4 Key issues in the design and delivery of technology-enhanced learning

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Following on from the broader discussion of pedagogy and pedagogical development in the networked environment in Chapter 2, this chapter focuses in particular on pedagogical and learning support issues raised by the fusion of e-learning environment systems with digital libraries and resources. Taking the position that access to digital content is not synonymous with e-learning but is an essential element of it, Allison Littlejohn illustrates the role of information access, sharing and use within the context of a constructivist model for e-learning design. With reference to three practical scenarios in e-learning design and delivery, she highlights potential directions for the learning support contribution of the librarian, with impact on both educational development and student learning. While these scenarios might not yet be widely operational, they reflect leading-edge developments in e-learning and open up intriguing perspectives on likely trends in pedagogical design and on the opportunities and challenges ahead for librarians in this context. The chapter concludes with the view held by other contributors to this volume: that new demands in the educational environment require a new type of practice in academic librarianship, in which traditional professional expertise is blended with expertise in information and communication technology and educational design.

Libraries are more than an interface to collections of resources, having an important role to play in supporting learning as a social process (Vygotsky, 1978). Learners view libraries as places for social gatherings, and for individual and shared study as well as the sharing of information resources (Currier, 2002). In the digital environment these social and collaborative

interactions are possible irrespective of location or point in time. Developments in digital and 'hybrid' libraries aim to extend beyond conventional elements of library activities such as facilitating access to online journals and electronic books towards support for these sorts of collaborative activities (Wang and Hwang, 2004). This requires integration with virtual learning environment (VLE) systems.

Every day in the UK, thousands of students access virtual learning spaces to download course information and learning resources (Britain and Liber, 2004). Many institutional VLEs are already linked to university libraries, giving access to a variety of online resources, including e-books and e-journals. Like conventional libraries, the online learning environment offers more than access to learning materials: it should also provide students with space to reflect upon and integrate new information into their current understanding of new concepts, and potential for collaborative study.

Another benefit of the digital environment is that individuals can arrange their own resources in their own way wherever and however they like (Duncan and Ekmekcioglu, 2003). The integration of formal collections of digital materials (a digital library) with localized informal collections of resources (a local learning environment) offers users a degree of flexibility in how they source, organize, share and manipulate learning resources that was previously unimaginable. Users can integrate formal resources (articles or book chapters) with their own self-generated materials, yet, at the same time, not compromise the organization of formal collections (Nicol et al., 2005). These new possibilities create exciting opportunities and challenges for students, tutors and librarians. However, they require major shifts in the way we think about libraries and learning spaces as well as in the roles of students, tutors and librarians (Hadengue, 2004; Joint, 2003). Therefore, the integration of virtual spaces will inevitably be accompanied by a merging of responsibilities and roles (Department for Education and Skills, 2003).

University librarians have been mistakenly viewed as curators of resources for learning and research, but their role reaches further than this narrow categorization suggests. Similarly, the role of the 'digital librarian' extends beyond that of curator of digital learning resources. The

continued fusion of digital libraries and e-learning environments is placing intense pressure on librarians to broaden their skills and creating ever-increasing demands.

This chapter explores these demands by outlining key issues in the design and delivery of technology-enhanced learning and teaching. It examines the meaning of e-learning, investigates the importance of basing course design on an educational model and describes the supportive role of a number of virtual learning systems. A range of learning support tasks assumed by information specialists are illustrated within the context of three scenarios that focus on common academic problems in higher education (HE). Finally, the chapter reflects upon how the role of the librarian is changing, focusing on new challenges. It is useful to begin by considering the meaning of e-learning and how it relates to learning in general.

An important definition in the librarian's vocabulary: the meaning of 'e-learning'

E-learning is a term used in radically different ways by different people. Perhaps this is unsurprising in an area in which definitions and boundaries are rapidly shifting. Like learning, e-learning is a social process in which students engage in activities and receive feedback from tutors and peers (Nicol et al., 2003, 270–80; Palincsar, 1998). Libraries play a significant role, offering students space to carry out learning activities, either alone or with other students.

