Key Decision Factors for Selecting e-Learning within UK Defence

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ABSTRACT

The UK MoD is undertaking a major investment in e-learning, with the Defence Learning Portal (DLP) implemented at the start of 2005. A recent internal review of Defence training proposed that approximately 20% of classroom-based specialist training be converted to e-learning over a five year period. For this proposal to be realised, a large number of training specialists will be required to evaluate the suitability of individual courses or course components for conversion to e-learning. Since relatively few of the training specialists concerned have detailed experience or training in the application or development of e-learning, it was clear that guidance and support would have to be provided to these specialists to ensure that selection decisions were made in a systematic, valid manner with documented steps for future reference.

This paper focuses on the identification of the key decision factors for selecting e-learning and the development of detailed guidance for applying those decision factors at a project level. Following a review of media selection theory, seven key decision factors were identified. These criteria were then further elaborated in order to develop detailed sets of questions to facilitate systematic information gathering. Critical dependencies between factors were also identified and elaborated to produce a model of these interrelationships. In the final part of the paper, a brief overview is provided of how the elaborated key decision factors and the interrelationship model were integrated into a spreadsheet-based, decision support tool.

ABOUT THE AUTHORS

John Huddlestone is the senior research officer in the Defence Human Factors Group in the Human Factors Department at Cranfield University. He holds a PhD in Applied Psychology from Cranfield University, an MSc in Computing from Imperial College London and a BEd in Physics from Nottingham Trent University. He is a Member of the British Computer Society and is a Chartered IT Professional. His research interests include simulation, training and task analysis. Prior to joining the University he was a commissioned officer in the Royal Air Force. As a training specialist, he gained extensive experience in training design, aviation training development, flight simulation and the development of computer based training.

Jonathan Pike is a freelance digital learning consultant with extensive experience of e-learning and knowledge management. His recent projects have included the specification and design of knowledge discovery systems operating on large unstructured textural databases, and the design and development of SCORM conformant e-learning packages to be delivered through the UK MoD Defence E-Learning Portal. His experience of e-learning design, development and evaluation spans both the military and civil sectors, and his roles have included teaching, technical consultancy, instructional design and project management. He holds an MSc in Applied Computing Technology from Middlesex University and a BSc in Biology from University College London.

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INTRODUCTION

This paper describes the development of guidance on the assessment of the suitability of e-learning as a potential instructional medium for military training courses. Seven key decision factors were identified and elaborated in a decision toolkit where the user is guided through a series of questions. The main focus of this paper is on the nature of the criteria that were identified as key decision factors and the fundamental relationships between these factors. A brief overview of how these factors have been encapsulated in the decision toolkit is provided at the end. This work package was conducted by Cranfield University as a member of the Human Factors Integration Defence Technology Centre.

Background

The value of e-learning within UK Defence is widely understood. In March 2001 the broad policy for Defence e-learning was defined in the Defence Training Review. This stated that, "we propose that 80% of appropriate classroom-based specialist training courses incorporate a minimum of 25% e-learning within five years" (DTR Report 2001, paragraph 75).

To achieve this, an e-learning strategy was drawn up focussing on delivery in 5 key areas; Facilities, Infrastructure, Courseware, People and Culture and Funding (Defence E-Learning Strategic Vision and Policy, 2003).

Key initiatives include the introduction of the Defence Electronic Learning Centres (DELCs), and the Defence E-Learning Delivery and Management Capability (DELDMC) - a defence-wide managed service Learning Management System (LMS) integrated into planned administration and personnel systems (ibid) to be launched in 2005. The courseware strategy strand embraces learning standards, course conversion criteria, conversion targets and partnering arrangements.

E-learning Policy and Policy Principles

The defence e-learning strategic vision and policy states that e-learning is to be treated as a training media within the Defence Systems Approach to Training (DSAT) Quality Standard (QS), and subject to the same quality standards and procedures applied to other training media within UK Defence. Additionally, e-learning must, "be considered as a potential learning delivery method for all training courses" (ibid). Individual Defence training providers within UK Defence have the responsibility for deciding whether training should be converted or created in an e-learning format.

