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A Project Management Module for Virtual Teaching

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Abstract

This paper presents design and results of the pilot deliveries of an on-line project management module. The module was part of the First Cycle Degree strand of the European Union funded GENIUS project. The scope and structure of the project management knowledge and competency domain was analysed using a process of decomposition and graphical representation using concept maps. A number of perspective views of the domain emerged which were mapped and analysed to determine a web resource structure and cross-linking methodology. The on-line delivery strategy was positioned on the technological dependency / pedagogical intent space in sympathy with the underlying pedagogical theories employed and the overall learning objectives.

The two pilot deliveries demonstrated, qualitatively and, in a limited way quantitatively, that the resource and pedagogical approach were liked by the students and achieved the stated learning objectives and the desired project objectives of the First Cycle Degree strand of the GENIUS project.

A project management module for virtual teaching

Introduction

In 1999 the Career-Space consortium (Career-Space) was formed by the European Union DG Education with the objectives of reviewing the Information and Communications Technology (ICT) industry human resource supply/demand balance and assessing the "skills gap". The "skills gap" being defined as the shortfall between supply and demand in qualified individuals required by industry. The consortium was also charged with defining new common curricula appropriate to the ICT Industry Sector. The consortium comprises BT, Cisco Systems, IBM, Intel, Microsoft, Nortel Networks, Nokia, Philips, Siemens, Telefonica, Thales and the Industrial partners and EICTA[1], ICEL[2] and CEDEFOP[3] as the organisational partners. A number of European Universities were invited to join the consortium as academic advisors.

The Career-Space consortium has completed two phases of work and has just embarked on the third. Phase one was the definition of common job profiles (Career-Space 2001) across the Industry Sector. Approximately 20 job profiles have been identified and described in industrial terminology. In phase two, academia was bought in for the purposes of surveying current academic provision against the defined job profiles, to help gather information about general curriculum content and to help formulate new common curricula appropriate for the ICT Industry sector requirements.

Two projects emerged from this phase of Career-Space, the first was a UK DTI funded project called PanICT (Ward, 2001). PanICT was a feasibility study into alternative ways of "skilling" individuals for the identified job profiles. The project also proposed a detailed academic content for all the technical skills and decomposition of the behavioural skills included in the Career-Space job profile data dictionary.

The second project aligned with the EU recommendation that new pedagogies should be investigated to foster accessibility and inclusivity of future pan European programmes.

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[1] European Industry Association for Information Systems, Communications Technologies and Consumer Electronics.
[2] International Co-operation Europe Ltd.
[3] European Centre for the Development of Vocational Training

The objectives of GENIUS were to investigate innovative content delivery mechanisms; develop content based on identified Career-Space skills requirements; develop a pilot pan European collaborative e-Learning environment and disseminate the results. The project considered five basic strands, one strand for each of the FCD[4], SCD[5], Multidisciplinary, Non-traditional learner models plus training. Underpinning all this is a review of pedagogy and its appropriateness to e-Learning.
This paper describes the project management module and pedagogical experiments undertaken using a test-bed learning resource at the University of York. The paper commences with an analysis of the project management knowledge and competence domain, next the pedagogical theories that influenced the structure and form of the learning resource are discussed. The final part considers the two pilot deliveries and the results obtained. Both pilots used a synchronous learning environment, one to a geographically focused and the second to a geographically dispersed cohort.

Project Management

The Career-Space consortium, in its generic ICT skills profiles (Career-Space 2001) defines project management as:

"Understand the requirements of working as part of a team to achieve a specific goal. This includes what has to be done as a team member and as a team leader. Should cover the basic project management activities such as planning and scheduling, estimating, project management and control, risk issues and change management, status and progress reporting. There is a wide range of programs available to assist the project manager with this task and whilst it is useful to have experience of these, a good grasp of the basic concepts is more valuable."

The Oxford English Dictionary defines two related terms:

Project, "*trans.* To plan, contrive, devise, or design (something to be done, or some action or proceeding to be carried out); to form a project of."

[4] First Cycle Degree (Undergraduate Bachelor degree)
[5] Second Cycle Degree (Masters or Postgraduate degree)

Management, "Organization, supervision, or direction; the application of skill or care in the manipulation, use, treatment, or control (of a thing or person), or in the conduct of something."