Unfortunately, the term 'e-learning' is commonly and imprecisely used across two other closely related areas: e-administration and e-dissemination. *E-administration* can be thought of as a process that supports educational activities. It can include, among other things, access to course information, online registration and records of achievement. *E-dissemination* is commonly used as a means of enabling students to access and download electronic learning resources. Although these two processes are important in terms of supporting learning, neither relates to the tasks students carry out in order to learn (Pask, 1988).

The notion that access to digital content is synonymous with e-learning is fairly common. Even national support organizations such as

the UK Learning and Teaching Support Network (LTSN) define e-learning as 'the delivery of content, via all electronic media, including the internet, intranets, extranets, satellite, broadcast, video, interactive TV and CD Rom. E-learning encompasses all learning undertaken, whether formal or informal, through electronic delivery' (LTSN, n.d.). Kaplan-Leiserson (2000) uses Vygotsky's (1978) notion of learning by carrying out activities by defining e-learning as 'a wide set of applications and processes, such as web-based learning, computer-based learning, virtual classrooms, and digital collaboration. It includes the delivery of content via Internet, intranet/extranet, audio- and videotape, satellite broadcast, interactive TV, CD-ROM, and more'. However, the problem with such a broad definition is that there may still be a focus on technology and content resources, rather than on the ways in which these might support learning.

So, how can e-learning be defined? We first need to consider the meaning of 'learning'. From a constructivist perspective, learning can be defined as 'the active, goal-directed construction of meaning' (Palincsar and Brown, 1984). Therefore we have to consider what students do in order to learn (the process) and what results from that (the outcome). In conventional forms of learning and teaching, learning processes are usually through non-digital, face-to-face interactions such as class discussion, group work, etc. Campus-based e-learning adds a layer of complexity in terms of the way in which students can communicate. They can choose to interact using both face-to-face and/or electronic means. In this context, e-learning is succinctly defined as 'any technologically mediated learning using computers, whether in a face-to-face classroom setting or from distance learning' (University of South Dakota, n.d.). This definition alludes to communication technologies being used as mediating devices that allow students to access learning resources that inform them of new ideas, which they can then reflect upon and integrate into their existing knowledge. To support e-learning processes effectively, it is important for librarians to view the relationship between resource management and learning from a variety of standpoints, including this social constructivist perspective. This is a useful starting point for planning e-learning processes.

The educational model: a tool to support librarians in course design

As librarians become progressively more involved in educational development, it is becoming imperative that they understand the usefulness of educational models for learning design. An educational model can be viewed as a framework for planning a course. Courses based on sound pedagogical principles are more effective than those that are designed through intuition. Despite this, many university courses are still planned intuitively ('I know my students will learn if I teach them this way because this was an effective method with last year's class') rather than in an informed manner ('I know my students will learn, because this course design is based on sound educational principles'). The most effective approach to course design is to base it on an educational model.

There is a vast range of educational models, some of which are highlighted in Chapter 2. All of these represent different ways of viewing and describing particular learning situations. The educational principles behind conventional learning are not fundamentally different from the principles underpinning e-learning (Alexander and Boud, 2001); therefore, any one of these models can be applied to e-learning. However, a number of models have been developed specifically to support e-learning design. These take account of the multiple layers of complexity offered by e-learning (de Freitas and Mayes, 2004). One such model is Mayes' Conceptualisation Cycle (Mayes, 1995), outlined in Table 4.1.

Table 4.1 Mayes' Conceptualisation Cycle

Stage	Characteristics	E-tools to support this stage
Primary stage: Information dissemination	Information disseminated via learning resources (notes, articles, animations, video, etc.)	Online library Digital repository
Secondary stage: Learning activity	Information usage: students performing a task to help them understand a concept	Shared workspace E-portfolio
Tertiary stage: Dialogue and feedback	Dialogue and feedback: two-way dialogue of students with tutors, peers or interactive systems	Discussion fora Blogs Online chat Videoconferencing Simulations and hyperworlds

The central argument of Mayes' Cycle is constructivist. It is based on the premise that learning is achieved through giving students tasks to perform. The model takes into account learning processes at three discrete but inter-related levels: primary, secondary and tertiary. These levels incorporate students' exposure to basic facts and information, their application of these facts through participation in learning activities, and reflection and discussion of their ideas. All three levels are essential for learning. If one level is not put into practice, students will not have sufficient opportunity to learn – though not all levels have to be online. The three levels are as follows.

