16. USING TECHNOLOGY TO SUPPORT PROJECT AND PROBLEM-BASED LEARNING

Roisin Donnelly
DIT

INTRODUCTION

This chapter aims to support lecturers in universities and colleges who have begun or are considering introducing project or Problem-based Learning (PBL). In order to keep up with rapid change and make the most of learning technologies as aids to both learning strategies, a range of practical insights based on research is provided, supplemented with a variety of examples of learning technology being infused into both strategies. The range provided is by no means exhaustive, and you may know of many more examples yourself. It is unlikely that any one student would experience all of these learning methods in a project or Problem-based Learning event, but they are provided for academics, thinking of designing new courses or remodelling courses or modules.

In this chapter, the stance is taken that both project and Problem-based Learning provide a natural setting for infusing learning technology into a higher education classroom. There is acceptance in the literature that computer-based technologies may support and extend well-designed learning activities, particularly in terms of improving student motivation and engagement with tasks, and providing access to simulated or modelled phenomena not otherwise available. Therefore, the perspective is stressed that introducing technologies does not guarantee effective learning; it is argued that they have to be part of a coherent educational approach. New technologies certainly can provide opportunities for enhancing both project and Problem-based Learning. As many new technologies are interactive, it is now easier to create environments in which students can learn by doing, receive feedback and continually refine their understanding and build new knowledge. These technologies can also provide access to a vast array of information, (including digital libraries), data for analysis, tools for organising ideas (concept maps), presenting ideas (PowerPoint presentations) and people who provide information, feedback and inspiration.

It is not within the scope of this chapter to focus on discussion of the finer points of the similarities and differences between project and Problem-based Learning. For a further discussion on this, see the first two chapters of the handbook. Rather, it is taken on board that both project and Problem-based Learning are enquiry approaches to creating a learning environment where students construct personal knowledge based on real world issues and practices. The essential quality of learner-centredness is most relevant to each strategy when learners are personally challenged with a problem to solve, a project to complete or a dilemma to resolve. Learning activities in each may be long term and open-ended, empowering the students with the ability to make choices and decisions. In these types of activities, students are more likely to internalise the learning that takes place because they feel a greater sense of ownership of their work when required to make decisions based on real world issues.

The technology examples provided in this chapter can be used in both project-based and Problem-based Learning curricula. Likewise, the issues raised about integration of learning technology into the curriculum are not dependent on any particular platform: examples provided in the chapter can be applied to various online learning environments (OLEs) such as WebCT, Blackboard, Moodle, alongside various simulation and communication software. In the context

of the chapter, learning technology refers to the incorporation of educational technology to support project and Problem-based Learning: on-campus or off-campus, synchronous (allow students to connect at a single point in time, at the same time) or asynchronous (allow students to connect together at his/her convenience) interaction and communication. The main similarity is that, as in project and Problem-based Learning, all have a learner-centred focus and facilitate knowledge collaboration and construction, shared meanings, life-long learning, learning communities, knowledge building and sharing, communication, high learner control, problem-based, active learning and authentic activities.

RESEARCH CONTEXT

Anstey (2000) posited that academic staff were still adhering to the use of the web for more passive and didactic forms of teaching and learning. Despite the growing discussion of information and communication technologies (ICT) development at university teaching levels (Skillbeck, 2001), even today, there are still numbers of academic staff in higher education in the Republic of Ireland who would not be comfortable with integrating such technology into their teaching and learning practices.

The research setting for much of the exploration of the integration of learning technology into project and Problem-based Learning is the Postgraduate Certificate and a specific 'Designing E-learning' module in the Diploma in Third Level Learning and Teaching, offered in the Dublin Institute of Technology. My research focus is on using technology to support the overall postgraduate certificate generally and in particular the project on curriculum development, which the participants undertook in collaborative groups. The Diploma module 'Designing E-learning' was delivered using a blend of face-to-face and online Problem-based Learning. Both courses are aimed at academic staff in higher education institutions throughout the Republic of Ireland, including lecturers, librarians, and academic support staff. By analysing key experiences regarding the integration of a variety of learning technologies in these courses an effort is being made to determine how the teacher's role can plan for effective integration of technology into the curriculum. While a mixture of new media can offer significant opportunities for teachers in higher education, this can also be a daunting hurdle for newcomers. Subsequently it is hoped that what is presented here in terms of the experience from these courses, can assist academic staff in feeling at ease with using a range of learning technologies to support project and Problem-based Learning and replicate that in their own teaching practice in their disciplines.

The main question that this chapter aims to address is how can technology be used to support both project and Problem-based Learning? Towards achieving this, the chapter explores how new technologies can support project and problem-based strategies in four ways. A separate section with examples is provided for each of the following:
- Bringing exciting curricula based on **real-world projects and problems** into the classroom
- Providing scaffolds, tools and **resources** to enhance learning
- Giving both students and teachers more opportunities for **feedback**, and **reflection**
- Expanding opportunities for student learning through **collaboration** and **discussion**

With the advent of technology-rich teaching on a large scale, there are now many new opportunities for creative and innovative teaching and new relationships both with students and the shifting world of knowledge. Based on research, Figure 1 illustrates some of the practical ways that a variety of technologies have been assimilated into the learning strategies of project and Problem-based Learning.

