feature can be selected while interpreting the model. The dark arc means that any number of optional features can be selected.

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scenario). Also the model delivers some constrains, e.g.: scenario instance \( m \) requires mobile tool \( M_1 \); students are not allowed to create scenarios (this constraint is not shown in Figure 1). The concrete description of realization of some relationships is presented in the Section 5.

Benefits of the introduced model are as follows: a) it describes hierarchy of features thus telling us about the internal structure of UNITE; b) it describes the parent-child relationships among the compound features, thus enhancing better understanding of UNITE and in this way empowering reuse; c) it describes the relationships between atomic features, thus tending to represent functional dependencies of UNITE.

5. Some relationships of UNITE features and their reusability: A case study

We analyse the implemented relationships with reuse in mind. Table 1 presents the scope of reuse (i.e., NoS) and some characteristics of NoS. Table 2 summarizes web-based and mobile tools, pedagogical guidelines and manuals in national languages, i.e. multi-linguistic interfaces that enhance reuse.

Table 1: Quantitative characteristics of the network of schools participated in the project

<table>
<thead>
<tr>
<th>Some quantitative characteristics of the NoS</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Countries: Bulgaria (BG), Croatia (HR), Cyprus (CY), United Kingdom (UK), Germany (DE), Greece (GR), Latvia (LT), Lithuania (LT), Malta (ML), Slovenia (SLO)</td>
<td>10</td>
</tr>
<tr>
<td>Number of schools</td>
<td>14</td>
</tr>
<tr>
<td>Number of teachers participated</td>
<td>46</td>
</tr>
<tr>
<td>Number of pupils in age 11-19 years involved</td>
<td>512</td>
</tr>
<tr>
<td>Number of classes participated</td>
<td>26</td>
</tr>
<tr>
<td>Number of e-scenarios implemented in schools</td>
<td>40</td>
</tr>
<tr>
<td>Average number of hours spent by one teacher for scenario implementation</td>
<td>42</td>
</tr>
<tr>
<td>Number of national languages for scenarios and content (all except Malta &amp; Cyprus)</td>
<td>8</td>
</tr>
<tr>
<td>Number of metadata were added into the repository of learning objects</td>
<td>254</td>
</tr>
</tbody>
</table>

Table 2: Use of multi-linguistic approach to enhance reuse of UNITE tools (relationships R1 & R2)

<table>
<thead>
<tr>
<th>UNITE tool or guideline</th>
<th>Languages</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface of platform</td>
<td>EN GR DE</td>
<td>LT HR</td>
</tr>
<tr>
<td>Course Editor</td>
<td>EN GR DE</td>
<td>LT HR</td>
</tr>
<tr>
<td>Mediaboard</td>
<td>EN GR DE</td>
<td>LT HR</td>
</tr>
<tr>
<td>PPC authoring tool</td>
<td>EN GR DE</td>
<td>LT HR</td>
</tr>
<tr>
<td>PPC player</td>
<td>EN GR DE</td>
<td>LT HR</td>
</tr>
<tr>
<td>SMS authoring tool</td>
<td>EN GR DE</td>
<td>LT HR</td>
</tr>
<tr>
<td>Evaluation forms</td>
<td>EN GR DE</td>
<td>BG HR</td>
</tr>
<tr>
<td>Platform guides</td>
<td>EN GR DE</td>
<td>BG HR</td>
</tr>
<tr>
<td>Pedagogy guides</td>
<td>EN DE BG</td>
<td>HR</td>
</tr>
</tbody>
</table>

Table 3 represents relationships R2 among the following authoring tools that were provided for teachers for the content development:

- Text processors: Unite tools (Course editor, Metadata editor, HTML editor), PowerPoint, Word, FrontPage, Dreamweaver, Acrobat.
- Subject specific: Excel, MathCad, Pocketslide, Access.
- Image makers: Photoshop, Paint, IrfanView.
- Video makers: Movie maker, Flash.

Examples of specific UNITE e-learning scenarios created, implemented and delivered by teachers: Geography and History – Historical heritage of Trbovlje; Ecosystem; The human being: Nutrition and digestion; Social Sciences: Youth crime; Teenage Well-being - Student Research Project; Elective course scenario: ‘Wonderful World of Inventions’; English – Famous Authors (Zoakou et al, 2007).
Table 3: Tools used by teachers and students in UNITE scenarios implementation (relationship R2)

<table>
<thead>
<tr>
<th>Authoring tools</th>
<th>School country</th>
<th>No. of sch.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GR</td>
<td>DE</td>
</tr>
<tr>
<td>Text processors</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Subject specific</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Image makers</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Video makers</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

Table 4 describes where and for what purpose mobile devices were used by students in e-learning scenarios outside the classroom (in library, in museum, in factory, etc.) (Relationship R3).

Table 4: Places where students have performed learning activities

<table>
<thead>
<tr>
<th>Places were students performed activities</th>
<th>School country</th>
<th>No. of sch.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BG</td>
<td>CY</td>
</tr>
<tr>
<td>School</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>At home</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Outside (to take pictures, to play learning games, to answer quizzes ‘on move’)</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

The content can not easily be re-used due to the fact that teachers are not from the same domain and the domain is not really generic (like science). Table 5 presents a controlled vocabulary of metadata, classification of subjects in metadata in order to enhance reuse:

Table 5: Characteristics of pedagogy-based reusability (categories of metadata) for content and scenarios reuse in UNITE (R4 relationship)

<table>
<thead>
<tr>
<th>Metadata category</th>
<th>School country</th>
<th>No. of sub.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BG</td>
<td>CY</td>
</tr>
<tr>
<td>Biological Sciences</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Economics and Social Science</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humanities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Languages, Linguistics and Cultures</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Mathematical and Computing Sciences</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Physical Sciences</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>No. of subjects per country</td>
<td>5</td>
<td>3</td>
</tr>
</tbody>
</table>

The UNITE e-learning scenario template (meta-meta scenario) created by experts and based on JISC template (JISC, 2004) is used by teachers as creators of meta-scenario. Table 6 illustrates scenarios created using the UNITE template and different content in English that was translated into national languages to enhance reuse:

Table 6: Enhancing reuse of UNITE learning resources through the use of multi-linguistic approach

<table>
<thead>
<tr>
<th>E-learning resources</th>
<th>Languages</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-learning scenario description</td>
<td>EN</td>
<td>DE</td>
</tr>
<tr>
<td>Learning content</td>
<td>EN</td>
<td>GR</td>
</tr>
</tbody>
</table>

Factors that hinder reuse of e-learning resources (ITC, English, Environmental scenarios and content) are the ages of pupils. Characteristics of UNITE NoS relationship R3 is presented in Figure 2.
Figure 2: Content reuse: Ages of pupils as hindering factor of reuse
Table 6 and Figure 3 describe other characteristics of the non-technical reusability, such as international collaboration in e-learning.

Table 6: International collaboration in e-learning scenario implementation and delivery

<table>
<thead>
<tr>
<th>Name of the scenario</th>
<th>Collaboration type</th>
<th>School country</th>
<th>School country</th>
<th>School country</th>
<th>School country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario</td>
<td>ICT in education</td>
<td>Teachers</td>
<td>Teachers</td>
<td>Teachers</td>
<td>Teachers &amp; students</td>
</tr>
<tr>
<td>Environmental</td>
<td>English language</td>
<td>Teachers</td>
<td>Teachers</td>
<td>Teachers</td>
<td>Teachers &amp; students</td>
</tr>
<tr>
<td>Student project</td>
<td></td>
<td>Bulgaria, Croatia, Lithuania, Slovenia</td>
<td>Germany, Malta</td>
<td>Cyprus, Greece</td>
<td>Lithuania, Croatia, England</td>
</tr>
</tbody>
</table>

Figure 3: Interdependence of the efforts (hours spent) of teacher and his consultant in the process of implementation of the scenario and teacher awareness of e-learning in different schools

6. Summary, evaluation and discussion

We have suggested an environment-independent framework for analysis of a given e-learning environment to evaluate it from the reuse viewpoint. Although reusability in e-learning is recognized as a very important issue which is analyzed in a variety of different contexts, this is done usually in ad
hoc manner. Our contribution is a systematic framework enabling analysis, understanding and evaluation of the e-learning environment at a higher abstraction level, thus enhancing reusability. Within the framework, we have also presented a model as a case study to describe the structure and functionality of the concrete e-learning environment UNITE, the unified e-learning environment for schools implemented for European network of schools. The model represents essential characteristics of the environment, which are described and modelled using the feature concept and represented using feature diagrams. The feature–based model contains a feature hierarchy where intermediate nodes describe compound UNITE features under consideration and leaves represent atomic features. From the reuse perspective compound features and their derivatives, i.e., atomic features are categorized as pedagogy-related, technology-related and non-technical ones. The benefit of the model is the explicit representation of relationships among various kinds of atomic features, thus enhancing understanding and promoting reuse.

As it has been shown in (Štuikys et al, 2008A and 2008B), feature diagrams have much wider capabilities for e-learning domain because such a formalism is influential for reusability in various aspects (e.g., methodological, component-based and generative reuse). However, feature diagrams have also some limitations: in literature there are some discrepancies in syntactic representation of feature diagrams, the lack of tools that support semi-automatic drawing of diagrams; it also seems that relationships at a higher level are too abstract for practical use and we need to represent them at a lower level (e.g., using tables as it is done in our case study); furthermore, the e-learning community is yet not prepared to use feature diagrams at a wider extent. Despite of those limitations of FDs, we found this notation useful because it allows also the explicit representation of various aspects of the complex system (i.e., UNITE in our case) focusing on variability of features and possible relationships and constraints.

We have identified factors that are enhancing reuse and those that are hindering reuse. Enhancing factors are: a well-defined pedagogical model for e-learning and m-learning, including guidelines for teachers, administrative support, generality and adaptability of scenarios (pedagogical ones); characteristics and capabilities of tools in the whole (technical aspects); the early involvement of teachers in the process, including such activities as participation in requirements for UNITE platform statement, training courses, participation in all phases of validation and acting as designers (e.g., development by teachers own scenarios and content); high-level managing and planning, multi-linguistic approach applied in the use of scenarios and content (non-technical reuse aspects that should be treated as the implementation of meta-design concepts); and finally the integration and coordination of all above stated.

As we have identified from our case study, factors that hinder reuse are: cultural differences in different countries, language barriers, students’ ages, differences in curricula, motivating and self-motivating of using content developed by others.

7. Conclusions

Reusability of e-learning content has many dimensions; however, they can be categorized into three categories: pedagogical, technical and non-technical. It is impossible to discriminate the importance of each category separately: for general assessment, they should be considered in the whole, but for analysis and investigation purposes they are to be first measured and then evaluated separately. To do so we have proposed a general framework and a model for evaluation of reusability aspects and presented a case study to analyze the UNITE e-learning environment from reuse perspective. What is needed to further enhancement of reusability of the e-learning content is a more effective educational design by combining a number of resources designed; new policies and processes in schools, which support the culture of collaborative work environment and enable the recognition of this form of work.

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References


Strategies for Embedding e-Learning in Traditional Universities: Drivers and Barriers

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Abstract: This paper addresses the question: how can e-learning be embedded in traditional universities so that it contributes to the transformation of the university? The paper examines e-learning strategies in higher education, locating the institutional context within the broader framework of national and international policy drivers which link e-learning with the achievement of strategic goals such as widening access to lifelong learning, and upskilling for the knowledge and information society. The focus will be on traditional universities i.e. universities whose main form of teaching is on-campus and face-to-face, rather than on open and distance teaching universities, which face different strategic issues in implementing e-learning. Reports on the adoption of e-learning in traditional universities indicate extensive use of e-learning to improve the quality of learning for on-campus students, but this has not yet translated into a significant increase in opportunities for lifelong learners in the workforce and those unable to attend on-campus. One vision of the future of universities is that ‘Virtualisation and remote working technologies will enable us to study at any university in the world, from home’. However, this paper will point out that realisation of this vision of ubiquitous and lifelong access to higher education requires that a fully articulated e-learning strategy aims to have a ‘transformative’ rather than just a ‘sustaining’ effect on teaching functions carried out in traditional universities. In order words, rather than just facilitating universities to improve their teaching, e-learning should transform how universities currently teach. However, to achieve this transformation, universities will have to introduce strategies and policies which implement flexible academic frameworks, innovative pedagogical approaches, new forms of assessments, cross-institutional accreditation and credit transfer agreements, institutional collaboration in development and delivery, and, most crucially, commitment to equivalence of access for students on and off-campus. The insights in this paper are drawn from an action research case study involving both qualitative and quantitative approaches, utilising interviews, surveys and focus groups with stakeholders, in addition to comparative research on international best practice. The paper will review the drivers and rationales at international, national and institutional level which are leading to the development of e-learning strategies, before outlining the outcomes of a case study of e-learning strategy development in a traditional Irish university. This study examined the drivers and barriers which increase or decrease motivation to engage in e-learning, and provides some insights into the challenges of embedding e-learning in higher education. While recognising the desirability of reaching out to new students and engaging in innovative pedagogical approaches, many academic staff continue to prefer traditional lectures, and are sceptical about the potential for student learning in online settings. Extrinsic factors in terms of lack of time and support serve to decrease motivation and there are also fears of loss of academic control to central administration. The paper concludes with some observations on how university e-learning strategies must address staff concerns through capacity building, awareness raising and the establishment of effective support structures for embedding e-learning.

Keywords: institutional strategies; embedding e-learning; academic preferences

1. International and national e-learning strategies

In recent years, pressures have emerged from policymakers and other stakeholders to embed e-learning technologies in mainstream higher education. The interest in implementing e-learning in higher education systems throughout the world has been influenced by a number of pressures and drivers. According to Hammond (2003) higher education institutions exist within political, cultural and social contexts which shape policy and practice. Within this context the main drivers are national policies and priorities with regard to economic and social development, beliefs and expectations of the role of education in terms of supporting those priorities, and developments in educational technologies which have the potential to enable the system to achieve these objectives. These three drivers are interdependent, and influence the adoption of learning technologies in the institutions through the role of funding and support agencies (Hammond 2003). According to this model, the pressures on institutions to adopt e-learning are substantial, however, the ability to do so can be constrained by numerous barriers, not least the availability of funding.