The primary level focuses on information dissemination. This is the most common use of e-learning systems (Crook and Barrowcliff, 2001). Typically, e-systems are used to facilitate student access to digital learning resources that may include online lecture notes, reading lists, articles, multimedia resources that include illustrations, and animations or more complex resources such as simulations. Increasingly, students are expected to source their own materials from multiple sources, including their tutor, other students, libraries, nationally available digital repositories, industry and so on. Many students are unable to develop effective search strategies and are likely to require information literacy support from library professionals (Nicol et al., 2005).

The secondary level involves students' mental processing of this information by carrying out learning tasks. Typically, these activities include tutor-marked assignments, computer-assisted assessments or collaborative group tasks. Conventional libraries offer students space to work collaboratively, source resources and carry out tasks. Unfortunately, some current e-learning systems offer students little flexibility in organizing their environment and resources – but this is changing. New systems are being developed that allow students to upload and arrange digital resources in a way that suits them, again increasing the need for effective information literacy support.

The tertiary level of Mayes' model focuses on feedback. Without feedback students cannot self-assess their understanding of concepts (Nicol and Macfarlane-Dick, 2003). Feedback can be communicated in a number of ways, including in face-to-face discussions, online discussions,

videoconferencing (where feedback is extrinsic) and online simulations (where feedback is intrinsic). Feedback may be entirely online (technology-delivered e-learning) or blended with face-to-face interactions (this is frequently termed 'blended learning').

All three levels of Mayes' Conceptualisation Cycle are essential for learning. A common scenario within campus-based courses is that students access learning resources via e-learning systems, but carry out activities face to face (Crook, 2002). Feedback is typically a mixture of face-to-face discussion with tutors and peers and written advice communicated via paper-based materials or e-mail by tutors. If any one of these stages is missing, students will have to devise their own tasks; otherwise they are unlikely to learn effectively.

In 1995, Mayes carried out an extensive study to appraise the design of a large number of technology-supported courses. He concluded that the vast majority of technology-supported courses at that time were inadequately designed (Mayes, 1995). Most used technology only at a primary level: for the distribution of learning resources. There was little evidence of learning resources being directly linked to learning tasks, either online or face to face, and even fewer examples of effective feedback. Despite advances in the development and availability of virtual learning systems, these findings are still largely true. An extensive study of the use of VLEs to support campus-based undergraduate courses in UK universities concluded that both tutors and students viewed VLEs as tools that were primarily for the delivery of digital content resources (Britain and Liber, 2004). They do not consider the communicative aspects of online systems. Nor do they specifically link this internal digital content with learning activities, face to face or online (Crook, 2002; Crook and Barrowcliff, 2001), or with other external resources, sourced from digital libraries (McColl, 2001).

The integration of VLEs with library systems may have the effect of intensifying this problem: as more and more online materials become available, there may be even less focus on what students will do with these resources. Librarians are already finding themselves centre stage in what is proving to be an era of rapid integration of library, registry and learning systems (Forsyth, 2003).

Integrated virtual learning environments and online libraries

VLE systems can be viewed as collections of integrated e-tools that enable the management of e-learning (Britain and Liber, 2004). Commonly-used, commercial VLE systems are WebCT (www.webct.com) and Blackboard (www.blackboard.com), illustrated in Figure 4.1. These systems have the potential to support e-learning at the primary, secondary and tertiary levels of Mayes' Conceptualisation Model:

- Course information is available through a messaging system or calendar. Most environments support the dissemination of learning resources. Students can access learning materials through web links. Most systems have 'drop box' tools that allow students to upload assessments.
- A range of e-tools is also available to support collaborative activities. These typically include discussion lists, chat facilities, quiz tools and shared whiteboards.
- Dialogue and feedback can be facilitated using e-mail, discussion and chat tools.