	Figure 1: Technology to support Project and Problem-based Learning
Method Authentic Learning	Audio-video resources used to stimulate learners' prior knowledge or Introduce the project or problem or provide key resources part-way through a project or problem to sustain interest
Resource based	**Different ways to electronically present course resources:** -Notes to be printed -Organiser paragraph with questions: this is a cognitive learning technique that helps students orient to a lesson. It encourages the student to think about the content prior to its presentation and provides a context for the instruction -Starting with a Question, then linked to textbook with animations -Online project or problem-based case study: http://www.ozprojects.edna.edu.au/sibling/home http://www.rumken.com/ioug2000/Paper953.htm http://www.economics.ltsn.ac.uk/showcase/pierpont_pbl.htm -Revision supplement: text with linked questions -Interactive worksheet: self-testing activities http://www.bized.ac.uk/stafsup/options/accounting/work01.htm **Using the web for researching the project or problem:** -WebQuests (an inquiry-based project that includes internet resources to help problem solve): http://edweb.sdsu.edu/clrit/PBL_WebQuest.html -Hotlists (a list of Internet resources that are related to a certain theme, topic, subject and/or project/problem: useful for open exploration of a topic): http://www.kn.pacbell.com/wired/China/hotlist.html -Online Field Trips (museums, galleries, educational institutions): http://rite.ed.qut.edu.au/old_oz-teachernet/projects/virtual-field-trips/index.html http://campus.fortunecity.com/newton/40/field.html -Hunts (a treasure hunt is an activity where one searches for clues and answers to build knowledge): http://www.mhhe.com/socscience/education/cybereducator/cybpart07c.html http://www.kn.pacbell.com/wired/BHM/AfroAm.html -Scrapbooks (a collection of Internet sites organised around specific categories such as photographs, maps, stories, facts, quotations, sound clips, videos, virtual reality tours…) http://www.kn.pacbell.com/wired/China/scrapbook.html -Interactive Tutorials: Self-directed Learning (The Internet Detective, RDN Tutorials): http:// http://www.sosig.ac.uk/desire/internet-detective.html http:// http://www.vts.rdn.ac.uk/ -Libraries: http://www.loc.gov/ -Encyclopedias: http://en.wikipedia.org/wiki/Main_Page -Search Engines and Clustering Tools: (Categorisation of data is the obvious solution to enable users to better deal with "information overload" on the Web) A9: http://www.A9.com Vivismo: http://vivisimo.com

Discussion	Can be asynchronous or synchronous before or after each face-to-face group meeting and can take the form of an online debate presenting polemical stances on a subject or a reasoned argument with supporting evidence E-Seminars, Online Debates: http://elrond.scam.ecu.edu.au/ronline/debating.htm http://cero.columbia.edu/help/about.html http://www.sciencemuseum.org.uk/lets_talk/debate.asp
Reflection	Encourage completion of a web log or online reflective journal/diary/log to support learning for the duration of the project/problem http://awd.cl.uh.edu/blog/ http://elrond.scam.ecu.edu.au/ronline/blog Videoblogging (posting videos to a web site and encouraging student response): http://www.videoblogging.info/ A site for blogging beginners: http://www.blogger.com Concept maps: http://www.inspiration.com
Presentation	Video conferenced presentation of work-in-progress to a guest (international) expert/other students overseas
Collaboration	Modelling, Simulation and Role-Playing are making use of a more sophisticated and complex world-views as information is presented and accessed via a mathematical or graphical modelling package -Simulation modelling a process which would be too dangerous to do for real: http://www.ida.liu.se/~her/npp/demo.html -Simulation modelling a study which would be too expensive to carry out: http://sln2.fi.edu/biosci/preview/heartpreview.html -Simulation modelling a behaviour that cannot be seen (even under a microscope)
Assessment	Online Quiz: http://www.albion.com/netiquette/netiquiz.html E-Portfolio: http://sll.stanford.edu/consulting/tools/efolio http://ddp.alverno.edu/

TECHNOLOGIES FOR AUTHENTIC LEARNING

Authentic, challenging tasks embedded in a long-term project are at the heart of the model for integrating technology to the curriculum in the Postgraduate Certificate in Third Level Learning and Teaching. It is argued that centring instruction around meaningful tasks can create pressure for other kinds of learning - specifically, for collaborative learning, heterogeneous groupings of students, teachers acting as facilitators rather than lecturers, multidisciplinary curricula, longer blocks of time, and more authentic forms of assessment.

E-learning can also contribute to Problem-based Learning by providing a highly authentic environment and access to resources, modelling and expertise to help learners solve problems. An important use of technology is its capacity to create new opportunities for curriculum and instruction by bringing real-world problems into the classroom for students to explore and

solve. When technology is used in support of challenging problems, it in turn can contribute to students' sense of authenticity and to the "real-life" quality of the task at hand.

The use of email, computer conferencing, web databases, online group discussions and audio and video conferencing significantly increase the extent and ease of interaction amongst all participants. The vast array of electronic tools available for analysis, design, planning, problem solving and giving presentations enable learners to perform sophisticated and complex tasks and solve problems in creative ways (Hootstein, 2002). Being able to access the tools that are used by professionals for similar tasks allows students to aspire to a level of work and quality of product that more closely reflects what they see and know of the outside world. Bringing the outside world into the classroom through the use of telecommunications adds another dimension of authenticity to learning as students are able to link with real people and places, as well as public databases, as information sources.

Figure 2: Practical Exemplars – Authentic Learning
As an aid in project or Problem-based Learning, the use of photographs, audio, video, animation and film are restricted only by the teacher's imagination and available resources. Some potential uses are:
- As a way of presenting the problem or as a trigger for discussion e.g. audio, video, animation or multimedia piece;
- As introductory material at the outset of a project to stimulate interest, to provide an overview of the area or to form a basis for further learning;
- As a major source of information, providing a flow of new ideas, vicarious experiences, techniques and procedures;
- As a means of modelling a technique or procedure in a clear step-by-step manner that students can either listen to or watch and emulate at their own pace;
- As a stimulus for discussion by introducing short, open-ended sections of audio or video or film;
- As a means of discussion by linking the students to experts in different professions in the real world.

Technology can help to create an active environment in which students can solve problems. It can offer powerful tools for addressing logical constraints, from providing video-based problems and computer simulations to electronic communications systems that connect classrooms with communities of practitioners in science, mathematics, and other fields locally, nationally or internationally (Barron et al., 1998). Indeed, the Postgraduate Diploma 'Designing E-learning' module is delivered using Problem-based Learning and links live to experts in universities in Scotland and Australia as part of the authentic context for the Problem-based Learning approach used.

Figures 3 and 4: Screens of the project brief and the problem

2005 Curriculum Project Brief: ⊙ View ● Designer Options

Home › **Course Lecture Notes** › **Module 2** › 2005 Curriculum Project Brief

ACTION MENU: Previous Next Contents Retrace Refresh

Module Two
CURRICULUM DESIGN AND ASSESSMENT STRATEGIES

CURRICULUM PROJECT

Project Context

"Learning cannot be designed; ultimately it belongs to the realm of experience and practice. It follows the negotiation of meaning; it moves on its own terms... And yet there are few more urgent tasks than to design social infrastructures that foster learning."