The European Union is one of a number of international bodies (including the OECD, the Council of Europe and the World Bank) which have an interest in promoting e-learning. ICTs and e-learning...
have been identified as essential approaches to adapting education and training systems to meet the Lisbon objectives (‘to make Europe the most competitive and dynamic knowledge-based economy in the world, capable of sustained economic growth with more and better jobs and greater social cohesion’) (CEC, 2003). The European Council conclusions on adult learning in May 2008 invited Member States to establish e-learning and distance learning opportunities to support a culture of lifelong learning (CEC 2008: 12).

The pressure to adopt e-learning should also be seen in the context of the pressure on European higher education systems to reform and modernise in terms of curricula, teaching methods, expanded learning outcomes, new types of students, qualifications frameworks, quality assurance, research and innovation (cf. Bologna reforms and the Lisbon Agenda). Universities have been criticised by the EU Commission (CEC 2006) for offering ‘the same courses to the same group of academically best-qualified young students and fail[ing] to open up to other types of learning and learners’ (p.3); their approach has ‘slowed down innovation in curricula and teaching methods’ (p.3); and universities are informed that they need to ‘grasp more directly the challenges and opportunities presented by the lifelong learning agenda’ (p7).

According to a review of national e-learning strategies by Anderson et al (2006), the two key drivers underlying the adoption of e-learning are (a) the need to upskill the population to meet the challenge of the information and knowledge society and (b) the need for accessible and flexible access to tertiary education to meet the changing nature of society and the lifelong learning agenda.

A number of countries have developed national e-learning strategies for the higher education sector which aim to meet needs for lifelong learning, upskilling, and quality improvement. For example, HEFCE (Higher Education Funding Council of England) has adopted a strategy to embed e-learning in all higher education institutions, ‘in a sustainable way, by 2010’ and is working with the Higher Education Academy and the Joint Information Systems Committee on implementing the strategy (HEFCE 2005). HEFCE defines e-learning as ‘any learning that uses ICT’ but stresses that it also encompasses ‘flexible learning as well as distance learning, and the use of ICT as a communications and delivery tool between individuals and groups, to support students and improve the management of learning’ (HEFCE 2005: 5). According to HEFCE ‘In the light of our rationale and definition for our e-learning strategy, we therefore aim to support the HE sector as it moves towards embedding e-learning appropriately, using technology to transform higher education into a more student-focused and flexible system, as part of lifelong learning for all who can benefit.’ (HEFCE 2005: 5). Seed funding to a total of £33m was distributed to 74 English universities in 2007, as a consequence of which, the majority of UK universities have now adopted or updated their e-learning strategies. Morris makes the point that ‘Within the UK, there has been a marked switch in national strategies for e-learning away from funding centralised initiatives (such as the UKeU and the National Health Service University) to decentralised activities with funding allocated to individual institutions” (Morris 2008: 336).

In New Zealand, the E-Learning Advisory Group to the Ministry of Education recommended that a tertiary e-learning consortium should be set up to coordinate the development of e-learning in the higher education sector (ELAG 2002) and an interim e-learning strategy was established in 2004 (Ministry of Education 2004). The Ministry of Education funds a number of e-learning initiatives, including the e-learning Collaborative Fund (NZ$28m between 2003 and 2007) and the Tertiary e-learning Research Fund, as well as the e-learning Portal at www.elearn.govt.nz.

It should be noted, however, that the adoption of e-learning does not necessarily increase access or widen participation to off-campus students. The OECD report on e-learning strategies adopted in institutions in thirteen countries found that enhancing on-campus learning was the leading rationale for adopting e-learning, whereas distance learning did not feature as a strong rationale in over half of the institutions surveyed (OECD 2005). Another report on e-learning strategies in Japan found that while over 70% of institutions had adopted some form of e-learning, less than 10% made courses available to off-campus students (Latchem et al 2007). In addition, a study carried out on behalf of the New Zealand Ministry of Education, which surveyed national e-learning policies in eight countries, found that the strategies tend to present e-learning as a ‘completely new phenomenon’ and that there is a disconnect in a number of national strategies with the ‘rich and long tradition of distance education’. This leads to a situation where there is a lack of policy alignment where the e-learning policy is not supported and reinforced in other tertiary policy initiatives (Brown et al 2007).
A number of national and international e-learning strategies hold out the goal of ubiquitous and lifelong access to higher education. However, it should be acknowledged that the realisation of such a vision will require more than the availability of technological infrastructure. Lifelong access to higher education via e-learning will require HE institutions to implement strategies and policies which focus on: flexible modular frameworks; innovative pedagogical approaches; new forms of assessments linked to learning outcomes, including eportfolios; cross-institutional accreditation and credit transfer agreements; institutional collaboration in development and delivery; multiple access and exit points from programmes; and, most crucially, commitment to equivalence of access for students on and off-campus. In the context of modernising the system, some of these processes are already in train in European higher education, for example, implementing the national qualifications framework and adopting the Bologna reforms. However, while the system is responding to the policy drivers, in the form of strategy formulation, there are also significant barriers to implementation at local level.

In the next section, we will examine some of the rationales for adopting e-learning strategies before examining the barriers to implementing such strategies, and ways in which these barriers can be removed.

2. Institutional e-learning strategies

A number of studies (e.g. Garrett and Jokivirta 2004; OECD 2005; Schiffman et al 2007; JISC 2008) have investigated the reasons institutions give for engaging in e-learning or adopting e-learning strategies. The majority of the rationales cluster into seven broad categories as follows:

- Enhancing Reputation
- Developing Information Skills/Literacies
- Widening Access
- Supporting the Disabled Student
- Improving Quality of Teaching and Learning
- Increasing Flexibility
- Reducing Cost/Improving Cost-Effectiveness

Garrett and Jokivirta surveyed 122 Higher Education institutions in a number of Commonwealth countries while Schiffman and his colleagues surveyed 738 US tertiary institutions which were engaged in online learning. What is interesting is that the institutions in the Schiffman study prioritised the recruitment of additional students from new geographical areas and new markets, while those in the Garrett and Jokivirta study foregrounded the enhancement of on-campus learning as their main reason for developing e-learning. This may indicate that the US institutions are further ahead in the implementation of e-learning and are now in a position to move beyond the campus. It may well also reflect the more competitive environment in which many US universities operate.

As noted above, the HEFCE e-learning strategy (2005) in England and Wales has stimulated an upsurge in e-learning strategy development, with the majority of UK universities now having adopted e-learning strategies. Analysis of a sample of such strategies indicates that most universities have adopted a ‘bottom-up’ rather than ‘top-down’ implementation policy; they tend to foreground the potential of e-learning to enhance teaching and learning; and to foster a wide variety of learning outcomes. In addition, staff training is seen as essential to successful e-learning but flexible support structures and mechanisms are seen as even more important (MacKeogh and Fox 2008). Again this reflects what is, for most institutions, a relatively early stage of e-learning development. The University of Lancaster (2006) e-learning strategy is quite explicit about the stages of e-learning development:

- **Minimum/Introductory** - the minimum standard readily achievable now for all programmes of study. This defines what all students should expect as part of their e-learning experience at Lancaster University.
- **Intermediate/Contextual** - development and embedding of activities into local LTA [Learning, Teaching, Assessing] practices (blended learning) and customisation to specific disciplines and contexts.
- **Advanced/Transformational** - significant shift in pedagogical practice and greater requirement for technical infrastructure and development.
In contrast with the situation in the UK, and other countries which have developed national e-learning strategies, Ireland has yet to develop its own national strategy. The Higher Education Authority (www.hea.ie) – the national funding body for Irish universities - established an expert group to enquire into the possibility of a national strategy for open distance learning in March 2008, however, at the time of writing, no announcement of the strategy had been made. To date, none of the seven universities in Ireland has established a formal institutional e-learning strategy, however, Dublin City University (DCU) set about developing its e-learning strategy in 2007. In the next section, we will discuss the outcomes of a case study of e-learning strategy development in DCU.

3. Dublin City University – the development of an e-learning strategy

Dublin City University (DCU) is a small university (9,000 students) which faces a number of challenges which will affect its development over the next five to ten years. These include: declining student funding in real terms; differential growth and decline in enrolments; fulfilling the commitment to extend access and widen participation; maintaining and assuring the quality of teaching and learning; maintaining the balance between teaching and research; and growing competition from institutions both in Ireland and abroad. These challenges are not confined to DCU, and in common with many other universities, DCU has turned to e-learning as a potential solution to some, at least, of these challenges. DCU has a long tradition of providing distance education programmes to adult students through Oscail – the National Distance Education Centre - which is part of DCU (see MacKeogh 2003), and it was the first university in Ireland to adopt the open source VLE, Moodle. Nevertheless, DCU is primarily a traditional university and the adoption of e-learning in the faculties is in its infancy and has, to date, not achieved any significant transformation of teaching and learning for traditional students (Blin and Munro 2008).

In November 2007, DCU Executive requested the authors of this paper to investigate and develop the basis for an e-learning strategy for the whole university which would involve the embedding of e-learning in all programmes, not just those delivered to off-campus students by Oscail. The authors were asked to investigate a range of areas and to make recommendations based on evidence from its research. The chief areas of investigation centred on the policy drivers for adoption of e-learning, including the demands of the Bologna process for transformation of university curricula, identification of best practice with regard to sustainable organisational structures for embedding e-learning in the university, and most importantly, the environment within DCU with regard to capacity and openness to adopting e-learning. In order to ensure that the needs of lifelong learners as well as those of traditional on-campus learners were kept in focus, it was recognised that e-learning covers a spectrum of provision, and can be used both to enhance existing provision, or to extend access to those who are unable to attend on-campus education. Therefore, the following working definition of e-learning was adopted: ‘The use of ICTs to improve the quality and flexibility of learning for all students and to extend access to higher education to those who are unable to attend on-campus for whatever reason’.

As part of its investigations, the authors carried out extensive reviews of the literature on e-learning policy, institutional strategies and initiatives, and trends in technology. With regard to the potential for e-learning in the University, the authors adopted a systems approach, recognising that any process in the university is affected by and affects in turn a wide range of individuals and groups, with various roles and responsibilities. In effect, e-learning is not just the responsibility of academics; administrative support units are key facilitators, including the Learning Innovation Unit, Library, Student Services, Computer Services, Registry, Finance, Human Resources etc. For e-learning to flourish, all systems must interact to ensure that there are no blockages or inhibitors. In order to ensure that all staff were involved in the consultation exercise and had an opportunity to voice their views a questionnaire survey examined attitudes, motivations, facilitators/inhibitors to participation in e-learning, expertise and training needs.

We now turn to some of the factors in facilitating and inhibiting the further development of e-learning in DCU which have emerged from the investigation.

4. Barriers and facilitators – staff attitudes

In the previous sections we have discussed the drivers leading to the upsurge in e-learning policy and strategy formulation, however, while much research has confirmed the need for top-down strategies, nevertheless, it is also widely recognised that academic staff acceptance and engagement is a key factor in the successful implementation of the institutional strategy (see Cummings et al 2005). The
political support of senior management is essential for the wider adoption of new practices, but innovations cannot be adopted without buy-in from rank and file academic staff who, in their role of subject matter experts, and in accordance with the tradition of academic freedom, can often choose whether or not to change their teaching practice.

In order to establish the climate of opinion within DCU with regard to adoption of e-learning, a series of unstructured interviews with some sixty key stakeholders in the university took place over a period of four months. These included Deans, Heads of School and Administrative Units, and academics and administrators, as well as group meetings with Faculty boards and schools. The interviews covered a wide range of issues, including the potential for converting programmes for e-learning, and the type of factors inhibiting or facilitating e-learning. The purpose of these consultations was twofold, firstly to establish the conditions likely to favour the embedding of e-learning in DCU, and secondly to create an awareness of the potential of e-learning for meeting a range of strategic objectives. The responses may be summarised below.

Attitudes to e-learning were mixed, ranging from highly sceptical, to highly supportive, particularly with regard to the pedagogical effectiveness of fully online programmes. It became apparent that there was a widespread lack of awareness of the potential and quality which e-learning can achieve, or the type of pedagogical philosophy underpinning effective e-learning. There was a strong allegiance to the face-to-face teaching model allied with a current of scepticism about e-learning, particularly around issues of quality, workload, and loss of control. However, there was also evidence of enthusiasm and strong expertise among some staff, with recognition of the need for new approaches. Oscail programmes are fully online (1,500 students), and some schools have developed innovative e-learning initiatives (although some of these were somewhat protective of their programmes and resistant to the prospect of top-down ‘interference’). There appeared to be a base of support and understanding among some administrative units of the requirements to support e-learning; however, there were also concerns on the part of some academic staff that central services would not be responsive to the needs for support required by academics adopting e-learning. Generally, there was mixed awareness of the potential offered by e-learning for providing solutions to the challenges presented by the Bologna reforms, and in particular, the university’s move to redesign curricula, based on learning outcomes.

Funding and competing agendas emerged as potential barriers. Some considered that government strategic focus on building up the research profile of Irish higher education through substantial research funding programmes, has proved detrimental to the teaching function, with teaching budgets cross-subsidising research projects, while senior academics are no longer available to teach. The priority in terms of funding and prestige accorded to research over teaching reduces the incentive to increase teaching commitments. The teaching function in Irish universities tends to be poorly funded compared with other countries, and this leads to higher student staff ratios. Over one fifth of academic staff teach classes of over 150 students with subsequent limitations on pedagogical innovation. In effect, there are few, if any, incentives for individual academic staff to take on additional students. Indeed, DCU’s small scale is regarded by some staff as a positive attribute of the DCU student experience. There is also a perception that additional income generated by more students may be ‘syphoned’ to support schools which are running deficits and therefore concern that the resources required to teach the additional students will not be forthcoming.

Following preliminary analysis of the interviews, a questionnaire survey of academic staff was carried out in April 2008. The questionnaire comprised a number of likert scales, as well as open-ended questions, and incorporated two scales developed by SUNY to assess factors which increase or decrease motivation to participate in online learning (Shea 2007). Ethics approval was provided by DCU Research Ethics Committee under the ‘Notification procedure as a low-risk social research project in which personal information of a non-sensitive nature is being collected by questionnaire’. A personal email was sent to 542 academic staff members requesting their cooperation in completing the survey which was administrated online and data were analysed using SPSS V.15. Following a number of reminders, a total of 139 usable responses were received. The overall response rate was 25.6% with a higher response rate of 35% for Oscail staff (Oscail is the distance learning centre in DCU; the majority of staff are part-time tutors), while response rates for the four faculties ranged from 20.2% (Engineering and Computing) to 24.6% (Humanities and Social Sciences). Four respondents did not indicate their Faculty affiliation. While the use of internet-based surveys has become increasingly common in research, the literature has noted that this has been at the cost of reducing
response rates (Nulty 2008). While the response rate must be taken into account, the survey generated a considerable amount of useful information, much of which confirmed the findings from the interviews and consultations.