The extent of the project management knowledge and competence domain is also informed by (Cleland 2001) and (Nokes 2003). A two stage domain analysis process was followed. Firstly domain decomposition was used to identify the component parts and their interconnections, then the concept map was used as a representational system.

Domain Decomposition

The various definitions of project management clearly show the domain can be viewed from a number of different perspectives. Table 1 shows the three perspectives considered herein. The first is the engineering process perspective which, in summary, considers project management as a process comprising activities or stages. The functional perspective focuses on the functions undertaken and the 'tools and techniques' required of the project manager. The idiosyncratic, or behavioural perspective considers the skills required of the project manager at the individual and interaction levels.

Process	**Function**	**Idiosyncratic**
Requirement capture	Work breakdown analysis	Written & oral communications
Design	Estimating	Personal effectiveness
Development	Project logic design	Team working
Approvals	Project plan formulation	Motivation & delegation
Production	Critical path analysis	Performance appraisal
Post production support	Financial justification	Problem solving
	Monitoring and control	Creativity
	Risk analysis	Managing meetings
	Technical and Progress reporting	Dealing with human resource difficulties

Table 1. Views of the project management knowledge and skills domain

These decompositions provide information about the key concepts of the overall domain and on the interactions between them. The decomposition was used to derive four sub-domains of knowledge and competence that can be used as a basis for a hierarchical structure to the learning resource. The four sub-domains are:

- Domain specific skills

  Those skills required of the project manager to understand the detail of the domain within which they are managing a project. To illustrate this, a project manager responsible for the development of a new Information Technology Centre must have some technical skills relating to IT, without such skills the manager would not understand terminology being used, specifics of challenges or understand the implications of technical tradeoffs faced during the project.

- Technical skills

  Technical skills, in this context, are taken to mean the skills a project manager requires that are of a technical nature. Examples of such skills include: Diagramming techniques for project plans and results; Critical Path Analysis; risk analysis, management and control techniques; investment appraisal and general financial analysis techniques.

- Behavioural skills

  Behavioural skills are the skills that are personal to the project manager or which affect individuals, the later being of importance in the understanding and leading of other individuals during the project management activity.

- Business skills

  Business skills are the skills required of the project manager to understand and manage the impact the project has on the overall organization's performance and the general impact it may have on the overall economy. Examples of skills in this category are accounting and finance, investment appraisal, marketing, human resource management, the law, environmental impact, ethics, etc.

The domain specific skills are not included in the scope of the project management module as they are addressed in the core technical scope of the overall programme of study being undertaken by the learners. The three remaining sub-domains were then further hierarchically decomposed to produce a tree structure of overall content.

Concept Maps

'A concept map is a graphical node-arc representation of the relationships among a collection of concepts. The nodes of the map contain the concepts, the links between the nodes indicate the relationships among concepts, and the labels on the links provide information about the nature of the relationships (Novak & Gowin 1984). Concept maps can clearly indicate complex multi-relationships between numerous concepts but do not demand complex skill to draw a map. The efficacy of concept maps in traditional education is well documented (Turns et al, 2000).

The map is an important methodological tool of Ausubel's Assimilation Theory of meaningful learning (Ausubel 1978) and closely aligns with other, less formal tools including mind maps (Buzan & Buzan 1995) and knowledge maps (Gordon 2000). The representational system used in this project captures the content and perceived linkages as a basis for the formulation of the learning resource structural design.

In a virtual learning system, where individual learner adaptation of content is one of the ultimate goals, as is the case in this project, an in-depth understanding of the initial conceptions and prior knowledge of the learner in the domain is important. This can be determined through some form of conversational interaction (Laurillard 1993). Part of this process can include the learner describing the domain by drawing their own concept map which can then be used as part of the assessment process (Turns et al, 2000). The differences indicate the individual learners' required knowedge set.

'Model' concept maps for the project management domain have been developed for each of the three perspectives in Table 1. Figure 1 shows the process perspective with a sub-set of the concept interconnections for clarity. These maps were used as the basis for the placement of hyperlinks between the domain concepts.