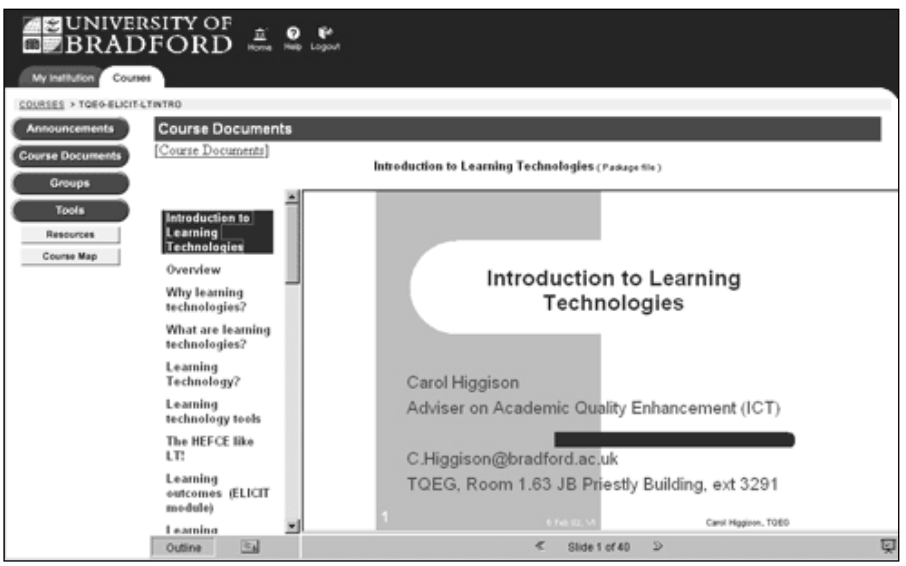

Figure 4.1 Blackboard – a commonly used learning management system (figure used with kind permission of Carol Higgison, University of Bradford)

Increasingly, VLE systems are based around digital repository tools: informal systems that facilitate the upload, storage, retrieval and re-use of resources. Repositories are being implemented at local (institutional), national or international levels. An example of digital repository software is Intralibrary (Figure 4.2). The main difference between a digital repository and a digital library is that any user can upload resources to a repository, but not to a library. Users (tutors and/or students) can upload resources in a variety of formats. During the process of uploading, users complete an online form that is used to tag information about the resource as 'metadata'. Other metadata information is automatically recorded by the system (author, date, etc.). To complete the upload, an information specialist must classify the resource using an appropriate taxonomy. Users can search for resources by keying terms into a simple search tool. Intralibrary allows users to make use of a browse tree which corresponds to a taxonomy of educational classifications. The search results will return metadata information about each resource.