Support for the Media Selection Process

Given the increasing adoption of e-learning within Defence, a need was identified to support and document the decision to adopt e-learning on an individual project basis. This is especially relevant given the extremely wide range of subjects, disciplines and types of training and learning objectives encompassed by Defence. The decision was made to produce a performance support toolkit encapsulating the key media selection decision criteria. The toolkit was designed to support the e-learning decision process in a systematic manner - enabling media selection decisions to be made more quickly and easily. Support and guidance is important as many training staff making media selection decisions in Training Options Analysis, do not necessarily have experience of, or training in e-learning as an instructional medium. The output from the toolkit captures the primary output in seven key areas and documents the criteria and variables that underpinned it.

Structure of the paper

The paper is in three parts. Firstly, the key decision factors are identified. Secondly, these decision factors are elaborated, detailed criteria developed and the key relationships between factors outlined. Finally, the embedding of these criteria into a decision support tool is described.

Definitions

For the purposes of discussion within this paper the following definitions are given:

1. **Methods:** techniques or strategies used to deliver learning. (Directorate of Naval Training and Education, 2003)
2. **Media:** the tools or materials required to support instructional methods. (ibid.)
3. **E-learning:** E-learning is a collective term used to describe training delivered by electronic means, including web-based systems, and computer and communications technologies, anywhere and at any

time on demand. (Defence E-Learning Strategic Vision and Policy, 2003)

MEDIA SELECTION CRITERIA

Media selection decisions can be divided between Strategic and Tactical decisions (Caladine, 2003). Strategic decisions apply to decisions that affect available media types within the overall training system, whereas tactical media selection decisions are made by learning designers as part of the Training Options Analysis phase. The Defence e-learning strategic vision and policy have acted as an e-learning enabler from a strategic level; whereas the e-learning selection toolkit is designed to support tactical media selection decisions made by individual training designers within training organisations.

The consideration of cost within tactical media selection models varies. Some media selection models separate cost factors from instructional delivery factors (which include, learning context, student characteristics and instructional management characteristics) (Lee and Owens, 2001). Alternatively, costs can be considered as a learning context factor (i.e. part of the constraints that operate to the context of instructional delivery) (Smith and Ragan, 2005). This model is discussed in detail later.

Intrinsic Media Characteristics

The primary intrinsic media factors from an instructional perspective are summarised below.

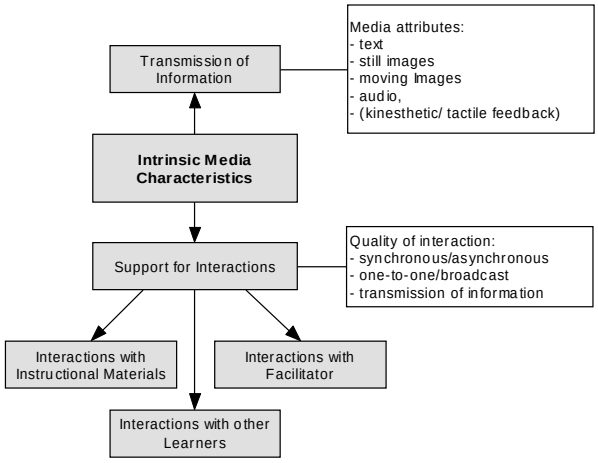

Figure 1. Intrinsic Media Characteristics

The intrinsic characteristics of an instructional medium must be sufficient to support the transmission of information required, and support for interaction required by the learning task (Dick, Carey and Carey, 2001). In other words, if an instructional task requires moving images to be presented, then the instructional medium should be capable of transmitting moving images. Likewise if an instructional task requires teamwork, then a form of learner-learner interaction will be required.

Transmission of Information

Transmission of information is characterised by the types of stimulus that can be transmitted to the learner, these are also known as the media attributes of the instructional medium. In an e-learning context these include text, still and moving images and audio. Other types of instructional information provided can include; motion, tactile sensation and physically modelled environments. It should be noted that some of the power of e-learning stems from its ability to embed or control other instructional media (e.g. video).