Wenger, (2004, p.225).

It is proposed that participants work in small groups, co-operatively for the curriculum design project in Module Two. Researchers in higher education report that, regardless of the subject matter, students working in small groups tend to learn more of what is taught and retain it longer than when the same content is presented in other instructional formats. Small group work, used both in and out of class (via WebCT) can be an important supplement to the module workshops, helping participants master concepts in curriculum design and assessment and apply them to their own teaching contexts, calling for application of critical thinking skills.

In the context of Module Two, *"co-operative learning refers to students working and learning with and gaining feedback from other group members."* Barry & King (1994, p. 572).

Project Brief

The requirement is that you will work co-operatively in groups to develop an **individual module of your choice**.

Depending on the pedagogical approach underpinning the module, you will be allocated to work with a particular tutor.

The deliverable of this curriculum project is **one full Module Descriptor of choice**.

The Module Descriptor should include the following:
- Indication of whether this is a core module, a pre-requisite or a co-requisite.
- Statement of title, aims/objectives, learning outcomes.
- A module philosophy including details of how it will be implemented in the curriculum design.
- A rationale for the curriculum design model selected.
- Outline of Syllabus Content covered in module.
- Delivery methods.
- A flowchart of module delivery should be included.
- Teaching resources required and student support systems offered should be indicated.
- Indication of required texts and general reading list and web references.
- Evaluation mechanisms should be outlined.
- Appropriate formative and summative assessment strategies as per DIT Quality Assurance Guidelines.
- Potential links to other DIT programmes and other relevant HE institutions should be indicated.
- The programme should be equality proofed and adhere to NQAI Guidelines.

Group Composition
✓ You will choose which co-operative group you wish to work in: each group has a designated academic tutor.
✓ Groups may exchange expertise as they deem appropriate.
✓ Groups are encouraged to use the Online Discussion Fora set up for your group in the WebCT Course to support their project work outside of scheduled class sessions.

Timescale
- Work-In-Progress (WIP) Presentation will take place on 13th April 2005; you will be presenting your project WIP to your tutor and co-operative group only.
- Completed Curriculum Project as part of your Teaching Portfolio (Part 2) is due 18th May 2005.

DT002 PG Diploma Online Learning Module	| MYWEBCT | LOGOUT | HELP |
	| COURSE MAP | RESOURCES |

Collaborative Group Problem: ◉ View ● Designer Options

Home ▸ **Tasks** ▸ **Problem space** ▸ Collaborative Group Problem

ACTION MENU: Previous Next Contents Retrace Refresh

The Problem: Passing on Shovelware!

Part 1:

You have spent a considerable amount of your time over the past academic year attending a host of e-learning events, all stressing the importance of the effectiveness of learning technologies for higher education. You want to develop an online course yourself, and are aware that, if done well, there may be an ancillary aim of positively influencing your department colleagues. At one of these events, you had an opportunity to network with a colleague from a similar Department in The Robert Gordon University in Scotland, which, like your institution, is now facing competition for attracting, teaching and supporting students from a wider geographical area than before.

Your students are of mixed ability, and are a mix of mature and new students to the institution. Due to a history of failed e-learning course materials around the institution in the past, in particular those that have been all glitz and no substance, or content which reflects a rote-learning, right/wrong approach to learning, you are aware of the need for the online course material to be interactive, easy to access and yield useful student learning outcomes. As many of the frustrations in your institution in the past in this area seem to stem from the expense of equipment, the speed of change and the need for continual updating, you are now suggesting an approach of starting with the pedagogy and not being driven by the technology. Just because the technology is available, you are not letting it be the sole driver for development. However, a questionnaire was distributed around the institution last year, and you are now aware of the multiple perspectives that have a vested interest in your proposed online course:

See Attached Data Analysis Sheet.

You have agreed with the expert at The Robert Gordon University that you and your course team will return on Tuesday 18th January 2005 to give a video conference presentation of your design for a component of a suitable module which you want delivered online with

this fellow institution. The presentation will be in the Telematics Room in DIT Aungier Street from 10.30-11.30am. The 20-30 minute presentation using powerpoint and any other interactive multimedia of your choice will be to The Robert Gordon Representative to assess the viability of your design. Your Work-in-Progress (WIP) should include the rationale for both process and product. The remaining time will be used to give formative feedback and will consist of a Question and Answer (Q & A) format.

Part 2:
Taking the expert's formative feedback into account, your course team has been given the go-ahead by your head of department to work closely with an assigned web designer to develop your design in WebCT and create exemplars of online content. The group will design a framework for an e-learning module in their own subject area, including reference to online assessment and evaluation. They also present the educational rationale and underlying learning model and theory for the module. It had been identified that the incorporation of multiple media for delivery is important.

Integrated with this should be a relevant evaluation strategy and an opportunity to revise your materials. All this is to be synthesised in the form of a group report to the head of department.

Format and length of the report will be provided on the supporting course web site.

TECHNOLOGIES PROVIDING RESOURCES

There is a vast array of information and resources existing on the web. The inclusion of links to other websites can save a great deal of time and expense in the development of web-based learning materials to support project or Problem-based Learning. Such links are an ideal way to include multimedia resources to support the project or problem and can be used for remediation, enrichment and/or motivation for the work. Any online learning materials provided by the teacher should be linked to the context of the project or problem, along with facts, knowledge and skill associated with what is to be learnt.

Figure 5: Practical Exemplars – Technologies Providing Resources
Content sequencing is important when topics are presented online to learners. There are a number of different ways in which online content can be sequenced:
- Chronological: topics are arranged according to when various events occurred;
- Order of performance: topics are arranged in the order they are executed;
- Known to unknown: this approach asks you to consider what learners already know and build upon this;
- Taxonomic: this approach is common in science and engineering and has also been used to classify learning objectives;
- Simple to complex: here the topic is arranged to begin with the most simple concept/task and to add to it in a logical fashion until coverage has been obtained;
- Problem-centred: a learning event may be centred around a problem or exploration of an issue; online materials need to provide learners with a context to learn the essential knowledge and skills involved in the problem.

Resource and reference materials of all types can be made both accessible and searchable. Supporting linking the theory of a subject area with practice can take many forms including exploring web resources, investigating best national and international practice in order to benchmark students' work and resource reviews. Students can be encouraged to ask questions in their project or problem group about the important theories within the subject area and how these can be applied to current professional practice.