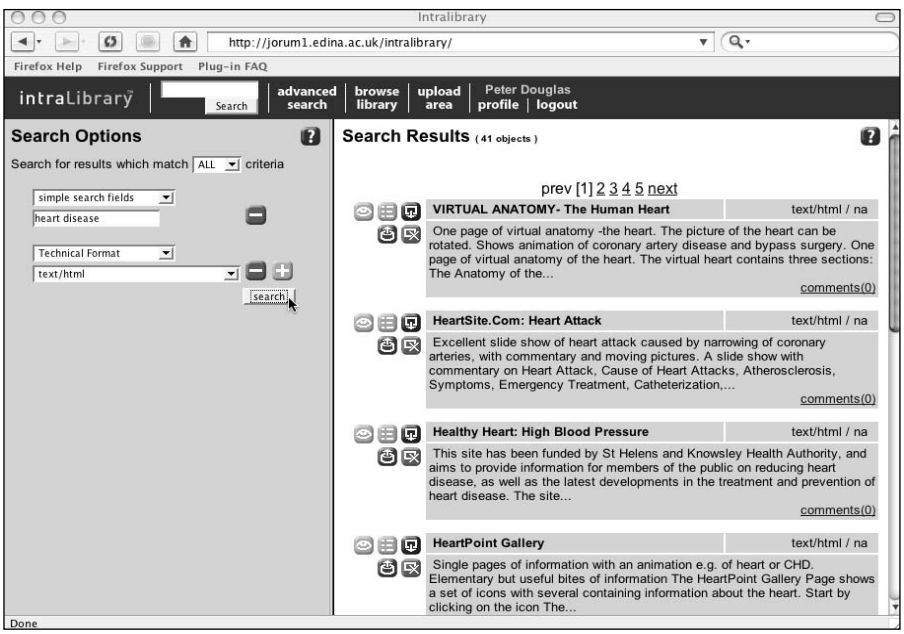

Figure 4.2 Searching for resources within Intralibrary (image used with kind permission of Intrallect, www.intrallect.com)

As with libraries, the value of digital repositories lies in the services they provide to users. Other types of repository also support resource upload, sharing and management, allowing students and tutors to build and share informal collections of materials. These systems provide students with an environment for collaboration within and across student groups and are frequently termed 'shared workspaces'.

An example is TikiWiki (Figure 4.3). This is an 'open source' system, which means that the software code is available for modification and potential integration with other systems. The TikiWiki system is based on a series of file galleries that allow students to upload and share materials. Access to these shared files is restricted to a specified group, who can control the permission settings that allow other students to view their materials. During upload, students are required to supply keywords and descriptions of each resource. Other metadata information, such as the date and the provider, is automatically recorded by the system. This allows limited searching of resources within and across the file galleries.

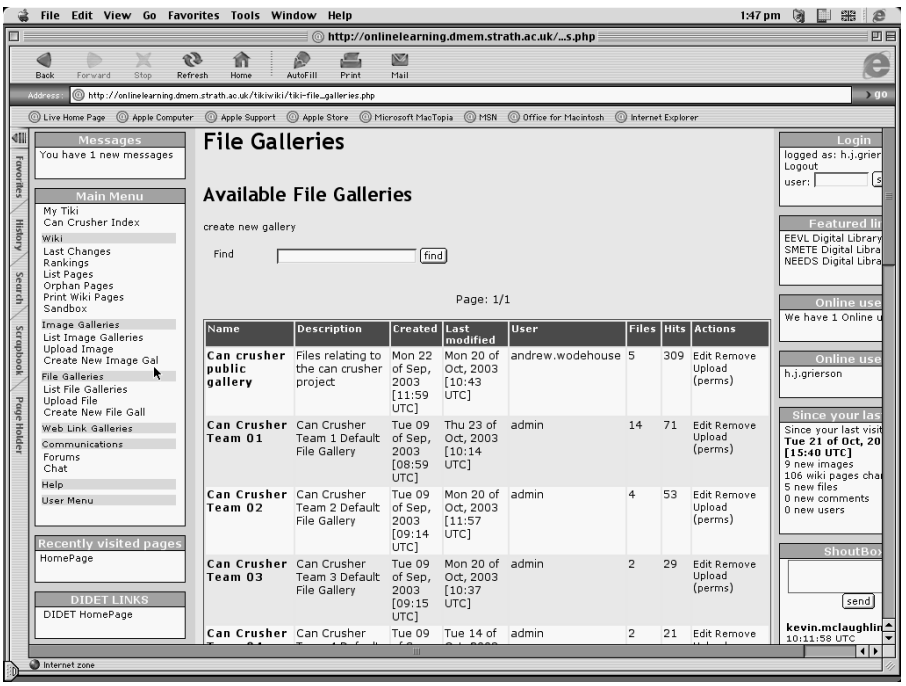

Figure 4.3 A file gallery in a collaborative workspace where students can upload and share learning resources

Yet other repository systems allow access to digital records containing personal profile details, records of achievements and/or mixed-media assignments and information. These are often termed e-portfolios.