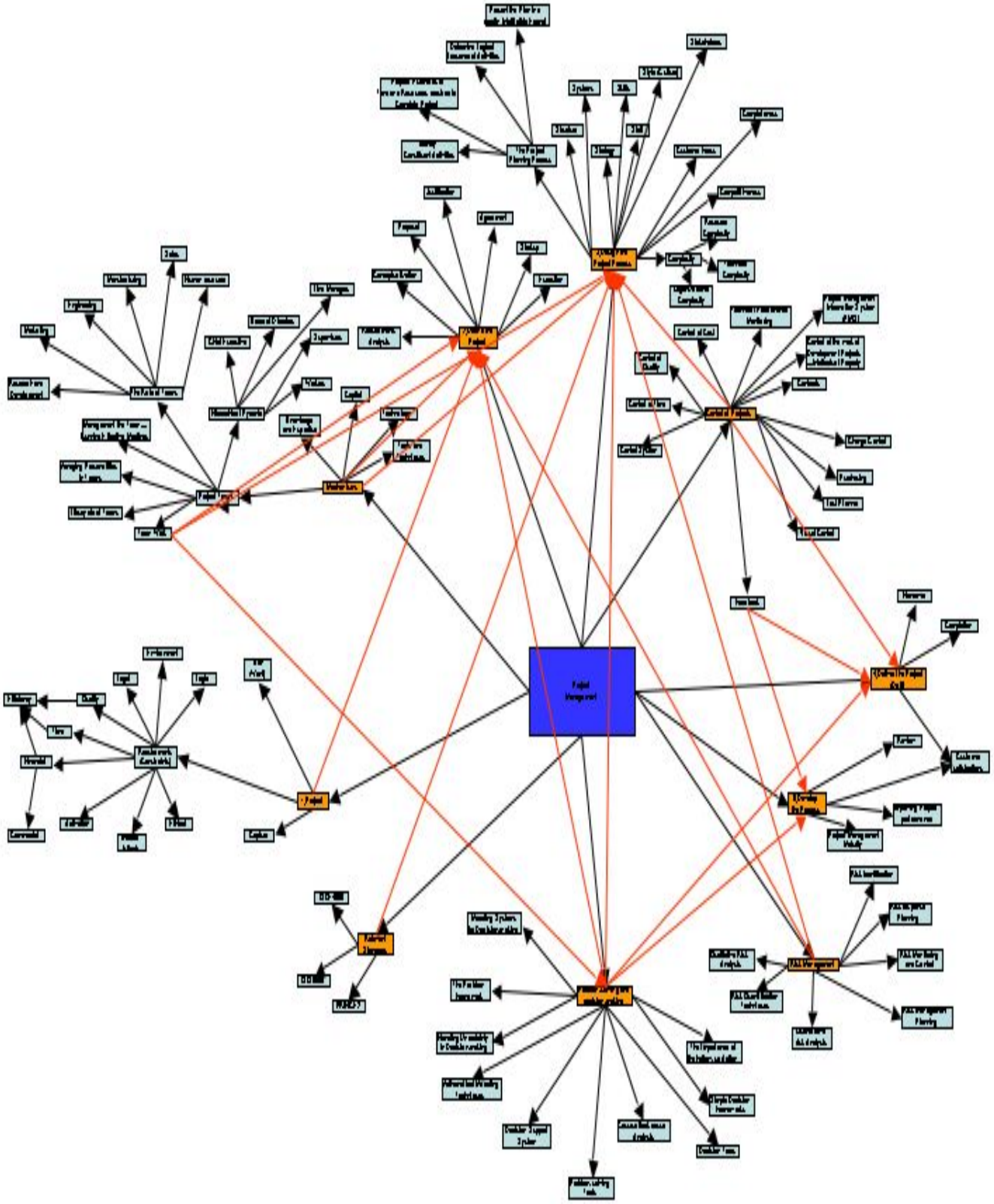

Figure 1. Process perspective of the project management domain

Technology and Pedagogical Intent

In on-line learning the technology used, and in particular the complexity of learner interaction, and the pedagogical intent of the module are linked. Figure 2 shows the placement of the on-line learning approaches considered for delivery of the project management module. The figure shows a 2-dimensional space with one dimension being level of technological dependency ranging from the simple viewing of documents on screen at the low end (technology as a support to learning) to feature rich, multimedia, fully interactive packages at the high end (technology as the predominant medium of learning). The second dimension is pedagogical intent with a range from a totally teacher-centric intent at one extreme to totally learner-centric at the other.