Support for Instructional Interactions

Support for interactions concerns whether the instructional medium can adequately support practice through interaction in a sufficiently realistic setting. Interaction may take a number of forms:

- Interactions between the learner and the instructional materials
- Interactions between the learners
- Interactions between the learner and the learning facilitator.

In this sense learning can be conceptualised as the designed provision of materials (transmission of information) and interactions towards an intended goal (Caladine, 2003). The requirements for different types of interaction are driven by the learning task. Beyond the basic provision for interaction, the learning task also drives the quality of interaction required. Some tasks require a level of interaction that requires personnel to be physically co-located, in other situations email, audio links or an online discussion group may be sufficient and appropriate.

Instructional interactions may be characterised on a number of axes; (1) they may be synchronous (such as video-conferencing) or asynchronous (such as email), (2) interactions may be directed one-to-one, broadcast (one-to-many), or group-collaborative, (3) the transmission of information supported by the media attributes of the communication (e.g. audio for audio conferencing or text for email).

Interactions may be recorded and played back in other instructional situations to illustrate correctness or consequences of action. In this context recorded interactions may constitute transmission of information.

E-learning supports interactions either internally (as in interaction with the materials in the course) or through Computer Mediated Communications (CMC) technologies, such as email - enabling messages to be passed to others. CMC also referred to as collaboration technologies, support learning interactions with other learners, or the facilitator. Examples of collaboration technologies include email, discussion forums, chat, voting, application sharing, audio and video conferencing (Horton and Horton, 2003).

Wider media selection considerations

Methods and media selection factors are not wholly dependant on the intrinsic properties of the instructional media and what it directly supports. Media selection decisions are co-dependant with a number of factors outside those directly concerned with media attributes – which together characterise the instructional situation. These instructional factors are collectively referred to as [instructional] delivery and management strategies. The relationships between the variables are summarised below (diagram adapted from Smith and Ragan, 2005):

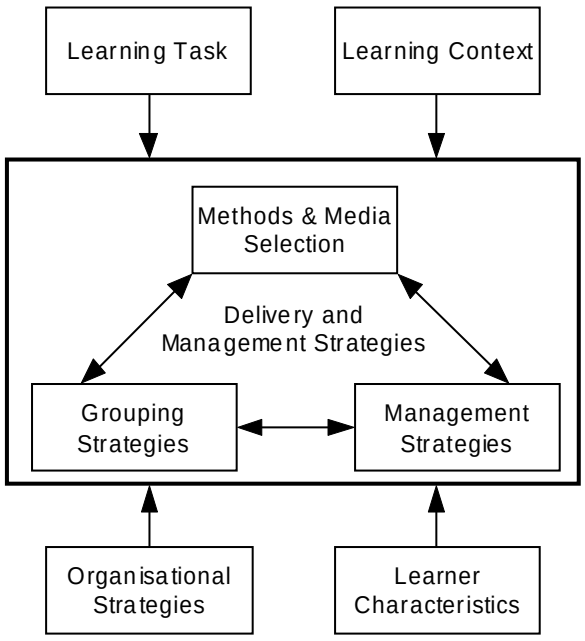

Figure 2. Delivery and Management Strategies

Methods and media selection are integrated with the selection of student grouping (also known as the grouping strategy), and the instructional management strategy (also simply referred to in this context, as the management strategy) (ibid).

The grouping strategy concerns whether students are best taught in a group, or whether individualised instruction, where students work at their own pace (though not necessarily alone) is more appropriate.

The management strategy concerns itself with scheduling lessons, production and allocation of required resources, assessment handling, production of management information and evaluation of the effectiveness of the system. The superset of all instructional management strategies and the resources and systems that underpin it comprise what is referred to as the Management of Training System (MTS). DSAT QS is a quality standard that assures the integrity of the MTS.