An important factor is how these systems are used to support learning. The following scenarios illustrate further the ways in which the role of the librarian is changing, within the context of a range of educational settings.

The librarian's multiple roles in supporting students' e-learning

Scenario 1: the librarian as curator of learning resources

A frequent problem in large, undergraduate classes is that of student inactivity. First-year students are taught in increasingly large classes, despite the widely held view that learning is a social process (Palincsar, 1998). Large class size can lead to social alienation and limited opportunity for dialogue, resulting in poor understanding of concepts. A solution to this problem is to question students in class on their understanding of each individual concept and to encourage them to discuss ideas in class with their peers (Mazur, 1997). This methodology has been used successfully in large lecture situations, with hundreds of participants (Boyle and Nicol, 2003). Students are presented with an objective question designed to test their understanding of the concept. They are given a fixed amount of time to answer individually using a personal response system (PRS). Their responses are collated and are instantaneously displayed on a screen (Figure 4.4). The students are then encouraged to justify their answers to their neighbour, providing them with feedback from another student. This method can be mapped against Mayes' Conceptualisation Model at three levels. At the primary level, the tutor disseminates information to the students during the lecture. At the secondary level, the students are given a task to carry out (the objective question). At the tertiary level, the students discuss their ideas with peers.

The concept test questions can be sourced from local or national banks of questions, saving the tutor's valuable time (Bull and Dalziel, 2003). Most tutors are familiar with gathering resources from many different locations to integrate them into a lesson, but the availability and

Figure 4.4 The personal response system (image reproduced with kind permission of the University of Strathclyde)

amalgamation of large pools of digital resources make this an increasingly daunting task (Duncan and Ekmekcioglu, 2003). For many years university librarians have been supporting tutors in finding resources stored in collections, but it is also important that librarians actively promote the learning resources available and how they can be used. This requires an understanding of how materials can be used in different educational contexts and of problems with student learning (Littlejohn, 2004). Therefore, the role of the 'digital librarian' has broadened to cross over with that of an 'educational advisor'. In addition, librarians are increasingly becoming involved in HE teaching (Allen, 2002).

Scenario 2: the librarian as a tutor

Another common problem in HE is inadequate planning of group projects by students. Students are inexperienced in assigning roles to group members and timetabling activities. One solution is for students to construct a weekly, reflective 'project log' (Stefani et al., 2000). The use of an e-portfolio tool to develop a digital project log ensures equal access for all students within a group at any given time. Figure 4.5 illustrates a project log constructed by a group of engineering students within an e-portfolio