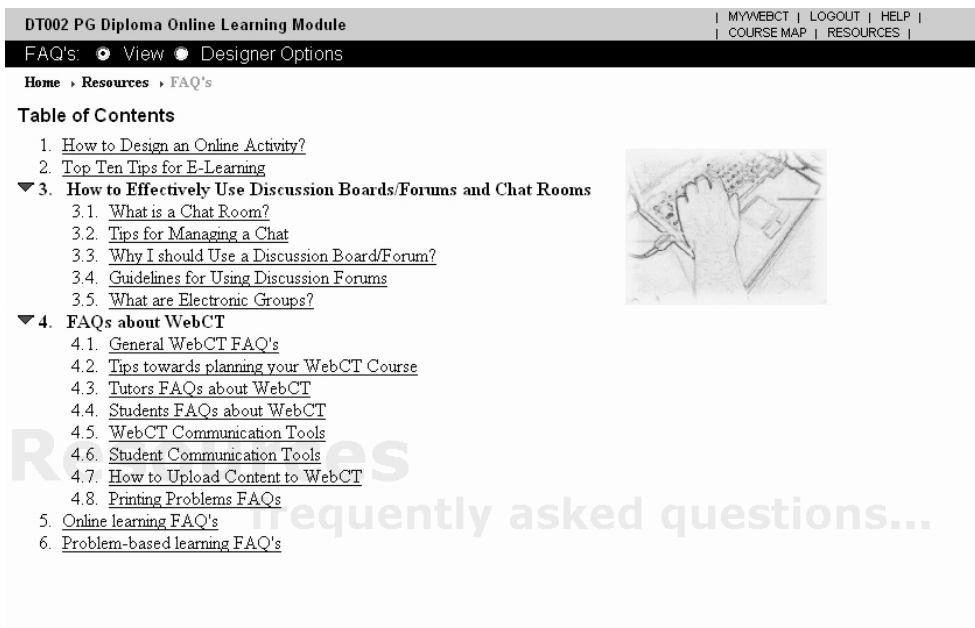**Figure 6: Practical Exemplars – Resource and Reference Materials**
The teacher can begin by distributing learning materials on the OLE:
- Bulletin boards
- Frequently Asked Questions (FAQs)
- Glossaries
- Past examination papers
- Prerequisite learning materials
- Resources for supporting the project or problem

The students can then continue adding to these resources, making it a truly dynamic learning environment. As part of their independent learning for the project or problem, students can also retrieve information from many other sources on CD-ROM and the web:
- Databases: includes those hosted by governments, libraries and educational institutions
- Journals: there are many professional journals available on the web
- Special interest groups via electronic discussions
- Learning events: there are a variety of live webcasts in many subject areas that students can join

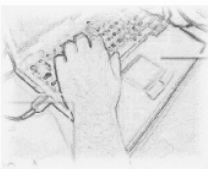**Figures 7, 8 and 9: Screens of the PBL FAQs, E-Resource Library (Cybrary)**

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| MYWEBCT | LOGOUT | HELP |
| COURSE MAP | RESOURCES |

FAQ's ◉ View ● Designer Options

Home ▸ Resources ▸ FAQ's

Table of Contents

1. How to Design an Online Activity?
2. Top Ten Tips for E-Learning
▼ 3. How to Effectively Use Discussion Boards/Forums and Chat Rooms
    3.1. What is a Chat Room?
    3.2. Tips for Managing a Chat
    3.3. Why I should Use a Discussion Board/Forum?
    3.4. Guidelines for Using Discussion Forums
    3.5. What are Electronic Groups?
▼ 4. FAQs about WebCT
    4.1. General WebCT FAQ's
    4.2. Tips towards planning your WebCT Course
    4.3. Tutors FAQs about WebCT
    4.4. Students FAQs about WebCT
    4.5. WebCT Communication Tools
    4.6. Student Communication Tools
    4.7. How to Upload Content to WebCT
    4.8. Printing Problems FAQs
5. Online learning FAQ's
6. Problem-based learning FAQ's

DT002 PG Diploma Online Learning Module | MYWEBCT | LOGOUT | HELP |
| COURSE MAP | RESOURCES |

Module resources: ⦿ View ○ Designer Options

Home ▸ Resources ▸ Module resources

Table of Contents

1. Using the web for research
2. DIT Library and Search Engines
▼ 3. Cybrary
   3.1. Indicative Reading for the Module
   3.2. Understanding E-Learning Pedagogy
   3.3. Online Tutoring e-book
   3.4. VARK Learning Styles Online Questionnaire
   3.5. Using Video Conferencing for teaching and supporting learning
   3.6. WebCT Accessibility Guidelines
   3.7. Online Learning Exemplars
   3.8. E-Journals
   3.9. Webliography
4. Learning and Teaching Glossary
5. Telementoring Taxonomy Example 1
6. Telementoring Taxonomy Example 2
▼ 7. **Personal Development Plans**
   7.1. An Example of a Personal Development Plan
   7.2. Template A: Personal Development Plan for E-Learning
   7.3. Template B: Personal Development Plan for E-Learning
▼ 8. **E-Learning Pedagogy**
   8.1. Implementing Principles of Good Online Practice

DT002 PG Diploma Online Learning Module | MYWEBCT | LOGOUT | HELP |
| COURSE MAP | RESOURCES |

Webliography: ⦿ View ○ Designer Options

Home ▸ Resources ▸ Module resources ▸ Indicative Reading for the Module ▸ Webliography

ACTION MENU: Previous Next Contents Retrace Refresh

Webliography

Organisations and Groups

Teaching and Learning Technology Group of American Association of Higher Education
http://www.tltgroup.org/about/index.html

Centre for Curriculum Transfer and Technology
http://www.ctt.bc.ca/

British Association for Open Learning
http://www.baol.co.uk

European Federation for Open and Distance Learning
http://www.ardemi.fr/FFFOD/efodl_e.html

British Evaluation Society
http://www.evaluation.org.uk/

The Training Zone: The Learning Community
http://www.trainingzone.co.uk

Asynchronous Learning Networks
http://www.aln.org/

Guidelines

TECHNOLOGIES FOR DISCUSSION

Probably the highest level of interactivity in projects and problems online is achieved by extending the dialogue which is taking place in the classroom into the virtual learning process. Asynchronous computer conferencing, online tutorial support and email communication between teachers and students are three relatively simple to implement and seemingly "obvious" ways of using technology to support student learning in project and Problem-based Learning in higher education. Students in the groups can be located at different campuses (or at home). The online discussions will give them an opportunity to continue their group work at times when it is not convenient to meet up face-to-face and thus overcome any feelings of isolation by creating a feeling of a learning community. The asynchronous nature of the discussion board

allows time for reflection and considered response and thus is a powerful learning tool. From the teacher's perspective, online tutorial support and email communication can be used to focus on learners' specific learning problems, or any that have emerged from group work, and can be used to provide rapid feedback on individual and group progress.