Almost 90% of Faculty staff and 100% of Oscail staff have used the VLE Moodle in their teaching, indicating an extremely high penetration of the VLE in DCU modules. However, the most common use is transmitting information, class notes and resources, with relatively low use of the more interactive and innovative features of the VLE. For example, less than one third of Faculty staff (31.6%) initiated online discussions, and just one fifth (20%) assessed online contributions (Oscail tutors make more extensive use of the VLE for teaching and assessment). The general impression of mixed views on the value of e-learning found in the general staff consultations was borne out. The majority of respondents were favourably disposed to teaching online, with Oscail staff, who have greater experience of online learning being more positive (72.7% Oscail and 61.5% Faculties satisfied; 67.6% Oscail and 60.8% Faculties would teach online). However, while most would accept teaching some courses online, the majority expressed a preference for face-to-face teaching (68.6% Oscail and 56.7% Faculties). Over half (51.5%) of Oscail staff agree that students learn a great deal from online courses, compared with just over one third (37.1%) of Faculty staff; however a further one third of Oscail (33.3%) and just under one half (46.4%) of Faculty staff are neutral in this regard, which indicates a strong level of scepticism about the effectiveness of e-learning.

In response to a series of questions aimed at identifying factors which would increase or decrease motivation to adopt e-learning, it appears that the potential to reach new students and experiment with new technologies rank highly as motivating factors, whereas factors likely to decrease motivation are more pragmatic, relating to inadequate technical support, time, and recognition of the work involved. More tellingly, perhaps, is that Oscail staff who are mainly part-time, and paid hourly rates are concerned about inadequate compensation for hours worked. If DCU is to move to greater use of part-time hourly paid tutors, this factor will need to be taken into account.

The successful implementation of e-learning requires not only adoption by enthusiastic innovators; institutional structures must be put in place to support the sustainability and mainstreaming of e-learning initiatives. The majority of respondents supported the development of a university strategy (86.9% of Faculties and 81.8% Oscail agreed), and institutional quality standards (Faculties 85.7%, Oscail 87.8%). There was also general agreement with a Central Unit, to provide support to Faculties (Faculties 83.5%, Oscail 81.8%), but, the importance of academic faculties retaining control over course delivery is indicated by more favourable responses (66% in each case) to the concept of E-learning units within faculties to deliver courses, whereas just over one third of Faculty staff favoured course delivery by a Central unit (in this case, two thirds of Oscail staff who are used to the concept of a separate unit providing programmes are in favour). While collaboration with institutions is favoured by 76.7% of Faculty and 87.9% of Oscail, less than one third of either Oscail or Faculty staff favour outsourcing.

5. Some conclusions

This paper has described a case study of e-learning strategy development in a small traditional university which is attempting to transform its teaching and learning to meet the increasing demands for change and modernisation in higher education. In developing this e-learning strategy, it is vital to (a) have a clear vision of desired outcome (i.e. ubiquitous, lifelong, access to higher education); (b) an understanding of the current capacity and attitudes of the relevant staff and (c) a coherent set of steps to move from the current situation to the desired outcome. It will be clear from the above that there are real obstacles in implementing change in a situation of tight funding and competing priorities. It also has to be acknowledged that while the support of senior management for change is essential, purely top down implementation strategies will not work in the traditional academic environment. The concerns and needs of academics and other stakeholders must also be addressed. In the context of DCU’s e-learning strategy, the next steps include adopting a series of actions designed to enhance e-learning capacity through awareness raising, training, funding flagship programmes, and adopting mandatory credits of online learning in all programmes. In addition, a series of institutional structures will be put in place to support e-learning developments, both at central and at faculty level.

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The Identification of Key Issues in the Development of Sustainable e-Learning and Virtual Campus Initiatives

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Abstract: This paper explores a number of key issues that have been identified as being important in the identification and evaluation of best practice within the context of e-learning and virtual campuses. The ‘Promoting Best Practice in Virtual Campuses’ (PBP-VC) project is a two year European Commission Education Audiovisual and Culture Executive Agency (EACEA) co-financed project that is aimed at providing a deeper understanding of the key issues and success factors underlying the implementation and sustainability of virtual campuses. The PBP-VC project team have been working with stakeholders from a number of large virtual campus projects across Europe in identifying and exploring key issues relating to best practice and sustainability. The importance of developing a practical framework for identifying, evaluating and promoting best practice in virtual campuses and e-learning can be demonstrated by the significant number of high profile e-learning and virtual campus failures both within Europe and globally. In many cases their failure has been quite spectacular with millions of dollars being wasted as a result some quite basic errors in overlooking key best practice issues that have occurred across several large-scale projects. This paper will provide a description of the different issues relating to models for best practice and sustainability that has been developed by the PBP-VC project.

Keywords: virtual campuses, e-learning, best practices, sustainability

1. Introduction

Despite the significant growth in e-learning and virtual campuses over the last 10 years, a number of key problems and issues led to expensive failures in a number of e-learning and virtual campus projects have been identified by the ‘Megatrends in E-Learning Provision’ project (www.nettskolen.com/in_english/megatrends/the_project.html). Examples of high profile e-learning and virtual campus initiatives that did not reach their targeted goals included the Californian Virtual University, the Scottish Interactive University, the United Kingdom e-University, the Alliance of Lifelong Learning and the Open University of the United States (Keegan et al., 2007). Many large-scale e-learning and virtual campus initiatives were funded using £10millions of public money which has largely been lost when these initiatives folded. Typical problems that led to the downfall of such initiatives have been identified by Keegan et al., (2007) as including overly ambitious plans in relation to the potential student market, lack of market research and a lack of financial planning.

Over the last 4 years, the European Commission Education Audiovisual and Culture Executive Agency (EACEA) has channelled more than 10 million euros into co-financing some twenty virtual campus projects across Europe in a range of areas such as virtual mobility, teacher training, the economics of e-learning, and the reuse and sharing of e-learning courses. Despite the establishment of these virtual campus initiatives and their undoubted successes the EACEA (2005) identified a range of issues they considered as affecting the successful implementation and deployment of virtual campuses and their long term sustainability, such as a lack of awareness about other virtual campuses and a lack of self promotion and valorisation among virtual campuses. As a result the EACEA (2005) recommended that an increase in the sharing of know-how should be encouraged across virtual campuses, obstacles and enabling factors should be studied, as well as support for the dissemination of good practice.
of replicable solutions for establishing virtual campuses. Whilst there is no universally accepted definition of the term ‘virtual campus’, within the context of the EACEA (2006), a virtual campus is considered to encompass cooperation among a number of higher educational institutions in the field of e-learning in relation to the design and development of joint curricula that are based on online and traditional learning methods. Therefore, a virtual learning environment by itself or the provision of an e-learning programme within a single higher institutional institution would not be defined by the EACEA as a virtual campus. To qualify as a virtual campus, the initiative would have to include a number of partners which could comprise higher education institutions, as well as other teaching and learning related organisations (e.g. training companies, learning and teaching associations etc) who through a partnership agreement cooperate in the development and implementation of joint curricula based on e-learning or blended learning delivery. Although virtual campus projects and initiatives may differ in terms of their model of delivery, e-learning issues such as those relating to e-learning technology and e-learning pedagogy play a key role in the development and delivery of joint curricula provided by a virtual campus.

It is within the context of the EACEA’s recommendations that the ‘Promoting Best Practice in Virtual Campuses’ (PBP-VC) project was initiated in 2007. The PBP-VC project is a two year European EACEA co-financed project primarily aimed at providing:

- a deeper understanding of the key issues and critical success factors underlying the implementation of virtual campuses;
- a practical framework to help guide the process of creating best practice in virtual campuses;
- published examples of best practice, case studies and use case scenarios;
- raised awareness of the issues and approaches to creating successful and sustainable virtual campuses.

The PBP-VC project has been working with key stakeholders within large-scale virtual campus projects across Europe in investigating key issues relating to best practice in the design, development and implementation of virtual campuses. Key issues have included the e-learning related pedagogy and technology underpinning a virtual campus, issues relating to cost effectiveness and the economics of e-learning, as well as addressing the needs of learners of different nationalities and from diverse cultural backgrounds.

2. The development of a best practice models for virtual campuses and e-learning

During the course of 2007 and 2008, several detailed face-to-face knowledge elicitation sessions took place with a range of stakeholders that included project coordinators, researchers, developers, learning technologists, tutors and external consultants associated with EACEA virtual campus projects and initiatives. The participants were selected because of their detailed knowledge, experience and understanding of best practice within the context of virtual campuses. The purpose of the sessions were to explore the more qualitative and interpretive aspects of best practice within the context of virtual campuses by exploring the viewpoints of different stakeholders. The interpretive based investigation was conducted using a form of systems map or ‘mind map’ which has been successfully used as an important first stage of a subjective approach to the process of eliciting views and opinions about some area of interest prior to the development of a computer-based information system. The subjective approach is known as the Appreciative Inquiry Method (West, 1995; West and Stansfield, 1998; West and Thomas, 2005) and its developers claim that it is an effective way of enabling interpretive inquiry. The systems map as used in the Appreciative Inquiry Method provided a quick and simple method of representing the main elements believed to be relevant to a particular area of interest or problem situation which in this case was ‘Best Practice within the Context of Virtual Campuses’.

In undertaking the identification of best practice case studies in virtual campuses, the PBP-VC project has worked closely with several European level virtual campus projects including the eLene Network which has three successful virtual campus projects in the EACEA eLearning programme (eLene-TT – Teacher training and the innovative use of ICT in higher education, eLene-TLC - Preparing universities for the ne(x)t generation of students and eLene-EE - economics of eLearning). The eLene Network is considered to be an example of best practice and sustainability. Other European level virtual campus projects also included e-move (an operational concept of virtual mobility) which is based on the operational concept of virtual mobility. In addition, an online questionnaire was
developed which was targeted at virtual campus projects and initiatives that included VCSE (Virtual Campus for a Sustainable Europe), eduGI (Reuse and sharing of eLearning courses in GI Science education) VCSE, and E-Urbs (European Master in Comparative Urban Studies).

The key issues that were identified as a result of the face-to-face knowledge elicitation sessions with the different virtual campus stakeholders were grouped under six main headings, which was further supported by the responses and feedback derived from the online questionnaires. The six main headings were:

- Organisational issues
- Technological issues
- Pedagogical issues
- Student/user issues
- Financial issues
- Consolidation issues

The authors are not proposing that the headings and models that follow (see Figures 1 to 7) contain an exhaustive or definitive account of all the possible key issues relating to best practice within the context of e-learning and virtual campuses. The models contain a summary of the key issues that were identified by the experienced stakeholders and practitioners that took part in the investigations that were conducted by the PBP-VC project. The value of the models lies in their ability to highlight key issues in an effective visual manner that can generate debate among relevant stakeholders and interested parties. In addition, there appears to be not a great deal of published literature that reflects upon best practices within the context of virtual campuses and e-learning, as well as providing practical models and frameworks within which to plan, develop and implement virtual campus and e-learning projects and initiatives.

2.1 Organisational issues

The main organisational issues underpinning best practice as identified by the stakeholders are shown in Figure 1. Many of the key issues centred around project management and leadership which were viewed as being central to the success of a virtual campus project. Establishing a clear vision and strong leadership, as well as demonstrating a pro-active approach to management so that potential problems can be more easily addressed, as well as opportunities explored to the full were viewed as being important. In many ways, issues relating to having a strong and effective project leader can be the most difficult to address since leadership skills can be difficult to master due to their experiential or tacit nature that cannot be simply achieved from following a series of steps. Leadership skills can often only be learnt over many years of experience and attributes such as ‘charisma’ can be difficult to define or reproduce. Also highlighted as being important was the ability of a project manager or leader to be able to establish effective partnerships with both internal and external stakeholders in generating enthusiasm and interest in the virtual campus project. In order for a virtual campus project to meet the real needs of users/students and the wider community (e.g., potential employers), then strong partnerships with external stakeholders must be established from an early stage. Having a supportive senior level project champion was also viewed by some of stakeholders as being useful in addressing bureaucratic and administrative ‘red tape’ that is often experienced in attempting to provide seamless, coherent educational experiences and exit awards, particularly when a course is delivered between numerous partners across international boundaries and cultures.

The problem of language and culture was highlighted by some virtual campus projects and initiatives in relation to many of the courses having to be delivered in English which could be the second or third language of some of the staff and students. In addition, it was highlighted by some stakeholders that certain institutions in different parts of Europe and subject areas may display more of a cultural resistance to e-learning and the concept of virtual campuses which may lead to problems in the uptake and successful completion of courses. As a result a key issue that was identified through discussions with virtual campus stakeholders in terms of underpinning best practice was the need to effectively manage diversity. Virtual campus project by their very nature are characterised by diversity both in terms of the project teams and students/users who are drawn from across many European states. Effectively managing diversity and providing dialogue among different transnational partners and student groups helps avoid misunderstandings, identifies any potential problems early, as well as
identifying the strengths of the transnational partnership and enables a team to better learn from each other.

Effective teamwork and agreeing on clear roles and responsibilities was identified as being important in ensuring that all partners work well together in achieving the outcomes of the virtual campus project. The adverse affect of this issue can be reduced in situations where the project partners have worked with each other on previous projects and initiatives in which effective teamwork has already been established within the partnership. In addition, the role of the project leader was also seen as crucial in terms of motivating the project team and ensuring that any areas of potential conflict are addressed quickly and that project deliverables are achieved on time by the project team.