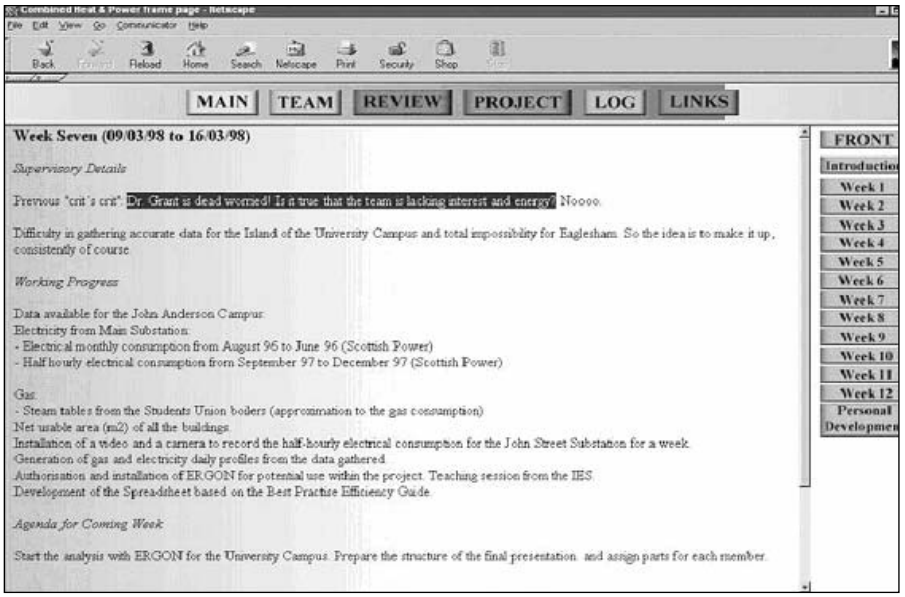

Figure 4.5 Student e-portfolio project log

system. The portfolio structure is determined by the students with guidance from an educational developer. The buttons at the top of the screen point to the six sections that contain information about the project team, a literature review, a collection of digital resources related to the project, the week-by-week log of progress reports and links to external sites. The project log is used by the students to identify and communicate any issues that arise during the project. Each week the tutor uses the log to identify potential problems and communicate ideas to the students who, in turn, incorporate this feedback into their weekly action plan. This project can be mapped onto the three stages of Mayes' Conceptualisation Cycle. At the primary level, the tutor disseminates basic information to guide students in project development. The students source additional resources from libraries, books, journals, websites, etc. At the secondary level, students use the primary information resources to develop ideas within their project. They have the opportunity to discuss ideas during face-to-face class sessions. At the tertiary level, students communicate their ideas to the tutor, who gives feedback on their progress via the project log.

Students require a high level of information literacy to source, upload, manage and share learning resources within repository systems. When students are uploading files, they may not have the information literacy know-how to appreciate the importance of applying useful search terms that will allow other students to source their materials. Consequently, they might not choose and apply useful keywords and descriptions to allow them to be sourced by others (Campbell et al., 2001). Another difficulty for students lies in evaluating the quality of a resource, both within closed virtual learning environments and across open resource collections (online libraries, portals and gateways). Students may require advice that their subject tutors are unable to provide (Grierson et al., 2004). To meet these requirements, more and more librarians are teaching information literacy to students as an integral part of their project learning (Littlejohn and McGill, 2004).

A wide range of outputs generated during student assignments (from PowerPoint slides and essays to whole project assignments) are being made available to other groups of students by tutors. This practice of re-using resources generated by students is likely to become an increasingly important part of e-learning or blended learning (Wiley, 2004). Therefore another area requiring partnerships of tutors and information specialists lies in making resources generated by students available to subsequent student groups (Littlejohn and McGill, 2004). This is explored in the next scenario.

Scenario 3: the librarian as a partner in educational development

A third problem area in education is that students frequently adopt a learning strategy that involves memorizing information (shallow learning), rather than using this information to develop new ideas and concepts (deep learning). A solution widely adopted in HE is to present students with a task in which they construct concept maps, or 'knowledge structures'.

In this scenario engineering students working on product design projects are asked to create knowledge structures to illustrate their conceptual thinking about the design problem and to communicate this

to others outside their team. The students collaboratively construct a concept map using a mapping tool within a shared workspace. The nodes of the concept map can be linked directly to relevant information resources stored within the shared workspace, providing a way of linking knowledge structures to resources (Nicol et al., 2005).

It is important that students have opportunities to organize their interpretation of resources in personal ways that suit individual group members and their ways of working (Nesbit and Winne, 2003). Concept map tools within shared workspaces can support students as they collaboratively create knowledge structures in a problem domain and enable them to share these representations within and across project teams (Nicol et al., 2005). There are advantages to students constructing their own knowledge structures and comparing their ideas with exemplars from other student groups. The more opportunities students have to actively inter-relate concepts, ideas, facts and rules with each other and with prior knowledge, the deeper their understanding and learning (Jonassen and Carr, 2000).

Knowledge structuring spans all three stages of Mayes' Conceptualisation Cycle. At the primary level, students source information resources from a wide variety of sources (libraries, gateways, portals, etc.). The secondary level involves students collaboratively constructing concept maps and populating these structures with the primary information resources. This requires students to discuss the inter-relationships of ideas and concepts within their group and with the tutor, which corresponds to Mayes' tertiary stage.