Delivery and management strategies do not exist in a vacuum, nor can be imposed without consideration of other influencing factors. The requirements of the following factors will constrain which delivery strategies are appropriate:

1) Learning Task – what are the characteristics of the learning task and what are the required instructional conditions?
2) Learning Context – where will students learn, what constraints exist and what practical factors (e.g. cost) have an influence on delivery choices available?
3) Organisational Strategies – determine how instruction is sequenced, what is presented and the forms of interactions that are designed. The classic nine events of instruction (Gagné, 1972) are lesson level organisational strategies.
4) Learner Characteristics – what are the entry behaviours and prior knowledge of the learners?

Any decision to convert a classroom course will need to consider the factors above in addition to intrinsic media factors. Sometimes it is the variability within a factor that has a strong influence on another – for example a high variability of learner previous experience (learner characteristic) or skill level makes adaptive instruction a preferred choice. This tends to favour an individualised grouping strategy, which then has an impact on the methods and media that can be selected. The decision on the choice of media and method must in turn be supported within the management strategy of the organisation (i.e. can the organisation manage students being at different part of a course given timetabling restrictions?)

Media Selection within UK Defence

A number of criteria for media selection are mandated within the DSAT QS. Specifically it states that:

"the selection of methods and media shall take account of:

a) the TOs [Training Objectives] and key learning points (KLPs) to be achieved;
b) the characteristics, locations and numbers of trainees;
c) the availability of suitably qualified instructors,
d) the availability of training resources;
e) the applicability of emerging technologies;
f) the training effectiveness of the methods and media;
g) the cost." (DSAT QS 001:2003, para 9.4)

Key Decision Factors

Synthesis of the previously discussed media selection theory and the DSAT QS criteria yielded the following 7 key decision factors:

1. **Cost effectiveness** – is e-learning a cost effective medium for delivering instruction?
2. **Learning context and practical considerations** – is e-learning possible given the context of the delivery situation and other practical considerations?
3. **Learning task considerations** – is the learning task suitable for e-learning?
4. **Grouping strategy considerations** – is the learning task capable of being handled through individualised instruction?
5. **Learner characteristics** – do the learners have the necessary skills, attitudes and motivation to conduct e-learning?
6. **Media attributes** – does e-learning support the necessary media attributes and interactions required for the instruction?
7. **Instructional management considerations** – is e-learning supportable within the wider organisational/cultural context?

In summary - can e-learning deliver the events of instruction that provide the necessary conditions for learning appropriate for the specific instructional outcomes required for the student population, in a cost effective manner?

ELABORATION OF KEY DECISION FACTORS

Once the key decision factors were identified the next stage was to design a set of questions and numerical spreadsheets to capture detailed information in each of the seven areas, these are discussed below:

1. Cost and Cost Effectiveness considerations

The cost and cost effectiveness model was based on the Horton return on investment (ROI) model (Horton, 2000). A detailed cost comparison for potential ROI was built on the basis of per course, per class and per student costs. The costing model enables the comparative costing of a blended solution against a traditional classroom course.

Whole life costs (WLC) are calculated by summing, per-course costs (which include course maintenance costs), with the per-class costs multiplied by the number of classes and per-student costs multiplied by the number of students. WLC divided by the number of learners over the project course lifetime generates a cost per learner. ROI is calculated from the WLC cost savings from conversion to e-learning divided by the additional upfront one-off per course costs incurred with e-learning.

Other initial cost effectiveness metrics that are calculated include; annual savings to operating costs and the payback period for the investment (i.e. when the build costs for e-learning are offset by annual cost efficiencies for delivery.)

2. Learning Context and practical considerations

With learning context and practical considerations, we need to be concerned with the delivery environment - questions such as:

- Will there be enough computers at the point of delivery?
- Are there enough licences on the LMS?
- Is there sufficient bandwidth?
- Is the necessary hardware and software available?

We also need to be concerned with how we ultimately get to the situation of the delivery environment, and so deal with issues of procurement, design and development as well as delivery/operation and provision for maintenance. Critical considerations involve; budget, personnel, facilities, equipment and production capabilities - some of the questions in this section fall into the category of "show stoppers".