Figure 1: Examples of organisational issues underpinning best practice

2.2 Technological issues

Within the context of e-learning and virtual campus related technology, Figure 2 highlights a range of issues viewed as underpinning best practice. The issue of embracing innovation was identified by a number of leading researchers and project coordinators, which was viewed as being part of pro-active management. By their very nature, learning technologies can become dated within a relatively short period of time. Identifying new trends and developments in learning technologies such as those provided by Web 2.0 (e.g., blogs, wikis, podcasting etc) is vital if virtual campus and e-learning initiatives are to continue to stimulate students/users and address the needs of internal and external stakeholders in an effective manner. In terms of meeting the needs of students/users, an appropriate technological infrastructure and standards must be adopted that are both cost effective and also ensure that key issues such as system security are addressed. Many of the virtual campus projects highlighted the need to adopt open source technologies in providing suitable flexibility and functionality in a cost effective manner. Approaches such as Rapid Application Development were viewed as being important within the context of testing and evaluation in meeting the needs and requirements of staff and students/users and being able to add extra functionality to virtual learning environments as required during the course of the virtual campus project.
Within the context of pedagogical issues which are shown in Figure 3, the choice of appropriate pedagogical models and approaches, as well as providing appropriate and stimulating content underpinning virtual campuses is of great importance since it has a big impact on the educational experience of the students. One of the key issues identified by many stakeholders relates to the adoption of a user centred design approach in terms of developing the content, functionality and
interfaces that users actually want rather than those the designers think that they might want. Therefore, it is vital that the pedagogy underpinning a virtual campus supports and enhances the students’ experience in learning a particular subject area. As with technological issues, the importance of evaluating the success of the educational content in meeting student/user needs was considered to be important. For example, virtual campus projects noted that through evaluation they were able to determine which was the most popular content and functions which sometimes were not always the ones that the developers might have intended. As with technological issues, embracing innovation within the context of the latest pedagogical developments and practices was also considered to be an important issue underpinning best practice in virtual campuses and e-learning. Providing proper guidance for students can be an important factor in underpinning success and retention. A number of virtual campus projects reported that many of their students felt that once they had received appropriate support and guidance they felt more positive towards their studies.

2.4 Student/user issues

As shown in Figure 4, important elements associated with student/user issues include the need to have in place clear and effective communication strategies in order to be able to interact with students and staff at different levels, whether using formal or informal mechanisms, as well as ensuring that clear guidelines and feedback mechanisms are provided.

![Figure 4: Examples of student/user issues underpinning best practice](image)

Many students/users of virtual campuses can be compared to what Prensky (2001) terms ‘digital natives’ who have grown up in a digitally sophisticated environment populated by home computers, the Internet, graphic rich computer games and movies, Internet gaming, mobile phones, interactive television, PDAs and iPods. Therefore, it is important that the students’ learning experiences are enhanced through appropriate technology which stimulates them and enables intercultural dialogue that represents the cultural scope of a virtual campus project that comprises students and staff from across Europe. The attitudinal and cultural problems associated with technology were highlighted by a number of virtual campus projects who noted that it was often staff who appeared to have the greatest difficulties in learning to use new technologies, which was often compounded by the negative attitudes of some staff towards the burden of having to learn new skills and master new technologies. Nearly all the virtual campus projects reported that on the whole students enjoyed learning and using new technologies in order to enhance their learning. Peer support among students was often reported as a useful means of students supporting and encouraging each other in learning new tasks and interacting with each other either online or during face-to-face classes when blended learning was adopted within a virtual campus project.
2.5 Financial issues

Issues relating to finance as highlighted in Figure 5 are important to virtual campus projects and initiatives if they are to continue to operate and become sustainable beyond the initial EACEA funding period.

![Diagram of financial issues underpinning best practice](image)

**Figure 5**: Examples of financial issues underpinning best practice

It is crucial that virtual campuses adopt appropriate costing methods and effective cost/benefit analysis in order to determine the full costs, both direct and indirect, of providing the range of services and functions to students/users. Therefore, it is important that virtual campuses develop an effective and transparent business model that enables them to generate sufficient income in order to become sustainable and finance future developments. In the past far too many virtual campus and e-learning projects and initiatives ended once the initial period of external start-up funding expired. In order to become more financially sustainable, a number of virtual campus projects highlighted the need to place virtual campus and e-learning initiatives within the wider organisational context of the institution comprising the partnership. This relates to embedding best practices derived from virtual campus and e-learning initiatives and practices within the more traditional educational offerings of a higher educational institution in order to secure its financial future. Securing the support of senior level project champions was viewed by some stakeholders as being important in securing the financial future of a virtual campus or e-learning initiative.

2.6 Consolidation issues

Consolidation issues as highlighted in Figure 6 reflect the kind of activities that can help sustain a virtual campus project by developing adequate marketing and dissemination plans targeted at groups of key stakeholders such as students, government bodies and companies in order to continue to generate interest and funding channels.

One of the ways identified as working towards enabling the consolidation and sustainability of a virtual campus project’s activities was that of developing a centre of excellence in the particular domain that it specialises in through providing accreditation and recognition for its courses through partnerships with respected professional and academic organisations and societies. Identifying best practices and unique selling points and undertaking dissemination and marketing activities were viewed as an important way of building upon the achievements of a virtual campus project and working towards securing its future beyond the initial period of start-up funding. In addition, a number of virtual campus stakeholders identified the need to focus on the wider organisation within which the virtual campus operates by involving key internal and external stakeholders and encouraging them to embrace the e-learning environment by exploring ways in which the virtual campus might contribute to organisational transformation. By doing this, virtual campus projects and initiatives are exploring long term issues
that will contribute to their continued development and success, rather than just focusing on the short term issues relevant to the initial start-up funding period.

In order to provide a sustainable virtual campus, it was considered important by many stakeholders that it should be underpinned by an effective and transparent business model based on sound market research which provides a revenue stream from student fees and/or sponsorship that enables the virtual campus to continue to develop in the future. Sustainability was viewed as being a key goal and activity that should be considered throughout the lifecycle of a virtual campus project, particularly at the planning stage, rather than just being an area for consideration once a virtual campus had been implemented.

3. Sustaining best practices in virtual campuses and e-learning

As a result of the investigation into the issue of best practice virtual campuses, the PBP-VC project engaged with a wide range of stakeholders from different virtual campus projects from across Europe. As a result of investigating these virtual campus projects, a number of different levels of maturity could be distinguished in terms of their planning, development, implementation, evaluation and sustainability. Virtual campus projects such as those that were part of the eLene Network that had been successful in securing three consecutive externally funded projects demonstrated high levels of development and maturity in relation to many of the issues underpinning best practice in virtual campuses. As a result from discussions with stakeholders involved in the eLene Network and other virtual campus projects and initiatives, a number of levels in relation to virtual campus maturity were identified. The levels are shown in Figure 7, which uses a diagrammatic way of representation that has certain similarities with Salmon’s (2002) E-tivities 5 stage model. The levels of virtual campus maturity represented in Figure 7 comprise:

- **Level 1 – Virtual campus planning and development:** This is at the very earliest stages of virtual campus planning and development where project teams have been recently formed and initial work is commencing on developing learning materials, the technical infrastructure as well as addressing bureaucratic and administrative issues that arise from running courses across transnational boundaries. Issues such as having clear vision, strong leadership and effective teamwork are important at this level in ensuring that planning and development are successful and completed according to plan. At Levels 1 and 2, a virtual campus would usually be heavily dependent upon external start-up grants to resource the project.
- **Level 2 – Virtual campus evaluation and refinement**: Once the virtual campus has been developed and students are studying the courses, it is important that rigorous evaluation takes place which enables the success of the virtual campus to be gauged from an organisational, technological, pedagogical, student/user and financial perspective. It would be expected that refinements to the technical infrastructure and learning materials would take place as a result of feedback from staff, students and other stakeholders. Issues such as having clear and effective communication are considered to be vital in ensuring the inclusion of all stakeholders. Many of the virtual campus projects involved in the study highlighted the importance of utilising the services of external, impartial evaluators which helps greatly in providing a fresh perspective in addressing key issues and evaluating the success of a virtual campus project.

- **Level 3 – Virtual campus integration**: At this level of maturity, a virtual campus project will be focusing on implementing plans for sustainability that enable it to continue past the initial external start-up grant stages. Issues such as pedagogical and technological reusability/interoperability enable the e-learning environment to be embraced within both the virtual campus and wider organisational setting to provide a better return on investment and a more financially sustainable virtual campus to continue in the future.

- **Level 4 – Organisational transformation**: At this level of maturity a virtual campus will be financially self sustainable in terms of being able to run without the need for external grants and will have received widespread recognition and support from senior decision-makers both at organisational level and externally. In addition, best practices established during the development of the virtual campus can become embedded within a wider organisational context. Thus the virtual campus, rather than being viewed as a separate project within an organisation, is viewed more as contributing to the wider organisational transformation in terms of providing effective economic models that will support and sustain real public-private partnerships in the creation, development and management of e-learning and virtual campus initiatives.

The different levels are shown in Figure 7.

**Figure 7**: The four levels of virtual campus maturity

It is not assumed that all virtual campus projects and initiatives will reach Levels 3 and 4. It might be that a virtual campus project runs for the duration of the external funding period that might be 2 years and then discontinues which does not allow it to continue to Levels 3 and 4. Over the coming months, the model of issues underpinning best practice and the four levels of virtual campus maturity will be developed further into a detailed framework for identifying and promoting best practice in virtual campuses. The PBP-VC project will be working closely with several European level virtual campus
projects and initiatives in developing case studies and use case scenarios aimed at demonstrating the best practice framework in use.

4. Conclusions

This paper has explored a number of key issues relating to the concept of best practice and sustainability within the context of virtual campus and e-learning initiatives. Work so far conducted by the PBP-VC project has identified a number of key issues relating to best practice within the context of virtual campus project management, virtual campus development and implementation, and wider organisational transformation. It is hoped that work conducted by researchers and projects such as the PBP-VC project might contribute in the future to promoting best practice within the context of e-learning and virtual campus initiatives further, and perhaps contribute to the greater sustainability of these initiatives. It is not suggested that the issues explored in this paper are definitive and exhaustive. The value of the models used to explore some of the key issues lies in their ability to generate debate among different stakeholder groups. It is only through generating greater debate and awareness among the academic, business and professional communities that a better understanding of best practice and why virtual campus and e-learning projects and initiatives might fail can be gained.

Acknowledgements

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http://cis.paisley.ac.uk/research/journal/vol6.html


Adoption of Web 2.0 Technologies in Education for Health Professionals in the UK: Where are we and why?

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Abstract: This paper describes the findings about the use of Web 2.0 technologies in the education of health professionals in the United Kingdom (UK). The work is part of a wider study scoping the use of e-learning.

Its objectives were to:

- Explore issues influencing implementation and use by both early and late adopters
- Identify barriers to implementation and good practice
- Review the employment of e-learning within curricula representing a range of teaching models

In phase one, a postal survey obtained data from 25 higher education institutions relating to their uptake and development in this field. A second phase identified four case studies, two from early and two late adopters, reflecting the features identified from phase one. In the case studies, interviews and focus groups with students and staff were conducted to gain a deeper understanding of the issues which were significant to them. The main findings suggested e-learning development and use varies, with a spectrum of employment across the sector. The predominant engagement is with instructivist learning approaches managed through a Virtual Learning Environment with only limited experimentation in interactive learning online.

This paper will discuss the findings from the study where they relate to the limited use of Web 2.0 technologies. It will include a discussion on the moral, legal and ethical implications of current and future developments.

Keywords: Web 2.0, survey, case study, e-learning, web based learning

1. Introduction

This study was conducted for the Higher Education Academy, Health Science and Practice Subject centre (HEA HS&P), an organisation that supports higher education institutions provide the best learning experience for students. The study scoped the development and use of e-learning in health science and practice education in universities within the United Kingdom (UK). As part of the research we explored the development and adoption of Web 2.0 technologies.

Web 2.0 is a term describing the trend in the use of World Wide Web technology and web design that aims to enhance creativity, information sharing, and, most notably, collaboration among users. These concepts have led to the development and evolution of web-based communities and hosted services, such as social-networking sites, wikis, blogs, and folksonomies. The term Web 2.0 became notable after the first O'Reilly Media Web 2.0 conference in 2004 (O'Reilly, 2005).

These technologies have increasing numbers of users and are finding a place in many areas including healthcare management, education and practice. Patient support groups, with or without the involvement of healthcare professionals, are adopting Web 2.0 technologies and identifying a range of advantages and potential risks (e.g. Frost & Massagli, 2008).

It has been argued that Web 2.0 technologies have the potential to change the education of healthcare professionals, at undergraduate and postgraduate levels, from a didactic one way process, in which information is transferred from the “expert” to the student, to a collaborative and participative process, empowering the student to be an equal participant in the learning process. However there are significant challenges and hurdles which need to be considered (Boulos & Wheeler, 2007).

The potential for e-learning to enable and empower healthcare students within educational programmes has been discussed for many years (Salmon, 2002), however this has been challenged with calls for moves from instructivist to constructivist learning approaches, built around “Communities...
of Practice”, which potentially provide the greatest scope for learning through interaction and discussion (Moule, 2007). More recent developments argue that behaviorism, cognitivism, and constructivism are unable to adequately address learning that occurs outside of people (i.e. learning that is stored and manipulated by technology). They also fail to describe how learning happens within organizations. Therefore constructivism has been proposed as the “integration of principles explored by chaos, network, and complexity and self-organization theories” (Siemens, 2004). It recognises that learning is a process that occurs within nebulous environments of shifting core elements – not entirely under the control of the individual. Learning (defined as actionable knowledge) can reside outside of ourselves (within an organization or a database), is focused on connecting specialized information sets, and the connections that enable us to learn more are more important than our current state of knowing (Siemens, 2004). Web 2.0 technologies offer online environments that can support both constructivism and connectivism.

Web 2.0 technologies are emerging as platforms to enable or encourage students to be collaboratively creating and sharing their own insights into current and emerging themes within their education. This “architecture of participation” has been described as “emphasising the pre-eminence of content creation over content consumption”, (Boulos & Wheeler, 2007, p3) and the use of Web 2.0 applications as “mind tools to stimulate reflection and actively involve learners in their own construction of knowledge” which have been proposed as a way to yield powerful learning experiences (McLean et al, 2007). It may also be important for healthcare professionals to be aware of the emerging technologies, and their potential development not only for their own use to inform practice, but also because the trend for patient and client use is likely to continue and increase.

Whilst it seems Web 2.0 might offer the potential for online learning to support pedagogy in higher education there is little understanding of how and where it is being used to support healthcare education. In order to try and draw some understanding of current engagement this study aimed to explore issues influencing the implementation and use of e-learning by both early and late adopters and in so doing identified the level of Web 2.0 use.

2. Data collection

The study included two phases of data collection. Initially data were collected through a survey questionnaire developed from the Joint Information Systems Committee (JISC) funded Managed Learning Environment Study survey tool (http://www.mlestudy.ac.uk). The Managed Learning Environment Study survey tool was adapted for use in the current study with the permission of JISC. Some of the original sections were re-worded or removed, leaving a total of 62 questions. It was recognised that not all elements of the survey would not necessarily be completed by all respondents, depending on their institutional position.