In terms of group projects and problems, there are several opportunities to seamlessly integrate various learning technologies both asynchronously and synchronously:

Figure 10: Asynchronous Practical Exemplars
Students can be introduced to Online Group Discussions, through an OLE of choice; they can be encouraged to take a more active role on the learning process by setting up Discussion Boards to be used:
- As a forum to discuss their group project proposals or problem exploration by setting project milestones and problem action plans;
- To collect and exchange data;
- In blended courses, to maximise f2f discussion, students can post up summary of learning issues online;
- To encourage discussion of project and problem work outside of scheduled class time; for example, each week a journal article relevant to the face-to-face class can be discussed by the students in an online discussion board. Generally there is not sufficient time for the teacher and students to explore in sufficient depth the theory behind a topic during a scheduled class session. By using this online opportunity, the dialogue in class is extended and deepened through these online dialogic reflections. The students can be invited to respond to the online article through relating it to their own contexts, practice, and experience. They can voice their own thoughts, choose their own words and know that others will be "listening";
- For peer tutoring/critiquing/mentoring;
- To assist students to be more tolerant of differing viewpoints and better prepared to formulate and express their own opinions;
- To help resolve small problems or inconsistencies over time in project/problem related matters in a timely and effective manner (online tutorial).

Research has found that real-time chat is appropriate for both distance students and on-campus students who do not have regular in-person contact in groups.

Figure 11: Synchronous Practical Exemplars
Chatrooms can be useful at different points of project and problem work:
- in a buzz group, a small group of learners can discuss aspects of the project/problem without the assistance of the teacher; perhaps the group members need to quickly resolve issues in the project/problem;
- brainstorming can be useful early on in a project/problem lifecycle as a means of generating a number of different solutions;
- role-plays can be set up amongst groups and are designed partially to replicate the real world; the larger group will have a discussion and from that a series of problems may be suggested. The smaller groups are asked to prepare a role-play on one of the problems to demonstrate the problem. After the role-play the group should analyse what has happened;
- as an open help line, the teacher can make themselves available online at a particular time to answer student queries;

- for involving a guest facilitator/leader when the person is only able to make a 'one off' commitment but not longer term engagement in the discussion board;
- socialisation is important online in the groups as chat can be informal.

Figures 12 and 13: Screens of the problem discussion forum

A principal aim of such computer conferencing is to encourage discussion of work between students and teachers and to provide mutual peer support and learning through discussion

among students themselves. Experience has shown that it does not realise its aim without skilful handling by teachers online. To develop the potential requires a careful mixture of persistence, enthusiasm and ongoing development of moderating skills on the part of the teacher.

TECHNOLOGIES FOR REFLECTION

Reflective learning has been defined as 'an intentional process, where social context and experience are acknowledged, in which learners are active individuals, wholly present, engaging with others, and open to challenge' (Brockbank et al., 2002: 6). The reflective journal is a tool for creating meaning and context from events and experiences in the project and problem, leading the learner towards creating new meanings and further enhancing their ability to contextualise and progress towards self-directed and deep learning (Donnelly, 2004a).

Web logs (blogs) offer a new and powerful toolkit for the support of reflective collaborative and individual learning that adheres to the patterns of contemporary information-intensive work and learning outside of formal educational settings (Downes, 2004). Blogging encourages students to reflect and reflection is often a key element in the learning process. Depending on what you call the blog, you can encourage students to reflect and record many different impressions and ideas as a learning activity. Many teachers use blogs to encourage learners to be reflective about their learning. Other times they can be used simply as a record of effort, a diary of progress etc. This can help to maintain an outlook on students' progress in large independent projects and problems.

Figure 14: Practical Exemplar – Technologies for Reflection

Options for students using blogs in projects or problems include:
- Reflective or writing journals;
- Field notes of professional practice;
- Knowledge management;
- Dialogue for groupwork;
- E-portfolios;
- Share project or problem-related resources.

In terms of supporting the group process in project and Problem-based Learning, concept mapping (also known as mind mapping) is becoming increasingly popular, whether it is to draw a research territory map of the area of investigation, or to show relationships and ideas within the project or problem, or to act as a form of visual shorthand or emphasise key points.

Figure 15: Screen showing the use of a mind/concept map
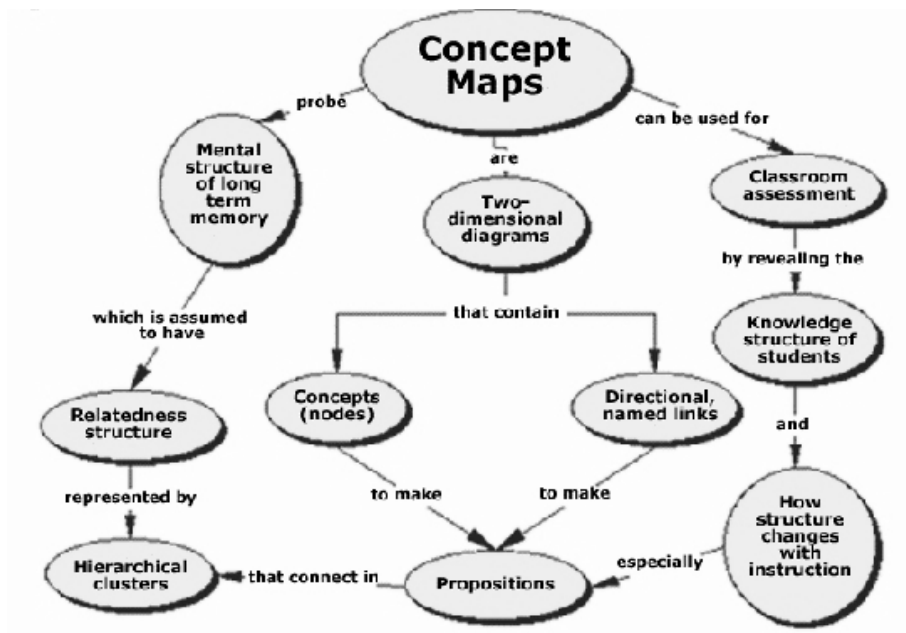
TECHNOLOGIES FOR PRESENTATION