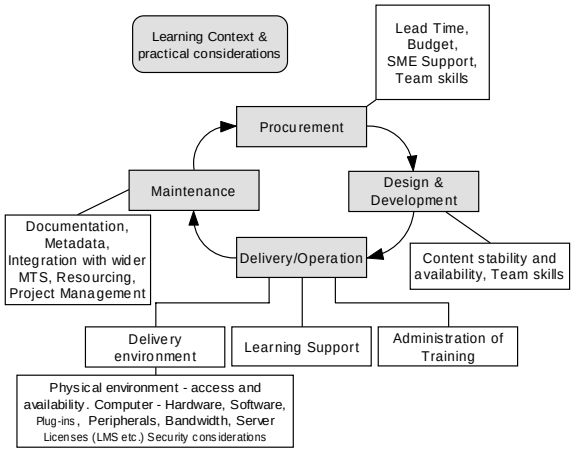

Figure 3. Learning Context considerations

Questions in these areas cover subjects such as available budget, level of Subject Matter Expert (SME) support that can be allocated, customer staff allocation to procurement, lead time available before training delivery takes place, security classification of material, decisions on outsourcing or development in-house, skills of the development team, access to equipment, locations or situations described in the content, content stability and where and how the students will physically access the material. Figure 3 illustrates the main concerns as they occur in the training development lifecycle.

3. Learning task considerations

Learning task considerations can be split into; breakdown of learning objectives, suitability of instructional methods, learning task attributes and learning environment availability.

Breakdown of Learning Objectives

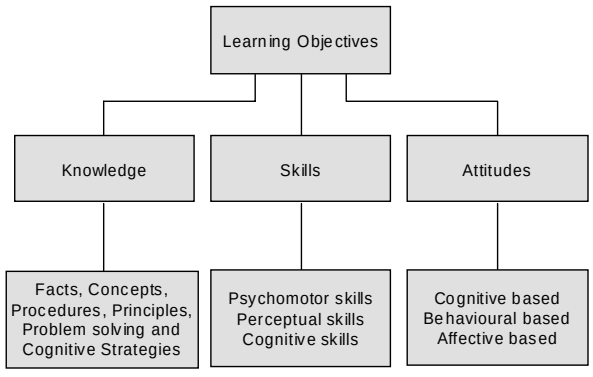

Figure 4. Breakdown of Learning Objectives

The breakdown of learning objectives into knowledge, skills and attitudes is part of the learning task considerations. Knowledge based objectives (which include declarative knowledge, concepts, procedures, principles, problem solving and cognitive strategies) are commonly handled through e-learning and well-suited to it (Driscoll, 1998). Figure 4 shows how learning objectives can be broken down.

Psychomotor skills can be partially taught through e-learning – as the 'executive routine' of a psychomotor skill is an intellectual skill (Smith and Ragan, 2005). Just as books on playing golf exist and instructional videos of parachuting have instructional value, so e-learning can be used to teach the intellectual components of the skill. However to actually learn a psychomotor skill the opportunity for skill practice must exist. The question then becomes does a computer environment support the necessary opportunity for that practice? If the skill involved the control of a piece of equipment through a PC-type interface one could make the case that it could. On the other hand, practising skydiving or stripping a weapon will require the real situation or a good facsimile of it (a wind tunnel for instance).

Cognitive skills and perceptual skills can be taught through e-learning providing that support for the necessary practice environment can be provided – this may be in the form of gaming or emulation, supported within an e-learning context.

Attitudinal objectives are comprised of a cognitive component, a behavioural component and an affective component (Smith and Ragan, 2005) Attitudinal skills are classed into which of these 3 components is dominant. Teaching attitudinal objects requires that the student know how to perform the skill (cognitive), is able to demonstrate it (behavioural) and have internal motivation to behave in that way (affective). Attitudinal learning is based on the principles of persuasive messages, [role] modelling and dissonance (acting counter to one's private attitude) (Fleming and Levie, 1993). Research indicates that persuasive messages put across face-to-face are more effective than through mediated communication (including CMC), and that active participation and interaction produces more attitude change than passive reception of information (ibid). For these reasons face-to-face 'traditional' learning is preferred under ideal situations – especially as the opportunity for the practice of attitudinal objectives should exist. E-learning can represent persuasive messages and allow role modelling, through the use of video. Where e-learning has some potential limitations is in the realm of skill practice (for example - practising safe driving behaviours), and the ability to

support dissonance – which is essentially in the realm of student – student interaction, or student – facilitator interaction, and is best through direct unmediated communication.