An initial list was created from personal contacts. We also searched departments on the Quality Assurance Agency for Higher Education Major Review of healthcare programmes reports listing: (http://www.qaa.ac.uk/reviews/reports/healthReviews.asp and the Nursing and Midwifery Admissions Service institution listing: (http://www.nmas.ac.uk/instit/index.html). We added those HEAs not identified previously from the HS&P Subject Centre list of contacts. The HEA HS&P list contained a number of duplicates and no contact names. For reasons of confidentiality, names of key contacts from the HEA database were not divulged to the research team. A final sample of (n= 93) were sent a paper version of the survey.

A second phase included case study visits to explore questionnaire responses in more detail. Four case study sites were identified from the responses to phase one using the criteria to include both early and late adopters of e-learning. In this study the terms early and late adopters reflect both the numbers of staff and students involved in e-learning and the variety of e-learning activities undertaken. Our definitions are therefore not consistent with Rogers (1995) definition of early and late adopters that suggested the early adopters lead revolutionary change and risk taking.

At the case study sites visited we reviewed learning and teaching strategy documents and e-learning strategy documents for the faculty and university, interviewed key staff and viewed e-learning materials using an outline schedule. Focus groups were held with students in each site.
3. Results

3.1 Phase 1

Responses to the initial survey were received from 25 UK universities. The main findings suggest that e-learning development and use was variable. The pre-dominant engagement is with instructivist learning approaches managed through a virtual learning environment (VLE). Over 80% of the respondents used discussion boards, email, CD ROMs and DVDs, however less than half used blogs and wikis. Mobile phone usage and SMS texting had not yet been incorporated into the educational technologies employed.

E-learning technologies used by the respondents’ faculties, schools and departments are shown in Table 1. E-mail (96%), CD Roms (84%), DVDs (80%), and discussion boards (84%) were used by the majority of the respondents’ institutions, while SMS texting (8%) and mobile phones (16%) were used by a minority. Only a relatively small number of responders were using Web 2.0 technologies such as podcasting (32%), blogs (44%), wikis (28%) and virtual worlds (16%).

Table 1: e-Learning applications being used

<table>
<thead>
<tr>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>email</td>
<td>24</td>
</tr>
<tr>
<td>Discussion boards</td>
<td>21</td>
</tr>
<tr>
<td>CD-ROMS</td>
<td>21</td>
</tr>
<tr>
<td>DVDs</td>
<td>20</td>
</tr>
<tr>
<td>Online videos and sound</td>
<td>16</td>
</tr>
<tr>
<td>Blogs</td>
<td>11</td>
</tr>
<tr>
<td>iPods</td>
<td>8</td>
</tr>
<tr>
<td>Wikis</td>
<td>7</td>
</tr>
<tr>
<td>Mobile phones</td>
<td>4</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
</tr>
<tr>
<td>SMS Texting</td>
<td>2</td>
</tr>
</tbody>
</table>

3.2 Phase 2

The case study visits, undertaken as a second phase of the study, enabled us to explore some of the reasons behind these findings. The limited use of Web 2.0 technologies was affected by a number of issues such as lack of drivers, lack of information technology (IT) skills, development support and the reluctance of students to use social networking in education.

3.2.1 Lack of drivers

There was no pressure to use Web 2.0 technologies from the funding bodies, students or staff. Priority was given to the delivery of particular curriculum areas, such as biological sciences, where factual information takes precedence over discursive techniques used in the social sciences.

‘they [purchasers] demand lots of other things and this [e-learning] isn’t a priority

Case study 4

3.2.2 Limited IT skills and development support

Many of the staff felt that they had limited skills to explore new e-learning approaches and lacked the requisite IT skills to engage. Although they generally felt fairly comfortable with “office applications” and had learnt to use their institutions VLE they felt this is where their expertise ended. They did recognise however that they may need to engage with Web 2.0 technologies in the future if student demand increased and a number of staff who might be viewed as ‘champions’ were making demands for blogs and other Web 2.0 technologies. It seemed however that there was little support for these developments from local and central IT development units, a position that compounded the situation and would not encourage Web 2.0 use.

another area I think is a whole question of sort of [web2] social networking, collaborative approaches to e-learning I think that’s a challenge that we are all going to face really and I think partly our students are pushing us in that direction, so, and you know how do we incorporate that sort of thing with these types of materials, they don’t necessarily want the tools if they can’t interact with in that way
Case Study 11 respondent 2

well we have a few members of staff who have been asking for blogs, because they want to use it and was hard to convince the IT department, when it comes to e-learning then somehow the IT services think it is our responsibility in the centre for development of teaching and learning… I had to put a lot of pressure for them to make one available for me for a project so there is always a kind of tension.

Case Study 4 – Respondent 1

3.2.3 Reluctance to use social networking tools for education

Although the majority of students engage with Facebook or other social networking tools in their daily lives, the use of these by the universities was limited, reflecting the wider situation in UK universities (Ipsos MORI, 2008). Interestingly, students stated a reluctance to use such tools in the course of their education, preferring to maintain these sites for personal use (Swain, 2007).

RF what about things like, more social uses, do any of you use anything like you, I think you mentioned at one stage myspace or facebook. Do any of you use anything like that?

2: facebook yeah
RF would you welcome that being used by the university to tell you
2: no
RF no,
1: no, cos like that’s separate
2: separate […] and they say employers and everyone look on facebook about what [your profile is] and things like that and I wouldn’t know, no I think it’s separate like, I know nursing is like a vocation but I think you’ve got to draw a line like at the end of the day you go home and you switch off and I wouldn’t want to check my facebook page and have an email by my teachers and everyone

Case Study 11

one of the students was very, she didn’t want to answer the question at all about social networking, she said ‘well are you going to try and access it then, that’s my, that’s my personal diary’ and so we have obviously got to be very careful about intruding like that,

Case study 11 Respondent 1

It is obvious that these students had an online presence that they would rather keep separate from the formal university ‘workplace’. They preferred to engage in social networking sites for pleasure rather than for study and wanted to keep the personal and professional separate.

Staff were also concerned that students were naive in their use of social networking sites and felt that they often presented an online presence that might expose them to risk. One member of staff stated,

‘I know some institutions encourage the use of Facebook and Bebo within their learning and teaching. We have said “No, we’re not going to do that” there’s a number of issues regarding data protection, IPR, so …And I think it’s also very important, I mean, you’ve obviously seen recent articles about Bebo and Myspace, people not understanding that you put stuff up there and it can actually be used in articles by journalists and things like this …

… and I think we need to make our students much more savvy in this area.

I think they’re very, very naïve. A lot of students who come to us are very naïve about their digital identity and how they’re promoting themselves on-line…

and a lot of time I’m working with them I think, you know ,right, interview anyone, let along put them in Post, I’m always checking what they’re doing on Bebo and Myspace and they look, sort of like, horrified.

Case study 8 Respondent 1
4. Discussion

This study found that the VLE provided the mainstay of e-learning provision in most universities. This said, the range of possible functions offered by a VLE is not exploited and universities continue to limit use to repository functions, with poor employment of discussion forums. This finding echoes those results of previous research suggesting e-learning systems are still predominately used to provide digital information access and dissemination (Crook and Barrowcliff, 2001), including the provision of lecture notes, reading lists, journal articles and images (Levy, 2005). Given the reluctance of universities to exploit the full potential of VLEs it isn’t surprising that experimentation with Web 2.0 technologies is limited.

Web 2.0 technologies allow users to not only retrieve information but to use the network as a platform to create and own the data (O’Reilly, 2005). This social software can support online reflection and interpersonal and community based interactions and knowledge sharing (Levy, 2005). A current European Union funded study aims to identify and analyse the existing practices and related success factors of major Web 2.0 initiatives in the field of learning in Europe, particularly in relation to the potential of social computing applications to (re-)connect groups at risk-of-exclusion (IPTS, 2008). In this study we found 11 of the responding universities were using blogs, eight were using ipods, seven were engaging with wikis and the use of SMS texting and mobile phones was limited. There may be a number of factors affecting this uptake, though it appears that the lack of drivers and demand of Web 2.0 technologies and the limited level of staff IT skills contribute to poor uptake and development.

The case study discussions revealed that there are issues around lack of drivers for e-learning development. It is interesting that e-learning, including Web 2.0 technologies have been seen as a way of meeting the growing global demand for education, negating the need to find sufficient resources to build new campuses (Brown and Adler, 2008). Given the potential to use e-delivery to capture national and international markets, one might expect that the provision of health care education to a global learning community might be a driver for e-learning and Web 2.0 developments. However, none of the universities included in this study rated inclusivity as a significant factor in their developments. None were planning to develop learning provision for national or international markets using IT. This reflected the positioning of the institutions at the time of the study. It appeared as if they were still focussed on using e-learning and Web 2.0 technologies to support blended learning and local populations, rather than aiming at markets further a field. It was apparent that they felt able to maintain current student support using limited functions of the VLE and long standing delivery methods used for distance learning and face-to-face provision.

Interview data also revealed a perceived lack of staff IT skills for Web 2.0 technology development and use. This is a significant factor affecting the development and use of new Web 2.0 technologies. It is difficult to know if the perceived lack of skills was related to the age and gender profile or specific characteristics related to those entering healthcare professions (Wishart & Ward, 2002). It was clear that many staff felt unable to engage in Web 2.0 development and use. Those staff who were ‘champions’ trying to move these developments forward described being thwarted by the lack of IT support from learning technologists on site.

Students demonstrated engagement in Web 2.0 technologies for social use and were able to clearly articulate their use of social networking sites such as, Facebook and Youtube, in other aspects of their lives. Students were keen to maintain a distinction between their use of social networking sites and their use of e-learning to support professional development and education. Students wanted to keep their social networking activities separate from the university, seeing this as their social and ‘off work’ space. There were concerns expressed by university staff regarding the formal engagement of students through social networking sites. Staff commented that there is the potential for students to operate naively in these environments and place themselves at risk if they expose too many personal details or images in publicly accessible forums. This public profile it was suggested may also reflect badly on students when they apply for employment or in other formal contexts. Although not expressed during this study, other sub-conscious concerns may exist amongst staff about how much of themselves they should reveal in interactions mediated by Web2.0 technologies. Staff may also be keen to maintain a professional distance between themselves and the students, preferring to support students through the VLE and other more formal sites than through being ‘friends’ on Facebook.
Despite the concerns about the use of social networking sites, there are examples of engagement in blogs, wikis, podcasts and social networking tools by formal education providers. In an attempt to provide some protection for student users, universities can restrict access to particular groups of students and the sites are often “moderated” by a member of staff. Many students are also using such sites to take greater control of their own learning. There are also examples of students setting up their own mechanisms, sometimes via platforms such as Facebook, for both structured and “just in time” learning, to enable them to collaborate without the presence of academic staff (Hodges, undated).

These developments bring challenges to existing learning and teaching structures and power relationships, including those existing for e-learning. For many years, academic staff or experts have often had control over the learning process, providing learning materials for students and deciding on the modes of delivery and time and place of learning. The traditional approach to e-learning has been to employ the use of a Virtual Learning Environment (VLE), software that is often cumbersome and expensive - and which tends to be structured around courses, timetables, and testing. That is an approach that is too often driven by the needs of the institution rather than the individual learner. In contrast, e-learning 2.0 (as coined by Stephen Downes) takes a 'small pieces, loosely joined' approach that combines the use of discrete but complementary tools and web services, such as blogs, wikis, and other social software, to support the creation of ad-hoc learning communities (O'Hear, 2006).

The use of student led online sites may shift the control of learning, with students exercising more power over their learning as individuals or within groups. This may be challenging for many, both academics and students, and will require different perceptions of role, and possibly demand a rethinking of existing pedagogy. Students are able to use Web 2.0 technologies in this way because they are part of a new approach to learning, one characterized by a demand-pull rather than the traditional supply-push mode of building up an inventory of knowledge in students’ heads. Demand-pull learning shifts the focus to enabling participation in flows of action, where the focus is both on “learning to be” through enculturation into a practice as well as on collateral learning (Brown and Adler, 2008). Thus, there is the potential for students to organise their learning online through Web 2.0 technologies and gain control of when, what and how they access information and views and opinions.

Perhaps the way forward is, instead of using enterprise learning-management systems which provide a VLE and record of student learning, to make use an interlocking set of open-source applications. While there is still an element of content delivery in these systems, there is also an increasing recognition that learning is becoming a creative activity and that the appropriate venue is a platform rather than an application. In the future it may be more widely recognized that the learning comes not from the design of learning content but in how it is used. What is needed is exploration of how learning content, whether professionally authored or created by students, can be used as the basis for learning activities rather than the conduit for learning content (Downes, 2005).

5. Conclusion

Within the health science domain the use of e-learning has developed significantly in recent years but there does not seem to be significant demand for Web2.0 technologies. Some staff have demonstrated a willingness to explore new approaches, but many still hold reservations about engaging with innovative pedagogical tools and have not yet realised what can be achieved with the tools.

A variety of barriers to further implementation of Web 2.0 technologies in this field have been identified including; student maturity, the inherent risks of reducing the educational structure and shifting the balance of power between academics and students. These along with a blurring of the boundaries between personal and professional online activity may require significant changes in attitudes and culture before potential benefits can be achieved.

The potential offered by Web 2.0 technologies in the education of healthcare professionals, is significant, however these developments need to be balanced with the inherent risks and challenges, and further research undertaken to explore these.
Acknowledgements

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How Reproducible Research Leads to Non-Rote Learning Within Socially Constructivist Statistics Education

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Abstract: This paper discusses the implementation of a new e-learning environment that supports non-rote learning of exploratory and inductive statistics within the pedagogical paradigm of social constructivism. The e-learning system is based on a new computational framework that allows us to create an electronic research environment where students are empowered to interact with reproducible computations from peers and the educator. The underlying technology effectively supports social interaction (communication), knowledge construction, collaboration, and scientific experimentation even if the student population is very large. In addition, the system allows us to measure important aspects of the actual learning process which are otherwise unobservable. With this new information it is possible to explore (and investigate) the effectiveness of e-based learning, the impact of software usability, and the importance of knowledge construction through various feedback and communication mechanisms. Based on a preliminary empirical analysis from two courses (with large student populations) it is shown that there are strong relationships between actual constructivist learning activities and scores on objective examinations, in which the questions assess conceptual understanding. It is also explained that non-rote learning is supported by the fact that the system allows users to reproduce results and reuse them in derived research that can be easily communicated.