Individual students within a project group can be called upon to present case studies unique to the topic area they investigated for the group project. A slot can be reserved on some face-to-face sessions for a case study presented by a student on an aspect of their learning that was innovatory for them. This is based on an outlook that much that can be learned about, can come from fellow students rather than solely through the conduit of teachers. Dissemination of such learning materials, including the case studies can be encouraged at all times; a newly formed web site could be used for this. It can be a dynamic resource and the students can be encouraged to submit their own work for inclusion on the site.

> **Figure 16: Practical Exemplar – Technology for Presentation**
>
> Video provides students the opportunity to experiment with novel approaches when producing learning materials for their project or problem: using relatively cheap cameras and presentation packages to produce a multimedia presentation.

Technology use tends to lengthen the amount of time devoted to a given project or problem by the ready availability of a convenient electronic record of prior work. When students have their own folders (individual or group) on a computer, they can easily go back to their work and revise it or augment it before presentation. The pride they take in their technology-based work appears to increase the likelihood that they will revisit it and the capabilities that technology affords for easy modification of one's prior work support the inclination to revise and refine.

TECHNOLOGIES FOR COLLABORATION

Real-time or time-independent communication can take place among learners and teachers on a project or problem. The Computer Mediated Communication (CMC) features of an OLE are very useful for this. In the area of designing for interactivity, three aspects are salient. The first form is the collaborative student-to-student interactions where students are engaged in discourse, authentic Problem-based Learning, and product-building using web-mediated communication and collaboration tools. This integration component helps learners validate their learning experiences, requiring a level of reflective articulation that promotes collective knowledge-building and a deeper personal understanding of what is being studied. The second form of interaction is the student to teacher interactions where an interpersonal/social component occurs when learners receive feedback from the facilitator or peers and colleagues in the form of personal encouragement and motivational assistance. The third form is the student to resources interactions where students access online materials and receive task-oriented feedback from the facilitator or from a technology-driven feedback system.

Simulations can provide an interactive environment where students, in project or problem groups, can explore, experiment, question and hypothesise about real life situations which would otherwise be inaccessible. Students are receiving classroom experience that mirrors the workplace. They have considerable educational potential with projects or problems because they provide an opportunity to 'learn by doing'.

Why ask the participants to collaborate? Collaboration as a member of a group working towards three common goals can be a highly effective mode of learning: learning collaboratively, problem solving collaboratively and achieving individual curricular outcomes collaboratively. Overall, members of the project or problem group are supporting one another's efforts in achieving individual outcomes.

Figure 14: Practical Exemplars – Online Learner Tools

Online learner tools contain the various features students require to facilitate their individual identity and learning:
- Calendar;
- The means to check assignments and track progress;
- Manage home pages;
- Edit their profiles.

TECHNOLOGIES FOR ASSESSMENT

Educational reformers call for new kinds of assessment embedded within learning activities and capturing the kinds of skilled intellectual performances that are the real goals we have for our students. Technology supports this practice when used in the context of meaningful projects and problems because it provides products (student writing, multimedia presentations, computer simulations, spreadsheets) that can be stored, duplicated, shared, and discussed.

One of the more attractive features of online teaching, generally, is the use of online quizzes. In project and Problem-based Learning, they can be used effectively at the outset for teachers to check individual student prior knowledge in a subject. However, in terms of assessing higher order learning outcomes involved in project-based learning such as applying, comparing, analysing, synthesising, evaluating, interpreting and reflecting, many classrooms internationally, are now actively developing student portfolios, and much of the work that goes into these

portfolios can be generated using technology (e-portfolios or e-folios). E-folios are ubiquitous, portable, electronic knowledge databases that are private, personalised and sharable and easily accessible via the web.

In both project and Problem-based Learning, many educators believe that the most important feature of technology is timely and personal response to learner contributions and questions. Students too tend to appreciate the instant feedback they receive and the flexibility of being able to take a quiz when/where they need to. Informative feedback that offers learners guidance about how they might improve their performance can come from teachers and other learners themselves. During the process of project or Problem-based Learning, students need to think about arguments made by others and contribute their own ideas to the group. Over time, they learn to cite other students' entries in the process of making their own arguments. They need to learn expectations for interacting with each other, the responsibilities of differentiated roles for co-operative work, strategies for coping with conflict, and the qualities of helpful comments and constructive feedback. As one of its many uses to support learning, the internet is increasingly being used as a forum for students to give feedback to each other. Peers can serve as excellent sources of feedback but it is important that teachers should establish delineated (negotiated) guidelines posted at the beginning of the project or problem for this to happen effectively.

TECHNOLOGIES FOR ADMINISTRATION

In terms of project and problem management, technology also has a useful contribution to make.

Figure 18: Practical Exemplars – Technologies for Administration

- Notice board contains announcements, updates and reminders during the project and problem process;
- Course/Module Information contains general information about the learning event, including overview, learning outcomes, prerequisites and time and dates for the various activities;
- Facilitator information provides a profile/biography of the tutors and how to contact them.
- Advanced Organiser previews the learning events taking place around the project/problem.

FAQS ON TECHNOLOGY INTEGRATION

This final section in the chapter explores some of the common issues and frequently asked questions (FAQs) academic staff have posed over the past five years on the postgraduate certificate and on the 'Designing E-learning' module on the Diploma in Third Level Learning and Teaching, as they began to contemplate integrating technology into project and Problem-based Learning in their own subject disciplines.