To illustrate the application of this model 6 broad regions are shown. Region 1 is the province of learner access to on-line lecture notes and general course information. Region 2 generally covers fully synchronous learning environments where the teacher is in control of the learning process. If learners are given freedom to explore the domain as part of the synchronous learning sessions the region would extend further to the right. Region 3 is where media rich, asynchronous self-study learning packages lie. At the low technology, learner–centric, Region 4 area, learners explore resources using simple tools such as internet search engines and information portals. In the central area, Region 5 includes multimedia lecture support packages.

The GENIUS project management module sits roughly in the Region 6 area. A synchronous VLE was used to deliver lectures in conjunction with a relatively lower technology website learning resource but with some specific tools such as discussion groups and an on-line moderated 360 degree group level performance review system.

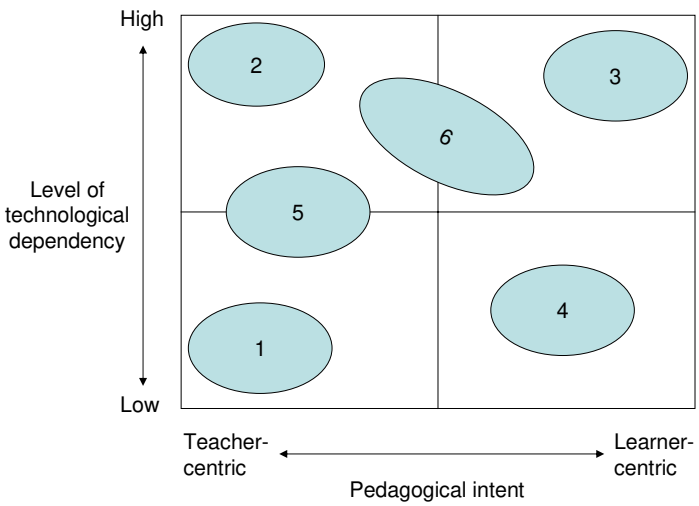

Figure 2. Classifying on-line learner interactions

The significance of this model to module delivery infrastructure cost, content production cost and train-the-trainer requirements are self-evident.

Underlying Pedagogical Theories

The next stage in the design process was to consider relevant pedagogical theories. The major components of the project management domain span the full hard/soft skills spectrum and thereby require a range of different pedagogical approaches.

The overall pedagogical objective was constructivist in nature, in which learning is constructed by the learner through the joint processes of conflict resolution and reflection about discovered theory (Bruner 1960). The learner plans their own learning strategy based on current external and prior experiences which should enhance their engagement predisposition and serve as a source of guidance on the domain exploration sequence. The comparing of new theory to experiences should also enhance cognitive structure development (Bruner 1966). Additional merits of constructivist learning lie in enhanced long-term information retention and deeper understanding.

As has already been noted elements of the conversational model of learning (Laurillard 1993) were used to help learners identify the areas of the overall project

management domain they personally needed to focus on and explore in depth. As the first pilot delivery progressed the exploration desires of individual students identified new areas that were added into the resource.

Whilst short term memory tests of knowledge were used as a means of ensuring all students in the cohort had considered the key elements of the module learning objectives and to periodically synchronize the students within the content, most activities were designed to avoid simple rote learning and focus on the meaning of concepts and their relationship to one another in the domain and thereby promote deep learning (Marton et al. 1984).

The structure and design of the overall learning resource was also designed to be appropriate, to both serialist and holistic learners (Pask 1975). Different ways of accessing the content were provided to meet the differing requirements of these learning strategies, examples include provision of a sequenced route through the content, an overall visual concept-map representation and an overall set of target learning outcomes all as entry points into the resource.

The final key theory used was Bloom's taxonomy (Bloom 1956) which provides a useful tool for understanding the cognitive levels at which a student is operating and how best to target an assessment to encourage the student to think at the appropriate cognitive level for the desired learning outcomes. The full range of Bloom's 5 levels were used in the assessment instruments, for example, level 1 for the quick memory tests and level 5 for the individual critique report.

The following points summarize how elements of the module align with the underpinning pedagogical theories considered:

- Closed assignments were used to assess competence in hard skills.
- Multiple learning cycle iterations with specific guided reference to the reflective stage of experiential learning were included for each behavioural skill wherever possible.
- Peer and supervisor assessment of exhibited behaviour was used as the development and assessment mechanism for behavioural skills.
- To encourage deep learning the core content was supported by additional exploratory learning resources.