Keywords: statistics education, reproducible research, reproducible computing, social constructivism, non-rote learning

1. Introduction

Within the context of ICT-based and math-related education, the pedagogical community has shown great interest in the role and importance of social and individual constructivism (Von Glasersfeld (1987), Smith (1999), Eggen et al. (2001)) and its implementation in statistics education in particular (Nyaradzo Mvududu (2003)). The following citation may clearly summarize the importance and the great interest of educational researchers in constructivism (Miller 2002):

Constructivism is a philosophy that supports student construction of knowledge. Since students uniquely construct their knowledge, instructional strategies that support constructivist philosophies naturally advocate student understanding. Instructional trends in the mathematics and statistics education communities support the active-learning orientation of constructivist philosophy. I posit that, while not the only philosophy of teaching and learning, constructivism is one of the best such philosophies.

While the relevance of a constructivist pedagogical approach to statistics education is well documented, there seems to be no direct or obvious relationship with the concept of “Reproducible Research” (I prefer the term “Reproducible Computing” because the underlying concept exclusively refers to the computational aspects of research). Nevertheless, the problem of our inability to reproduce statistical computations that are presented in papers has received quite a bit of attention within the statistical computing community. The most prominent citation about the problem of irreproducible research is Claerbout's principle:

An article about computational science in a scientific publication is not the scholarship itself, it is merely advertising of the scholarship. The actual scholarship is the complete software development environment and that complete set of instructions that generated the figures. (source: de Leeuw, 2001).

The importance of the irreproducibility problem has been highlighted by many authors and is related to science, the dissemination of science, and academic education. Some of the leading arguments can be found in Peng, Dominici, and Zeger (2006); Schwab, Karrenbach, and Claerbout (2000); Green (2003); Gentleman (2005); Koenker and Zeileis (2007); Donoho and Huo (2004). Several approaches to solve the problem have been suggested and implemented. Some of the more promising attempts have been described in Buckheit and Donoho (1995); Donoho and Huo (2004); Leisch (2003).
If academic statisticians find it hard (if not impossible) to verify or review the results in empirical papers, how could we possibly expect students to learn from statistical results without the proper tools to easily review, verify, or challenge them? The solution that I propose within the context of this paper is new and differs from previously developed solutions in the sense that it can be used by anyone and without the need to understand the technicalities of scientific word processing (LaTeX) or statistical programming (R code). Such a novel approach is obviously needed if one hopes to support students in their quest to learn and understand important statistical concepts.

The research presented in this article bridges two seemingly separate worlds and describes the implementation of a new e-learning environment that effectively supports statistics education through reproducible computing within the constructivist pedagogical paradigm. The outline of the paper is straightforward. Section 2 clearly defines the major conceptual aspects and the infrastructure of the proposed approach while section 3 discusses the integration of the various ICT components. Section 4 provides the preliminary empirical evidence that clearly indicates that the proposed approach is effective and that a thorough investigation promises to yield interesting results in future research.

2. A new e-learning approach

There are several reasons why the constructivist approach may lead to non-rote learning. Such explanations however cannot be empirically tested if they are not defined in a precise and measurable form. Likewise, there is no way to provide empirical evidence to sustain the claim of this article's title without clear descriptions that can be easily implemented and measured. Therefore, I introduce operational descriptions of the concepts that are needed to construct testable hypotheses.

2.1 e-Learning environment

The open source software called Moodle (which is freely available at http://www.moodle.org/) was used as the Virtual Learning Environment. The are several reasons why this software was chosen:

- it is designed to support social constructivism featuring various tools for communication, collaboration, assessment, interaction, etc...;
- it is well-written and has an open, modular design which allows us to seamlessly integrate other software components into the learning environment;
- it has a well-structured (and open) database design which allows researchers to easily retrieve data for research purposes.

The core section of the courses involved various activities (workshops) that require a lot of research and reflection about a variety of problems at various levels of difficulty. The workshops have been carefully designed over a period of four years, and cannot be solved without additional information that is provided within the Moodle course or by the tutor. It is for this reason that these problem-oriented workshops and their subsequent lectures are of a “reflective” nature.

The courses that were offered contained a wide variety of statistical techniques and methods. The following topics were covered: probability, descriptive statistics, explorative data analysis, hypothesis testing (about the mean, the variance, and proportions), multiple linear regression, and introductory time series analysis. One could argue that it is rather unusual to treat so many topics in an introductory course. It is however very important for students to learn that statistical problems can be analysed in different ways – based on different techniques. For this reason I introduced a total of 73 different types of techniques with a variety of model parameters which yield a very large number of combinations.

For each technique students had one or several web-based software modules available. The modules are based on the R Framework and are available free of charge at http://www.wessa.net/. The R Framework allows educators and scientists to develop new, tailor-made statistical software (based on the R language) within the context of an open-access business model that allows us to create, disseminate, and maintain software modules efficiently and with a very low cost in terms of computing resources and maintenance efforts (Wessa, 2008).

One of the pedagogical advantages of using the R Framework is that there is no need for students to understand the underlying statistical code while the computation is still transparent and flexible because the R code can be viewed and even edited by any knowledgeable user. In addition, there is no requirement to download or install anything on the student's computer because all computations
are performed within a network of dedicated servers. In other words, anyone with an internet connection can use the computational system for the purpose of research and education. The output that is generated by the statistical software consists of tabular text and charts.

Each technique is described in a series of learning resources that were made available to students in a Moodle course. More than 4300 A4 sized pages were made available in electronic form to the students. Several search mechanisms were available to find relevant information which was always presented in modular form (without the requirement to read preceding chapters). One example of such a learning resource is the e-Handbook of Statistical Methods which is freely available from NIST/SEMATECH (2006) at http://www.itl.nist.gov/div898/handbook/. Another example is the website http://www.xycoon.com/ that contains formal information about a large number of descriptive statistics, hypothesis testing techniques, econometric methods, and tools for time series analysis. The learning resources contain examples, case studies, mathematical proofs, formal properties, and verbal descriptions about the techniques that are available in the statistical software. Most importantly, the underlying assumptions of each technique are described in detail and can be quickly found through simple searches.

2.2 Dynamics of social constructivism

During the fall semester of 2007, the proposed system was thoroughly tested in two different student populations: 111 Bachelor students, and 129 “Switching” students who already have a professional bachelor degree and registered for a (mandatory) preparation programme before switching to an academic master. The programme of study for both populations involves applied economics and business courses. Statistics is treated as an important and compulsory subject because students are required to engage in empirical research in later years (Bachelor thesis and Master thesis).

All students had to submit their workshop assignments at weekly intervals. During the lectures I illustrated frequently made mistakes based on sample submissions, and explained new methodological issues that might be helpful to solve the problems that students encountered. At the end of each lecture, I provided an introduction into the next workshop assignment. Students had the opportunity to ask questions during the lectures, or through the on-line forum that was supported by Moodle.

After each lecture, students worked on their next assignment and provided a well-motivated assessment of the submissions from the previous week (double-blind peer assessment). Even though students had to assess the submitted workshops and give them a score, the peer review was not intended as an evaluation method (it did not count towards their final score). On the other hand, it enabled students to provide feedback, learn from mistakes made by others, communicate solutions about a variety of problems, and provide an incentive in the form of encouragement to fellow students. This feedback-oriented process is similar to the peer review procedure of an article that is submitted to a scientific journal. The process of (anonymous) assessment by peers is an intrinsic part of scientific endeavour, and may help students in nurturing their scientific attitudes (through peer review experiences) and non-rote learning (through construction of knowledge).

Peer assessments have been performed for each workshop and by students from both populations. Switching students had to complete a series of 12 workshops of which the second half was completed by the Bachelor students too. A total of 1907 workshops were completed and subjected to peer review. Every submission was sent to a group of 5-7 students and every review involved between 3 and 6 assessment criteria (questions) that students had to grade. For every graded question students had the ability to provide verbal feedback to the other student.

As a consequence, a total of 41960 grades and 34438 verbal feedback communications were received by students. This implies that, on average, 22 grades and 18 verbal feedback messages were generated for each submitted workshop without any intervention by me. The administration of the peer assessment procedure was automated and fully supported by the Moodle software. The grades that were generated by the peer review process did not count towards the final score of students. Instead, I graded the quality of the verbal feedback messages that were submitted to other students based on semi-random sampling techniques.

The semi-random sampling technique is based on various statistics that are automatically produced by the Moodle software about submitted reviews. Each review is accompanied by a score which can
be easily compared to the scores that were given by other students. For instance, if five (out of a total of six) reviewers submit a grade which is “excellent” and only one students rates the work under review with a “poor” grade then this discrepancy can be immediately detected in the overview screen which is created by Moodle. In such a case I would grade the quality of the feedback that accompanies the “poor” grade and two random feedback messages that correspond to “excellent” grades. For reasons of fairness, I make sure that every student's feedback is reviewed (by me) a sufficient number of times.

It is important to emphasize that this grading process was a powerful incentive for students to take the review process seriously. Moreover, the process of verbalisation was an important learning activity that required students to thoroughly investigate the research that was presented by peers.

For obvious reasons, this educational approach (in which students play the role of an active scientist) is only possible if students are empowered with all the necessary tools to exactly reproduce computational results and reuse them in derived work. Hence, a solution for the irreproducibility problem is a *conditio sine qua non* for the creation of an effective learning environment based on peer review of documents that contain statistical computations.

### 2.3 Reproducible computing

Truly reproducible computing has to be presented in such a way that any reader is able to confirm the results by recomputing the underlying statistical analysis. This is only possible if the author of research results includes all the meta information (data, parameters, and statistical software) that is necessary to reproduce the analysis into the document that is used for dissemination. Obviously this involves a lot of work for any author (student or scientist). Therefore it was necessary to build an automated procedure that keeps track of all the meta data that is needed to ensure reproducibility so that it can be instantly packaged, transmitted, and archived.

Within the context of the proposed e-learning environment I define a *Compendium* as a *research document where each computation is referenced by a unique URL that points to an object that contains all the information that is necessary to recompute it*. These objects are archived in a repository (*Compendium Platform*) that is available free of charge at [http://www.freestatistics.org/](http://www.freestatistics.org/) and which is funded by the OOF 2007/13 project of the K.U.Leuven Association, and private sponsors.

There are some unique features of the *Compendium Platform* that are of particular importance in the e-learning environment that is proposed:

- any computation that is created within the *R Framework* can be easily archived in the repository – there is no need for students to keep track of the data, the model parameters, or the underlying statistical software code;
- any user who visits the unique URL of an archived computation is able to instantly reproduce the computation or reuse it for further analysis – only an internet browser (and an active connection) is required to use the repository;
- educators and researchers are able to retrieve data for research purposes.

With the *Compendium Platform* the process of reproducing computations has become easy and transparent at the same time. This allows students and educators to focus on the interpretation of computational results instead of the underlying technicalities. At the same time, this does not imply any limitation towards advanced students: they are still able to observe and reuse the R code that was used.

### 2.4 Non-rote learning

The final examinations that were employed in the courses measured analytical skills and conceptual understanding of statistical methodologies rather than the ability to reproduce theoretical aspects, use mechanical rules, or apply cookbook recipes that were memorized. The following three learning goals were specified to define true (non-rote) learning within the context of these introductory, undergraduate statistics courses:

- the ability to select one or several appropriate technique(s) to analyse a statistical problem;
the ability to read computational output (of software) and correctly interpret it in terms of the problem to be solved;

the ability to check the underlying assumptions of the employed technique(s).

Shortly before the final examination, students received a Compendium containing raw, non-chronological computer output about the analysis of a dataset that was never before discussed in class. Students were allowed to study the computer output, make notes, and bring all types of documents, text books, and “unconnected” laptops to the exam which had a duration of two hours.

The actual exam consisted of 18 multiple choice questions about the raw computer output in the Compendium. All questions had an unambiguous right/wrong answer but students were allowed to write an explanation if there was any doubt about the exact interpretation of the question. In addition, students were allowed to skip questions in order to avoid the guessing penalty: the exam scores were obtained by subtracting the number of wrong answers from the number of right answers. Most questions required students to examine multiple computations (based on different techniques) and careful interpretation to come to the correct (and unique) solution. Two questions were extremely difficult to solve – therefore, any student with an exam score that is equal or greater than 8 is considered to have passed the test.

3. Integrating the e-learning components

The three major components (R Framework, Compendium Platform, and Moodle) can be operated independently or in combination. A series of automated communication mechanisms allows each component to transmit information to the other component. Therefore each component is able to perform tasks in a student-friendly manner and at the same time it provides valuable data for the purpose of educational research. Table 1 provides an overview of how the communication interfaces have been implemented. For each component a brief discussion of the technological implementation is provided.

Table 1: Communication mechanisms between the three components of the new e-learning environment

<table>
<thead>
<tr>
<th>How do the row-components communicate with the column-components?</th>
<th>Moodle</th>
<th>R Framework</th>
<th>Compendium Platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moodle</td>
<td>Moodle session id</td>
<td>UserID and CourseID are transmitted through HTTP GET request</td>
<td>UserID and CourseID are transmitted through HTTP GET request</td>
</tr>
<tr>
<td>R Framework</td>
<td>Stored Moodle session id is used in HTTP GET</td>
<td>R Framework Session id</td>
<td>User Session Data (incl. software, data, parameters) through a HTTP GET callback mechanism</td>
</tr>
<tr>
<td>Compendium Platform</td>
<td>Stored Moodle session id is used in HTTP POST</td>
<td>Stored User Session Data (incl. Software, data, parameters) is submitted through a HTTP POST request</td>
<td>Repository Session id</td>
</tr>
</tbody>
</table>

Let us now have a look at a brief example that illustrates how the three components communicate: a selected sample of the employed learning resources was made freely available and can be consulted in a Moodle course at http://www.freestatistics.org/moodle/ (click on “Open Course Materials” and login as guest user). Suppose a student wants to review the solution to exercise 1.13 (available under section 2 of the on-line course). For this purpose I created a tailor-made R module which solves this particular problem and allows students to experiment with various parameter settings. If a student clicks on the hyperlink (called “The Babies Calculator”) in the Moodle course then the respective R module (based on the R Framework) is shown in a separate window which contains an URL that contains two tags:

http://www.wessa.net/rwasp_babies.wasp?protag=Open+Course+Materials&utag=Guest+User

These tags identify the user (“Guest User”) and the course (“Open Course Materials”). Both tags are stored in server-side sessions on the wessa.net web server and allow us to attribute subsequent computational actions to the actual user who submitted the requests. This clearly illustrates, as
indicated in Table 1, that Moodle communicates with the R Framework through a simple HTTP GET request where the UserID and CourseID is contained.