Each concept map can become a reusable resource for other student groups. This type of resource, a by-product of learning activities, has been termed 'generative' (Wiley, 2004). It is likely to become more widely reused (Littlejohn and McGill, 2004), which poses an interesting problem for librarians: how to ensure that informal resources can be made available for re-use by others. To develop and implement these sorts of processes, librarians are rapidly becoming integral members of educational development teams, advising on information use and reuse. One such process for information flow from an informal shared workspace to a formal collection has been piloted through DIDET (Developing Innovative

Design Education and Teamwork), a project that is part of the JISC/NSF *Digital Libraries in the Classroom* programme. This involves an iterative process of metadata creation and checking by the student, the teacher and a librarian (Figure 4.6).

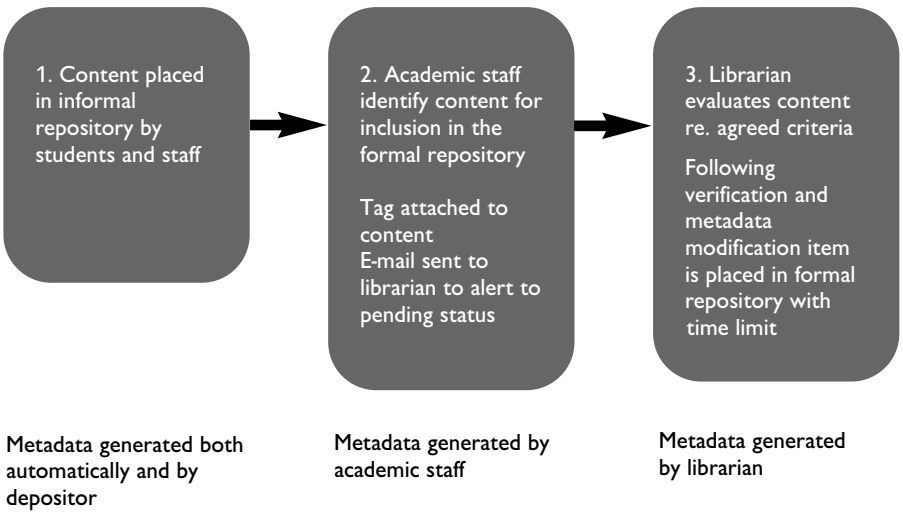

Figure 4.6 A process for metadata checking when 'informal' resources are archived (image reproduced with kind permission of the DIDET project team at the University of Strathclyde)

In future, e-learning is likely to move towards interlinking of formal and informal environments, leading to increased integration of formal resources (such as articles) with informal 'work in progress' documents (such as notes, sketches, essays and reports). Librarians will need to raise tutors' awareness of the revolutionary changes that have made online libraries an integral part of the virtual classroom.

Summary: the multi-skilled librarian

As VLEs and online libraries are integrated, the role of the librarian as

curator of online resources is broadening. As illustrated in the three scenarios within this chapter, traditional boundaries between the roles of tutor, educational developer, learning advisor and information specialist are becoming less distinct (Currier, 2002).

This is fuelled by an escalation in the number of online resource collections; the integration of virtual learning systems with formal and informal digital repository tools; advances in federated searching across these systems; and the rapid increase in the number of 'informal' resources available for re-use, including materials generated through student activities. These developments require students (and tutors) to develop high-level information literacy as an integral part of their learning (Martin, 2003).

These new demands require a new breed of librarian, who has been described as 'an academic librarian who combines the traditional skill set of librarianship with the information technologist's hardware/software skills, and the educational designer's ability to apply technology appropriately in the teaching–learning process' (Blended Librarian Organisation, 2004). Developing these multiple skills presents an enormous challenge to any individual. Partnerships of students, librarians, tutors and IT support staff are proving to be one of the most useful ways of resolving this issue. However, as outlined in the following chapter, these multidisciplinary alliances require all individuals to understand each others' perspectives and language (Littlejohn and Peacock, 2003). Librarians in institutions across the UK and beyond have already demonstrated willingness to rise to these and future challenges, since their support is inextricably linked to the success of e-learning.

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