- There were regular summative assessments to encourage a consistent time and effort application.
- Objectives for the module and the individual skill development activities were made public.
- Private levels of personal behaviours and reflection were challenged through the 360 degree feedback carried out through the first pilot.
- Two versions of the learning resource could be accessed, a prescribed 'timetable' approach designed to lead the serialist through the content, and a graphical 'map' version of the content aimed at the holistic learner.
- Bloom's taxonomy terminology and levels were used in the formulation of assessment instruments.

Project Management Learning Resource

The project management learning resource was constructed using a range of existing teaching material supplemented by new material specifically created for the GENIUS project. All material was reformatted into a common standard and placed within an overall web site. Virtual lectures were formed by extracting elements from the web site and uploading them to the VLE server. A module logo was included in the top banner to give a consistent identity and to alert learners to when they had entered additional, support resources provided by others.

Entry to the resource is via a welcome page which offers alternative entry points as noted above. The user interface is designed so that from one of the main resource views the learner only needs three clicks to reach the detail level. A breadcrumb is included below the top banner to show the user where they are in the site and provide a quick access route to higher levels. Full module administration details are provided including learning objectives, assessment scheme and weightings, how the module is to be delivered, description of the group task and instructions on how to use the VLE.

From the welcome page learners can also access the discussion groups area, the feedback forum (the welcome page to the on-line moderated 360 degree feedback system), a search facility and the Learnlinc VLE.

Third level pages show the key resources available to support the topic, class notes that will be used during the associated class and web links which contain further exploratory information to enable deeper exploration of the topic. All pages at this third level of the web site are designed to look the same and have the same structure. In this way consistency and user familiarity is maintained throughout.

Module Delivery And Feedback

First pilot delivery

The first pilot delivery was to a group of 19 4th year Master of Engineering Electronics students at the University of York. There were 3 female and 16 male students in the cohort. For three students English was not their mother tongue. The module was delivered over a 9 week period with 3 scheduled lectures per week and was a compulsory component of the students' degree programme. The module was delivered in a mixed mode with some lectures being virtual and others face to face. This mix allowed the task, individual assessments and the virtual learning environment to be introduced in a controlled way. The learning environment used was Learnlinc and the first virtual lectures were held with the students in a computer laboratory supported by a technician with the lecturer in a different room. As experience in virtual learning was gained the students were given the choice of where they accessed the virtual lectures.

To support the development of project management skills the students were arranged into groups of four to undertake a group project. Assessment was based on their performance in planning, managing and reporting on the process of project management rather than the group deliverable.

Group project

The group project was not designed to be technically complex and could be considered to be a 'simple' task (Harvey & Brown 1991), the task being to produce a 6 page (12 side) first edition of a student magazine. However the need to work as a team was forced by virtue of the marking scheme and the requirement for all students, individually, to produce a critique of their contribution and of the appropriateness and usefulness of the project management tools and techniques to their personality and role preferences. The groups (of four students) were assigned randomly. They were

given access to a team role preference assessment instrument, feedback on the meaning of the results and an on-line session on team working and team dynamics. Communication was required using electronic means which added a further dimension of complexity to the overall task.

A team approach was necessary to enable members to gain new experiences, in particular of assessing and being assessed by their peers and supervisor in a moderated 360 degree feedback system. The task also allowed team members to utilize their specific skills to maximum effect in the task. Consensus and commitment was also needed since the group was required to define the specific area to be covered by their magazine and the artistic style to be adopted. These align well with the criteria for the necessary adoption of a team approach (Moss Kanter 1988).

Second pilot delivery

The second pilot delivery was to a cohort of 15 all male students located in Ulm (Germany), Linkoping (Sweden) and Namibia (Africa). The tutor did not meet the students face-to-face before, during or after the course. All lectures were thus delivered virtually. Delivery was over a 2 month period with specific lectures arranged to suit the students wherever possible. All students undertook the module voluntarily and for no academic credit reward. The students were arranged into groups of four and given the same assignment albeit as a voluntary activity. No group completed the assessments.