Now, suppose that the student clicks on the Compute button in the R module. The R Framework receives the submitted request and instantly creates pre-processed R code which is stored in the web server's local cache. Now a special load-balancing software is invoked which selects the remote machine that has to execute the computation from a list of dedicated R servers. The wessa.net web server downloads the computational result from the R server and creates a nicely formatted result page based on a template and sends it back to the student. This process has very favourable properties in terms of performance, scalability, and security (Wessa, 2008). In addition, all computational results (including the UserID and CourseID) are stored in a session database of the R Framework.

Suppose that the student wants to include the computational results in a paper in such a way that anyone can verify, reproduce and reuse them. The student clicks on the hyperlink “Click here to blog (archive) this computation (opens new window)” and fills out a simple submission form. When the student clicks the submit button the R Framework will retrieve the stored information from the session database and create a package that can be safely transmitted. It then calls a remote procedure at the Compendium Platform which downloads the package through an HTTP GET callback (see Table 1). The Compendium Platform stores the packaged computation in its repository and creates records about important meta data and keywords that allow for various types of queries to be executed.

If all goes well, the student will see a result page with a hyperlink to the archived computation. The student can visit this link and view the html page that provides a summary of the computed analysis. In this example the system generated the following reference that can be inserted into any document (Statistical Computations at FreeStatistics.org, 2008):

http://www.freestatistics.org/blog/date/2008/Jun/06/t12127572549onpj8u7m2ygvcq.htm/

The fact that this link has been inserted into this article makes it (by definition) a Compendium. Now any reader is able to reproduce the simulation experiment that was originally conducted (just click the link to try). Note that the analysis is based on simulation techniques: the obvious implication is that the reproduced computations may slightly differ from the archived result.

4. Preliminary empirical evidence

This section provides preliminary empirical evidence that supports the claim that is suggested by the title. The main purpose of this analysis however, is not to find definitive answers, but to foster discussions about the pedagogical implications and about directions in future research.

4.1 Hypotheses

Based on previously defined concepts and data descriptions it is now possible to formulate two statistical hypotheses that can be tested.

Hypothesis 1. H0: the number of submitted (verbal) feedback messages (about the workshops of peers) is not associated with exam scores.

Hypothesis 2: H0: the number of received (verbal) feedback messages (about the student's workshops) is not associated with exam scores.

If learning occurs through the “active” construction of knowledge then the test should reject the first null hypothesis because the verbal formulation of feedback about workshops requires students to have constructed a sufficient level of understanding. The argument here is that students who don't understand the statistical concepts, allowing them to write meaningful feedback, will just submit a grade with an empty feedback text. As explained in section 2.2 there were 34438 verbal feedback messages out of a total of 41960 grades. This implies that 18% of all grades (7522 grades) were not accompanied by text. Students knew that I would grade the quality of (a sample of) their feedback so they had every reason to make the feedback messages meaningful. I can confirm that almost all feedback messages that I rated were meaningful and (to some degree) intended to provide moral support. It is also important to emphasize the fact that meaningful feedback can only be written if
results from peers are reproducible and reusable. Hence, the number of submitted feedback messages is a proxy measure for the ability of the student to construct knowledge based on reproducible research. If this variable is associated with objective exam scores (measuring conceptual understanding instead of rote memorization) then we can reject the null hypothesis and conclude that reproducible computing supports non-rote learning (of statistics).

If learning occurs through “passive reception” of explanations or feedback then the test should reject the second null hypothesis. Such a rejection would imply that true understanding can be fostered through the reading of feedback. If the second hypothesis is rejected and the first is not rejected, then the Compendium Platform should be primarily used to create course materials instead of a simulated research environment where research results are challenged through peer review. The main difference between active and passive modes of learning is related to responsibility. In active (constructivist) learning the student is responsibly engaged in learning activities because the e-learning environment allows the educator to track, verify, and accurately measure the learning activities and processes. In passive learning the student completes the assignment and then waits for a reply in the form of feedback. Even if the feedback contains valuable information then there is no guarantee that the student actually makes good use of it.

In this sense, there are interesting analogies between statistics learning and scientific research:
- reproducibility of research leads to honesty and responsibility;
- peer review (grading) of reproducible research leads to quality output;
- reviewing the work of peers (and writing meaningful feedback) is very demanding but at the same time potentially edifying.

### 4.2 Analysis

The exam scores that represent non-rote learning have been cut into three mutually exclusive intervals. The lowest interval [-3,4] represents scores that could be associated with pure guessing. The second interval [4,7] contains scores that are insufficient but unlikely to be attributed to pure guessing. The third interval [7,18] represents scores where students have passed the exam. Note that this exam only accounts for 50% of the final scores that students received. For the purpose of testing both hypotheses however, it is important that we only use the objective exam scores. The number of submitted and received feedback messages have both been cut into two mutually exclusive intervals (“low” and “medium/high”). In each case the cut-off point was chosen such that minimum frequency requirement (in each cell) was satisfied.

**Table 2: Reproducible computations - two-dimensional contingency table - by population**

<table>
<thead>
<tr>
<th>Bachelor</th>
<th># Submitted Verbal Feedback Messages</th>
<th># Received Verbal Feedback Messages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Score</td>
<td>(0,100]</td>
<td>(100,450]</td>
</tr>
<tr>
<td>[-3,4]</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>[4,7]</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>[7,18]</td>
<td>14</td>
<td>45</td>
</tr>
<tr>
<td>X-squared</td>
<td>11.58</td>
<td>3.13</td>
</tr>
<tr>
<td>df</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>p value</td>
<td>0.00305</td>
<td>0.20891</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Switching</th>
<th># Submitted Verbal Feedback Messages</th>
<th># Received Verbal Feedback Messages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Score</td>
<td>(0,150]</td>
<td>(150,450]</td>
</tr>
<tr>
<td>[-3,4]</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>[4,7]</td>
<td>12</td>
<td>19</td>
</tr>
<tr>
<td>[7,18]</td>
<td>14</td>
<td>59</td>
</tr>
<tr>
<td>X-squared</td>
<td>12.21</td>
<td>5.74</td>
</tr>
<tr>
<td>df</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>p value</td>
<td>0.00223</td>
<td>0.05663</td>
</tr>
</tbody>
</table>

(click to reproduce this computation)
Table 2 presents the analysis of two-dimensional contingency tables and Chi-square tests for both hypotheses. Each test was performed for the Bachelor and Switching student population separately.

It is clear that the first hypothesis should be rejected for both student populations (left side of Table 2). The p-values are extremely small which leaves no room for doubt. The results are preliminary and do not provide proof of a causal relationship. However, for the purpose of presenting the new e-learning environment, it represents a very strong indication that the creation of the Compendium Platform was a good investment and that a detailed analysis of the database in future research is well worth the effort. On the right side of Table 2 we can see that the second hypothesis should not be rejected unless a high type I significance threshold is employed. Depending on the actual cut-off points that define the categories, the p-value for the Switching students might fall (slightly) below the 5% level. The p-value for the Bachelor students however, never falls below a two-digit percentage.

In 2008 an improved version of the Compendium Platform was released, based on student experiences from the previous year. The main improvement consisted of a design change of the communication features in the software. Instead of relying on the communication features of the peer assessment module which is included in Moodle, a threaded communication forum was included in the Compendium Platform. Students were required to submit their feedback through the newly implemented forum which was hoped to increase the efficiency of peer review-related learning.

At the time of writing, the efficiency effect of this design change cannot be discussed because it is described in an article which is currently under review. However, the data from the 2008 course confirm the findings that are displayed in Table 2. The only difference is that the association between exam scores and the number of received feedback messages in the Switching student population is far from any reasonable significance threshold. This implies that, based on the 2008 data, the first null hypothesis is clearly rejected whereas the second is accepted. An online R module was created that allows anyone to consult/verify these results (Wessa, 2009; click here to open).

5. Conclusions and future research

The proposed e-learning environment has various unique properties that support statistics learning within a constructivist setting:

- The R Framework allows students to perform any type of statistical analysis without the requirement to understand the underlying technicalities and without the need to download/install any executable code on their computer.
- The Compendium Platform allows students to archive, reproduce, and reuse computations. In addition, students can easily create/maintain Compendia of reproducible research which support various forms of constructivist learning activities (communication, collaboration, and peer review).
- All computational features have been seamlessly integrated into the Moodle learning environment. The three independent systems are perceived as a single e-learning environment by students.

From a pedagogical point of view it was demonstrated that reproducible research allows students to engage in peer review activities which leads to non-rote learning. At the same time the proposed technology presents us with a unique research opportunity to investigate statistics learning based on actual learning activities which are otherwise unobservable.

Taking into account the results from this analysis, I propose that future research should focus on (but not be limited to) the following questions:

- Which other proxy variables could be used instead of the count of submitted feedback messages?
- Could we find a measure for quality of feedback?
- How are these findings related to other data that is available (software usability, computational statistics, learning attitudes, group behaviour, learning experiences)?
- Can we induce causation? Are there any confounding variables that might result in spurious associations? For instance: the median workshop score is an excellent proxy variable that reflects prior knowledge of students.
- What are the best predictors for non-rote learning?
Acknowledgements

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Statistical Computations at FreeStatistics.org, Office for Research Development and Education, URL http://www.freestatistics.org/blog/date/2008/Jun/14/t1213478471rqn93e3pbymvbgm.htm/
The Implications of SCORM Conformance for Workplace e-Learning

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Abstract: This paper explores the impact that SCORM conformance has had on workplace e-learning. The author describes a project in which she was requested to "repurpose" some materials that had originally been designed for the face-to-face teaching of English as a Foreign Language, into SCORM conformant e-learning materials. The rationale for this request was that the training centre management wanted to track learners' progress via a Learning Management System (LMS). However, in order to integrate SCORM-conformant tracking functionality into the programmes, the learning materials would have to have been stripped of all the collaborative, productive and communicative aspects of their pedagogy. The learning designers and training centre management had to engage in a steep learning curve to find an alternative solution that was both pedagogically sound and administratively efficient. This anecdote highlights some of the challenges facing the corporate sector in terms of the management of e-learning content. To put the issues into context, the paper gives an overview of SCORM, and defines some related terminology - Sharable Content Objects (SCOs), LMS and Learning Content Management System (LCMS). SCORM conformance has two main aims: the ability to deliver content on any Learning Management System, and the ability to track learners' actions and scores when they use the materials. It is argued that, while the higher education sector has chosen to emphasise the first aim, focusing more on the development of stimulating learning content that can be shared across disciplines and across institutions, the corporate sector has emphasised the second aim, focusing more on tracking learners' progress through learning programmes. It is suggested that this is one of the explanations for the continued proliferation of relatively rigid, behaviourist style teaching materials for workplace e-learning. This instructivist style pedagogical model is considered in relation to the military and programming origins of SCORM, and a number of more innovative approaches to workplace e-learning from the recent literature are discussed. The paper concludes by arguing that, for corporate e-learning programmes to be successful, all stakeholders need to be included in the strategic decisions, and all stakeholders need to engage in a learning process to understand each others' points of view and explore the available options and their consequences. This study will be of value to anyone who needs to develop SCORM conformant courses, as well as managers who are charged with overseeing such projects, or developing an organisational training strategy involving an LMS/LCMS.

Keywords: learning design, SCORM conformance, LMS, LCMS, learning objects, e-learning 2.0

1. Background: “Why can't you just make these materials SCORM conformant?”

This study began when the author was leading a learning design team in the development of course materials for a large petroleum corporation in the Arabian Gulf. The team was requested by management to “repurpose” some English language training materials that had been produced for classroom-based teaching so that they could be “delivered” over a Learning Management System (LMS). Specifically, the brief was to make the materials SCORM conformant, i.e. to package the materials in such a way that they met the technical standards set by the Advanced Distribution Learning group (ADL 2007), thus enabling them to be used on any LMS. The main perceived benefit to management was that they would be able to track the progress of learners, since the LMS would produce detailed records indicating which learners had accessed which materials on what dates, and for how long. It would also detail learners' scores on any tests or quizzes.

The materials had been designed on constructivist principles. Converting them into SCORM conformant format, with the detailed individual learner tracking function requested, would have required breaking the materials down into very small, granular chunks. The materials would have to have been stripped of all activities in which learners wrote extended text of any kind, all speaking activities, and all other student-student interaction. Learner tasks would have been limited to mouse-click responses to multiple choice, true/false and drag-and-drop activities, resulting in no opportunity for learners to practise authentic communication. The trainer's role would have been reduced to that of an administrator. The overall result would have been to turn a dynamic, interesting set of learning materials that had been demonstrably successful in the classroom into a deadly, lacklustre electronic page-turner, punctuated by multiple choice quizzes.
The scenario was frustrating for the learning designers, and puzzling to the project’s sponsors, who had expected the “repurposing” of the training materials to be a straightforward process. After substantial research, experimentation and dialogue between the learning designers, technical assistants and management representatives, it was agreed that SCORM conformant materials which allowed for detailed LMS tracking functions should not be used as the primary teaching mode. Instead it was decided that they should be used as a support for either face-to-face teaching or for online courses involving the use of synchronous and asynchronous collaboration tools. In addition, the learning design team proposed that the company select an LMS on which the content could be seamlessly integrated into a more collaborative learning environment, such as Moodle, a popular open source platform. These conclusions directly contradicted the simplistic advice that had been given to management by vendors of large, commercial LMSs and e-learning software.

The above scenario highlights some of the challenges facing corporate trainers surrounding the use of technology in learning. Wilson’s (2007) recent study on how several large, multinational corporations are approaching e-learning points to the sector’s lack of awareness regarding the complexities involved in learning content management. To put these issues into context, the next section provides background on the history of SCORM and its current applications.

2. Overview of SCORM

2.1 Some definitions: SCORM, SCO/LOs, LMS, LCMS

SCORM stands for “Sharable Content Object Reference Model”. Its main aims are:

- to enable developers to format and package learning content in a standardised way so that the content can be used on all LMSs and shared amongst other members of the learning and teaching community
- to enable delivery of the learning materials to the learner and tracking of learners’ actions and scores (e.g. indicating when learners open a new page, complete a quiz, etc.)

To date there have been two widely accepted versions of the SCORM: SCORM 1.2 and SCORM 2004. A new version is currently under development, and will be released by the end of 2008. (LETSI 2008) (See 3.2.)