- **How will Learning Technologies (LT) enable the learners to manage their own learning?**
  The virtual learning environment of choice can assist students and teachers in tracking performance through various learning events and the marking and feedback available through online quizzes and assessments. In addition, one of the most salient features of e-learning is that it allows learning to be place and time independent (Vrasidas and McIsaac, 2000). Learners can arrange their learning around their lives without being constrained by time and place.

- **How can it supplement or complement the existing face-to-face projects or problems that may be in place?**
  In terms of supporting students online, it is clear that they can gain much from sharing their thoughts with fellow learners and often can make significant advances in their own thinking through trying to communicate their ideas online (with the semi-permanence which is not present in face-to-face exchanges). Group communication can be encouraged and enhanced because students are aware that the OLE archives will clearly show who participated and to what level. Why is this so? From an evaluation of one course, students pointed to a certain form of peer pressure, in that they did not want to let their peers down in the PBL group work (Donnelly, 2004b). They felt that this form of accountability was important for participation online. In addition, they appreciated the fact that these same archives can be visited by them when constructing their reflective journals, to assist their memory of activities.

  The teacher's role changes also. The teacher is no longer the centre of attention as the dispenser of information, but rather plays the role of facilitator, providing guidelines and resources, moving from student to student or group to group, providing suggestions and support for student activity. The majority of classroom time may be devoted to collaborative project and problem work. As students work in their technology-supported groups, the teacher moves into a facilitator mode, asking about the reasons for various choices, and suggesting resources that might be used.

- **How can it support working with larger groups?**
  Students can support the teacher by providing help to their peers. Students who are technology 'savvy' are usually eager to share their knowledge with others. Student coaching roles do not need to be something that teachers set up in any formal way, rather they can emerge naturally.

- **How can it support disparate ability levels within a group of students?**
  When complex tasks, collaborative teams, and technology are brought together, a great variety of skills are needed. Command of the subject matter, strategies for obtaining information and solving problems, communication and cooperative skills, and technology skills are all needed. Students who may not excel in one area are likely to excel in another. Especially when students are explicitly taught how to work together in productive teams, the teams evolve to function effectively, with students making diverse contributions.

  In many classrooms, teachers purposefully compose groups of mixed abilities, ethnicities, and genders. In classrooms of mixed abilities, the age of students within groups can also vary. Such heterogeneous groupings allow for multiple perspectives and diverse skills, enhancing the quality of project work and creating new avenues for individual specialisation and peer tutoring.

  In addition, technology can help to make the students' thinking processes more visible to the teacher, something that does not happen when students simply turn in a completed assignment for assessment. As teachers observe the students working online, they can see the choices each student is making, ask about the student's goals, and make suggestions for revisions or different strategies. By prompting learners to articulate the steps taken during their thinking processes, online discussion boards create a record of thought that learners can use to reflect on their work and teachers can use to assess student progress. This dialogue-based approach to learning can create a rich intellectual context, with opportunities for students to improve their understanding of a subject area.

▪ **How can it enable project or problem-based tutorials to be more effective?**
A variety of support features can be put in place such as using the electronic bulletin board to distribute a variety of student administrative information. The Synchronous Chatroom feature of OLE's can be used for problem-solving areas of the curriculum so that the teacher can help students on a one-to-one basis, or one-to-small group basis.

▪ **How can it assist in acquiring key skills?**
Students have the opportunity to gain skills that are desired by today's employer as they work in teams collaborating, communicating and decision making. They decide how to find answers, solve problems, and present information while collaborating with teachers, peers, and community members. A number of key skills can be developed during the online project or problem development: learners' ability to gather, collate and express ideas; creativity; problem-solving; teamwork and negotiation skills; written and oral communication; practical subject knowledge; internet research skills.

Students can interact with each other through posting email and bulletin board questions. When the project or problem-based group meet electronically through the OLE, their online participation is negotiated with their peers in their group. In addition to this, they are practicing skills such as contributing to a threaded discussion.

▪ **How important is student induction in the learning process?**
As well as inducting students in how to engage in project and Problem-based Learning, it is also important to ensure that introducing a range of learning technologies will not add to the students' work burden on the project or problem. Effectively integrating new technologies into learning environments is challenging under any circumstances. A main issue which may emerge is student's level of familiarity with ICTs. Their prior technical knowledge is important to establish at the outset of the project/problem. One cannot assume that all students have extensive knowledge of basic computing packages and/or web-based facilities. The lack of technical knowledge may hamper student interaction early on in the project/problem, with students needing to quickly learn how best to use the communication tools such as discussion boards. A common complaint early in proceedings can be the limitations of students without requisite skills not being able to communicate as effectively as they want to with their peers (e.g. online discussions becoming a one line, short answer advice session, rather than a consolidated information-sharing, knowledge-building session). In such a case, tutors may have to intervene part-way through to guide students in ways to manage technology for the duration of the project/problem. Ideally, an induction session needs to be timetabled for students in order to enable them to become familiar, and to a degree, confident in using the technology before the project/problem begins.

Finally, in this chapter, as both approaches engage students in authentic tasks in which they explore open-ended professional situations and both approaches involve long-term immersion in work that is often collaborative as well as both approaches valuing multiple sources of information and performance assessment (Esch, 1998), it is useful to identify a number of common areas where technology can be used to support both project and Problem-based Learning. Figure 19 shows the main learning theories underpinning the rationale for the way that technology has been used to support project and Problem-based Learning in the Postgraduate Certificate and Diploma in Third Level Learning and Teaching.

One of the important reasons of understanding cognitivism is how it informs instructional design of projects and problems, particularly the beginning aspects of *gaining attention* to

enhance retention (Gagne, 1985). Learners are central to the instructional design process. Cognitivism shows learning as a mental process of sensing, maintaining, and retrieving new information as it is needed throughout the project or problem process.