Pilot results and feedback

In the first pilot the student cohort commitment to the module was excellent. All students completed all activities associated with it and took an active part in the on-line discussion groups and individual assignments. The general feedback on the module was good in terms of content and achievement of learning outcomes but less complimentary in terms of the VLE used. There was an audio latency problem, common in synchronous communications, which made delivery where multiple students or students and the lecturer present in the same room, unacceptable. Students disliked a video 'talking head' to the extent this was switched off after a small number of on-line sessions.

An evaluation questionnaire using 5-point Likert scale questions was used to capture quantitative feedback. The sample size is small, however of the students with

English not their mother tongue the average response to a question relating to the easy of understanding the language of the material was 4.67 indicating high comprehension. To clarity of stated aims and learning objectives the average response was 3.5 and regarding the ease of understanding the material, 4.7. This very high figure is due to the fact that most students in the cohort felt the material would have been better placed in the previous year of their study. The low average score of 2.7 for interest in the material was also, from qualitative feedback, due to the same reason. Ease of use of the on-line tools and ease of navigation scored 4.0. The extent of the resource and the freedom to explore the resource in their own way were generally liked.

In the second pilot the audio latency was much less of a problem and the synchronous sessions were very successful. All sessions were recorded so that students who missed the lecture could review it at their leisure and attending students could repeat it. Access speed was a significant problem for some students with the bottleneck not always being the student's own modem. Lack of local technical support to deal with audio and video set-up was a problem throughout the second pilot as some students tried various access points to achieve a reliable and robust link.
Qualitative feedback from this group indicated that the general understanding of the content of the module is understandable and that the layout and structure of the on-line resource is good. The prior knowledge and experience of project management for this group was less than for the first group and the content, as reflected in the feedback, was more appropriate for this cohort.

Conclusions And Future Work

Overall the module development and the two pilot deliveries have shown that a complex module comprising technical skills as well as behavioural skills can be taught using a virtual learning environment. The analytical approach to the design of the resource was shown to be good and easy to navigate. The breadcrumb and multiple views of the learning resource were liked as it gave the learners freedom to explore in their own way.

For the future, in addition to the on-line learning resource being used for project management competence development, it is also being used as an

experimental test bed for exploration of adaptation to a range of learner characteristics.

References

Ausubel, D.P., *Educational psychology: a cognitive view*. 2nd ed. 1978: International Thompson Publishing. 733.

Bloom, B.S., *Taxonomy of educational objectives: the classification of educational goals*. 1956, New York: Longmans.

Bruner, J., *The process of education*. 1960, Cambridge MA: Harvard business press.

Bruner, J., *Towards a theory of instruction*. 1966, Cambridge MA: Harvard Business Press.

Buzan, T. and B. Buzan, *The mind map book: radiant thinking: the major evolution in human thought*. 1995: BBC Consumer Publishing. 320.

Career-Space, *http://www.career-space.com/*.

Career-Space, *Generic ICT skills profiles*. 2001: Cedefop. 85.

Cleland, D., *A guide to the project management body of knowledge 2000*. 2001: Project Management Institute. 226.

Gordon, J.L., *Creating knowledge maps by exploiting dependent relationships.* Knowlege based systems, 2000. **13**: p. 71-79.

Harvey, D.F. and D.R. Brown, *An experiential approach to organizational development*. 1991: Prentice Hall. 902.

Laurillard, D., *Rethinking university teaching: a framework for the effective use of educational technology*. 1993: Routledge. 296.

Marton, F., D. Hounsell, and N. Entwistle, *Experience of learning*. 1984: Scottish academic press. 254.

Moss Kanter, R., *The change masters: innovation and entrepreneurship in the American Corporation*. 1988: Jossey bass wiley. 432.

Nokes, S., *The definitive guide to project management: the fast track to getting the job done on time and one budget*. 2003: Financial Times Prentice Hall. 352.

Novak, J.D. and D.B. Gowin, *Learning how to learn*. 1984: Cambridge university press. 150.

Pask, G., *The cybernetics of human learning and peformance*. 1975, London: Hutchinson.

Turns, J., C.J. Atman, and R. Adams, *Concept maps for engineering education: a cognitively motivated tool supporting varied assessment functions.* IEEE Transactions Education, 2000. **43**(2).

Ward, A.E., 2001, *PanICT project final report*, University of York. p. 95.