There has been a great deal of debate as to the definition of Sharable Content Objects (SCOs), which are sometimes interchangeably referred to as Learning Objects. (Dalziel 2003, Koohang and Harman 2006, McGreal 2004, Oliver 2001, Wiley 2000) Much of the debate has surrounded the concept of “granularity”, or the extent to which a piece of a course can be removed from its context and used for other purposes. An SCO can be anything the learning designer (or the technologist) wants it to be: in many commercial programmes it is as small as a page; in the open-source offerings from higher educational institutions such as MIT, entire course can be a learning object. The defining feature of an object is that the LMS treats it as a separate entity, enabling it its own bookmark, score and completion status. (Rustici 2002)

The extent to which learning objects can be reusable has also been debated – some have argued that, divorced from their original learning context, learning objects may become meaningless. Questions have also naturally been raised about how authors and publishers would be paid for their contributions to learning object repositories, as well as how intellectual property rights would be protected. (Letts 2002) Despite these unresolved issues, there appears to be significant buy-in to the concept of sharing digital learning resources in common repositories, especially in the higher and further education sectors. (See 2.3 for further discussion on this.)

A related concept that has been the subject of some confusion is the distinction between Learning Managements Systems (LMS) and Learning Content Management Systems (LCMS). The main function of an LMS is to manage the administration of learning programmes, for example to track the time spent by learners on programmes or components of programmes, and to track their test scores. The main function of an LCMS is to manage the learning content – primarily to serve as the repository for learning objects inputted by learning designers/ content developers.
2.2 SCORM: military in origin and “pedagogically neutral”

SCORM was developed in 1999 by ADL (Advanced Distributed Learning) – a group formed by the US military – in cooperation with government, academia and industry. The purpose was to initiate a “collaborative effort to harness the power of information technologies to modernize structured learning”. (ADL 2007) The SCORM framework consolidated the work of several national and international bodies into a single reference model.

Responsibility for overseeing the SCORM initiative was recently handed over to an international, non-profit federation called LETSI (Learning-Education-Training Systems Interoperability). (LET SI 2008) Whilst LETSI’s 12 sponsors include organisations as diverse as Adobe Systems, Korea Institute for Electronic Commerce, the Aviation Industry Computer-Based Training Committee (AICC) and Fraunhofer Institute Digital Media Technology (LET SI 2008), the US Department of Defence remains its chief sponsor. A 1991 book by Douglas Noble called “The Classroom Arsenal”, gives some indication of the value placed on educational technology by the US Department of Defence:

“Each year..., the military spends as much on educational technology research and development as the Department of Education has spent [on similar research] in a quarter of a century.” (Friesen 2004)

SCORM’s military origins can be seen in the illustration (Figure 1) by ADL member Slosser (2002), showing how Sharable Content Objects (SCOs) are expected to lead to learning. The diagram clearly shows the implied “command and control” approach to learning evident in SCORM’s earliest formulations – despite protestations from SCORM’s proponents that the model was “pedagogically neutral” (IMS 2003). In Slosser’s depiction, objects are placed in the LMS, where they are processed by the machinery of the system, and are spewed out in the direction of the learner through a “delivery device”. The two-way arrows between the learner and the delivery device indicate that the learner’s role is simply to respond to the given stimulus.

Figure 1: How learning happens – the military way (Slosser, 2002)

Hoel (2006) refers to the implied pedagogy here as the “knowledge injection” model. Friesen (2004) and Wiley (2000) point out that, in addition to its military origins, SCORM was greatly influenced by
the computer programming field; in fact, the term “learning objects” and the formal description techniques used in the SCORM model arose out of the field of object oriented programming. It should perhaps come as no surprise then, that many of SCORM’s proponents promote a decidedly behaviourist view of learning. McGee and Green (2008) locate this approach within a Fordist view of the world, pointing to the emphasis on administrative control and the use of standardised, mass-produced courses. They note that this approach is clearly suited to the military, and possibly also to large corporate training departments in organisations that have “command and control” style leadership. Many organisations, however, have chosen an alternative approach, as discussed below.

2.3 Who is SCORM for and how is it being used?

In a “special briefing for implementers” in 2002, Dan Rehak, an ADL representative, announced somewhat controversially that “SCORM is not for everyone” (Kraan and Wilson 2002), and noted in particular that SCORM was not suitable for primary and higher education. According to Rehak (Kraan and Wilson 2002): “SCORM is essentially about a single-learner, self-paced and self-directed. It has a limited pedagogical model unsuited for some environments.” Whilst this statement led to some fierce debate at the time and called ADL’s integrity into question for contradicting earlier messages about “pedagogic neutrality” (Kraan 2002), it appears, with hindsight, to have been misguided. On the contrary, there is today a great deal of SCO-generating activity taking place in the higher education sector, as evidenced by the existence of large repositories such as MERLOT in the USA (Griffith et al 2003), JORUM in the UK (Stiles 2005), OpenLearn of the Open University in the UK, DART (Bond et al 2008), and LAMS, which was initiated in Australia (Dalziel 2003), to name just a few. This movement has not been without its challenges – Letts (2002), for example, points out that the educational publishing community has been slow to join the movement, due to concerns about copyright protection and payment, as well as uncertainty about the profitability of the model. He also details the conceptual difficulties that learning designers in higher education have encountered – primarily the need to shift from a paradigm in which the learning designer has complete control over an entire learning programme to one in which instructional materials are broken down into discrete, self-contained chunks. Nevertheless, the idea of creating and sharing user-generated materials in a digital format fits in with the growing Web 2.0 culture, and it seems reasonable to predict that the already substantial voluntary participation in learning object repository schemes located within the higher education sector, mentioned above, will continue to grow.

In the corporate sector, on the other hand, it appears that the “single-learner, self-paced and self-directed” model put forward by Rehak (Kraan and Wilson 2002), along with the ability to monitor learners’ activity through the LMS’s tracking function, was well accepted. It was perceived to be particularly well suited to compliance training, for example for mandatory health and safety courses. (Frauenheim 2007) The tracking function offered by SCORM enabled management to follow every click of every learner on every course, giving them a sense of control over the learning process, as well as a means of standardisation. The ease of “delivery” via the LMS also promised companies a substantial return on investment. However, the emphasis on compliance training and the extensive use of low-challenge training materials has led to severe credibility problems for workplace based e-learning. As Hoyle (2007, p12) puts it, “The more electronic page turning learners do, the more (they) are turned off.” He cites an example of a major UK-based corporation in which the completion rate for mandatory courses is less than 65%. Accordingly, he notes that much of the time, the “learning” consists of “repeatedly taking the test until, by a process of elimination they get the right answers (or are told them)”. (Hoyle 2007, p12) Whilst this is probably a relatively common scenario in corporate e-learning, it is, happily, not the full story. Some significant innovations that companies have introduced, or are introducing, into their e-learning strategies, are discussed in the next section.

3. Where to now for corporate e-learning?

3.1 The gradual merging of LMSs and LCMSs

As discussed above, it appears that the distinction between LMSs and LCMs has played out in different ways in higher education as opposed to industry. The education sector seems to have been inspired by the ideal of creating enormous, inter-disciplinary, inter-organisational repositories of sharable content objects that can be constantly drawn from, added to, and improved upon by educators. Teachers and learning designers in higher education have felt the impact of SCORM through their engagement with Learning Content Management Systems, and this has no doubt contributed to the growth of large, open-source LCMSs, with active volunteer developer communities,
such as Moodle and Drupal. One indication of the success of such platforms in higher education is the decision by the University of Southern Queensland (Australia), which recently won a Commonwealth Award for Excellence in open learning (USQ 2006), to replace the commercial LMS, WebCT, with the open-source LCMS, Moodle at the start of 2008. (USQ 2008)

In contrast, the focus in industry-based training has, to a large extent, been directed more towards the administration, tracking and reporting of e-learning, “enabling detailed analysis of the effectiveness of (their) training investment.” (Nishtar 2006) Hence the hugely successful market for large, commercial LMSs which promise to rigidly administer employees’ progress through a linear path of prescribed programmes. This market continues to grow, despite the reservations held by many corporate trainers and managers as to their effectiveness. According to the Chartered Institute of People Development in the UK, for example, “e-learning is seen as ‘most effective’ by only 7% of organizations, yet 57% of organizations use this form of development in some capacity.” (CIPD 2008, p13) In addition, over half of the organizations providing e-learning feel that less than a quarter of their employees actually take up, or complete, e-learning courses. (CIPD 2008, p16) These statistics possibly reflect the same disjuncture between the corporate world’s preoccupation with the administrative functions of LMSs, and their recognition that many of the courses which are designed to be easily trackable are not achieving their pedagogical goals, as described in the anecdote at the beginning of this paper. The same dilemma seems to be apparent in the US corporate sector. According to Kranz (2008), who summarises the results of two major, recent surveys on the US training market (ASTD and Bersin and Associates), “30% of training last year occurred online — up from 7% in 2005 — an astounding leap. But the question as to whether it improves worker performance or not remains unanswered.”

Interestingly, it seems that the higher education and corporate sectors may be starting to see possible benefits in each other’s vision regarding learning content management. Brandon Hall (2008) notes that the distinction between LMSs and LCMSs is becoming blurred, as more and more LCMSs include LMS functions. Also, many of the large commercial LMS providers (e.g. Saba, SumTotal, SAP) have recently begun to add content management functions, as well as options for learner collaboration such as chat applications and discussion forums, to their platforms. (Frauenheim 2007)

The next section looks at the emerging influence of Web 2.0 on the next generation of LMSs, and the possible impact on corporate e-learning.

3.2 e-Learning 2.0 at the workplace?

Allison Rossett, quoted by Sloman (2007), paints a colourful distinction between the “stuff and the stir” in e-learning. The “stuff” consists of learning objects stored in LCMSs, and the “stir” refers to the collaboration amongst learners, made possible by Web 2.0 tools, that is making learning more interesting – and potentially more effective. Downes (2005) coined the term “e-learning 2.0” to reflect the learning opportunities inherent in recent developments such as social networking platforms, social bookmarking, the open-source movement (e.g. MITOpenCourseware 2002, Shuttleworth Foundation and Open Society Institute 2007), and the ability for individuals to rapidly create their own digital learning objects and share them with others.

The notion of e-learning 2.0 is becoming a reality in the EU. The HELIOS consortium – a European consortium of researchers set up to inform policy decisions on e-learning – has summarised the shift towards e-learning 2.0 as follows:

- Learners create content, collaborate with peers through mechanisms such as blogs, wikis, threaded discussions, RSS and other means to form learning
- The learning experiences are learner-centred, taking advantage of many sources of content aggregated together in learning experiences
- Teachers (if any) and learners (students) are peers within social networking environment(s)
- Learning experiences are increasingly [characterised] by knowledge management, collaboration and search
- We are moving from “Communities of practice to social networking” (Downes)
- Finally, there is a shift from traditional learning applications and systems managing learning objects within a pre-defined architecture to an open learning environment composed of
Looking at the state of corporate training in 2009, interoperable, loosely coupled open-source platforms and tools aimed at supporting the social interaction of peers.” (Aceto et al, 2007)

While Naish (2007), in his research amongst companies applying for Brandon Hall’s prestigious US-based “Excellence in learning” awards, concludes that e-learning 2.0 is not yet mainstream in the corporate sector, Wilson (2007) notes that there is a rapidly growing awareness amongst companies concerning the nature of the content management challenges they are facing. Frauenheim (2007) notes that there is an increasing demand within industry for training programmes that encourage informal learning and peer collaboration – a trend he refers to as “water cooler 2.0”. For one thing, he notes that the ease with which individuals can create customised learning materials for their colleagues, using tools such as Microsoft’s PowerPoint, Articulate’s Presenter application and Adobe’s Captivate 2 product, has led to a decrease in reliance on off-the-shelf training programmes that may be less relevant.

Taking “water cooler 2.0” to the next level is the emergence of serious gaming within pockets of the workplace e-learning sector. Hoyle (2007) gives an example of a simulation game on client relationship management produced by a consultancy firm using an e-learning authoring tool. The game was relatively simple from a technical point of view, but highly compelling and effective as a learning tool.

Although some of this game-based training is taking place outside of the confines of LMSs, such as the courses offered by IBM to its staff in the 3D, online virtual world of Second Life (Frauenheim 2006), Burgos et al 2007 point out that it is possible to create games, or repurpose existing digital games, within a SCORM conformant format for use on LMSs.

These examples are probably not representative of developments in the corporate training sector as a whole, but they do point to some interesting directions for companies that are willing to go beyond the confines of closed, packaged content on LMSs. For mainstream corporate training programmes, however, there may be several advantages to retaining LMSs for the foreseeable future. For example, Alexander (2008) points to the relative ease of initiating instructors/trainers into the strategies and techniques of technology enhanced teaching within the structure of an LMS. He also notes that there is nothing within the architecture of LMSs that prevents learners and teachers from creating hyper-links to the World Wide Web, thus allowing for links to learner-generated media such as wikis and blogs, as well as to synchronous VoIP programmes if these are not included on the LMS platform. Wilson (2007) advises training departments to use content on the LMS for employee support, for example in the context of informal, peer-to-peer learning. Hoyo (2003) suggests integrating learning objects into people’s daily work routines in the form of job aids, rather than keeping the learning materials “locked up” in LMSs, where they are inaccessible to most employees.

Finally, it is worth noting that, in anticipation of the release of the next version of SCORM, a Teaching and Learning Working Strategies Group (TLWSG) has been set up under the auspices of LETSI. According to the LETSI website, “The purpose of the TLWSG is to provide input on teaching and learning so that SCORM 2.0 will support and facilitate a wide variety of teaching and learning strategies.” (LETSI, 2008) Let’s see...

4. Conclusion

This study has attempted to shed some light on a dilemma facing corporate training, namely that the demands for both pedagogical soundness and administrative efficiency appear to, at times, be at odds with one another. The conflict may be worked out in the SCORM arena, as SCORM seems to promise different things to different people, depending on whether their orientation is towards learning design or administration. Decisions about the choice of LMS to be used, the kinds of materials to be offered via LMSs, and the ways in which those materials are to be integrated into a broader, more informal and collaborative learning environment, need careful consideration, and should be made by management together with learning designers. It is likely that all stakeholders will need to engage in a shared learning curve in order to be able to understand each others’ concerns and expectations, and to fully understand the various options available and their consequences. Training administrators need to be aware that an overemphasis on data tracking can have negative implications for the learning process. Learning designers need to engage in the debates that are currently taking place in the field, and explore the exciting possibilities for learning design based on Sharable Content Objects.
Management needs to promote a culture of open dialogue and learning amongst those responsible for teaching at the workplace.

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