A constructivist approach is also very important for both project and Problem-based Learning because the students are constructing knowledge from the information received, versus simply receiving information. A major theme in the theoretical framework of Bruner (1986) is that learning is an active process in which learners construct new ideas or concepts based upon their current/past knowledge. The learner selects and transforms information, constructs hypotheses, and makes decisions, relying on a cognitive structure (mental model) to do so: essentially they are learning by doing. By engaging students in a project or problem-based environment that is stimulating and hands-on, students learn from those experiences and can apply those experiences to later learning situations. Connections with old or prior knowledge can give the new information more meaning, make it richer, and easier for retrieval within the context of the project or problem.
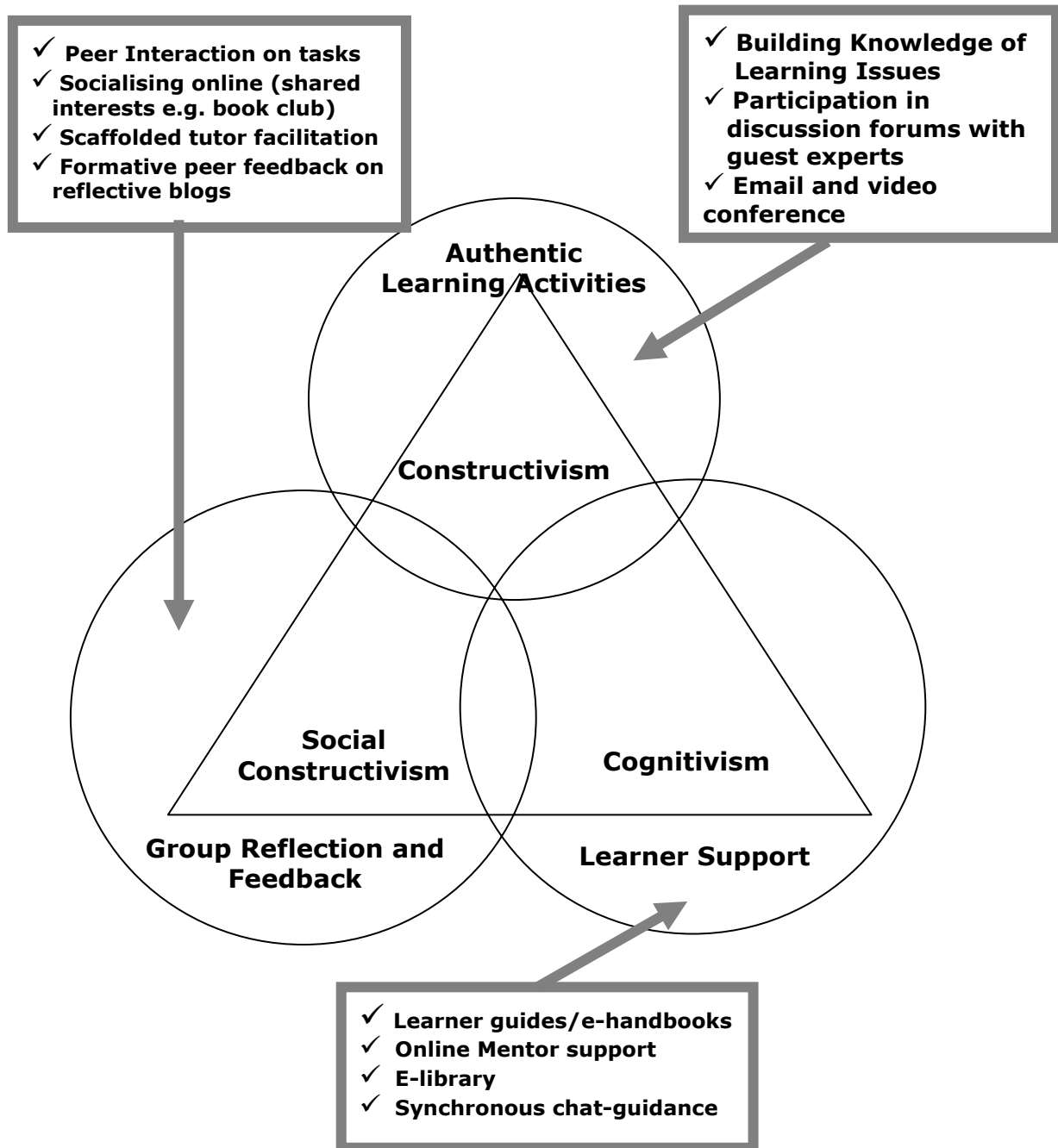
Social constructivism is also important because knowledge is the result of social interaction and language usage, and thus is a shared, rather than an individual, experience. Meaningful learning occurs when individuals are engaged in social activities. Intersubjectivity (a shared understanding among individuals whose interaction is based on common interests and assumptions that form the ground for their communication) not only provides the grounds for communication but also supports people to extend their understanding of new information and activities among the group members (Vygotsky, 1987).

CONCLUSION

As explored in the chapter, many issues can arise in considering how to effectively use technology to support project and Problem-based Learning. A central issue for teachers is making a decision on the best way to use technology to facilitate student learning. The best approach is the one that works for you in your classroom. Many teachers have chosen to blend these approaches together. Others vary the approach depending on the learning need.

Introducing technology to support project and Problem-based Learning can be exciting and rewarding, but it also can be complex and time consuming. Not only does it involve teachers developing a range of new technical skills, it also requires that they become "expert" in a new way of teaching and their students become proficient in and enthusiastic about a new way of learning (Donnelly, 2004c). However, there is little doubt that technology is changing the way academic staff teach and students learn. As technological advances are introduced into courses and modules in higher education, campuses are more and more attracted by the promise and potential of technology for enhancing access and learning.

Digital media are refining many aspects of higher education and students now need to be able to use these technologies to support them in thinking flexibly and creatively, solving problems and making decisions within complex multidisciplinary environments. As a result, there is a need for integrating different instructional methods, techniques and strategies. In the context of project and Problem-based Learning, the areas of student responsibility and initiative, generative learning activities, authentic learning contexts and assessment strategies, and co-operative support are all important considerations for teachers. Interaction is a critical component of such constructivist learning environments, whether via the web or in person, because learning occurs in a social context through collaboration, negotiation, debate, and peer review of project and problem work.

Peer Interaction on tasks
Socialising online (shared interests e.g. book club)
Scaffolded tutor facilitation
Formative peer feedback on reflective blogs

Building Knowledge of Learning Issues
Participation in discussion forums with guest experts
Email and video conference

Authentic Learning Activities

Constructivism

Social Constructivism

Cognitivism

Group Reflection and Feedback

Learner Support

Learner guides/e-handbooks
Online Mentor support
E-library
Synchronous chat-guidance

Figure 19
Using Technology to Support Project and
Problem-based Learning

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