Current Instructional Methods

Another primary learning task consideration is the current instructional method being used, or the instructional method that would be preferred if the learning was being delivered through traditional means. Some instructional methods can be more easily represented than others within an e-learning environment, and some are more suitable for conversion. Instructional methods that are characterised by a high degree of unmediated (direct) student-student, or student-facilitator interaction (for example role-play, or team training) may well have dependencies related to attitudinal objectives, or skill practice that relies on a group or team.

Learning Task Attributes

Learning task attributes cover issues such as the requirement for training on real equipment, the need for physical practice, the need for social interaction or the need for teamwork.

Learning Environment Availability

Learning environment considerations concern the availability of real equipment for training purposes, the availability of the real practice environment or the requirement for instructional delivery in a controlled or non-hazardous environment. These factors positively predispose e-learning or simulation depending on what needs to be represented and what type of interaction is required.

4. Grouping strategy considerations

Converting conventional classroom training to e-learning involves altering how the students are organised - transforming delivery from group delivery to an individualised strategy, where each student has the opportunity to work individually with the learning material. The grouping strategy determines part of this consideration; is an individualised strategy appropriate for the content, organisational context and learners?

There are many potential delivery benefits from moving to an individualised strategy, these are the potential for: (1) remote delivery, (2) on-demand or just-in-time delivery, (3) flexible delivery, (4) self-paced delivery and (5) adaptive delivery. From the organisation's perspective there may be advantages in an individualised student grouping – these concern resolving issues or inefficiencies with existing student grouping, primary considerations include instructor availability, ineffective/insufficient class size, very large class size, availability of trainees or the irregular arrival of trainees over time.

The potential advantages of individualised delivery can be seen in flexibility of delivery; highly appropriate for widely distributed student populations, the irregular arrival of students over time, just-in-time or 'on demand' delivery, training content that is to be used in multiple contexts or training delivered to both Regular and Reserve Forces. Moving to an individualised strategy allows the learner to interact more directly with the instructional materials, and allows the physical separation of students from the learning facilitator. Maintaining the necessary instructional interactions generally requires CMC in some form.

Self-paced and adaptive delivery, resulting from an individualised strategy has many advantages to the learner. Primary positive factors include; the accommodation of a wide range in learning rate, skill level or experience within the student population, and delivering different content for different job roles. The ability to stop and 'rewind' content is also critical in some situations. Potential negative factors involve dependencies on group dynamics these include: a requirement for face-to-face demonstration, learning practice and correction under close observation, requirement for human role modelling, forms of co-operative/competitive learning that necessitate face-to-face contact and learning that is dependant on group-problem solving.

Some learning tasks, such as teamwork and leadership demand a group learning strategy – as without it, there is no ability to practice what is learnt. This is not to say that certain forms of e-learning cannot support this, only that it would have to support synchronous CMC at the necessary level of fidelity to support the required human interactions.

Considerations such as the impact of (potentially) separating students from their peers, or separating a learner from a human instructor should be considered. Student characteristics have a strong influence on this and will be considered in the next question area. The learning context usually imposes practical constraints on which grouping strategies are possible – for example with a widely dispersed student population one is restricted to synchronous or asynchronous virtual classrooms or e-learning courseware.

5. Learner characteristics

Learner-intrinsic characteristics play an important part in media selection. Do the learners have the necessary

skills, experience and characteristics to make e-learning an appropriate media choice? Many students will be familiar with individualised learning and self-directed learning from school, and increasing numbers will have encountered some form of e-learning and CMC previously.

Many learner characteristics can be accommodated through the design of the instruction itself – matching language to the reading ability of the students for example. However there are some critical entry skills (literacy and ability to operate a computer) which may need additional training provision prior to the adoption of e-learning.

Motivation

Student motivation is a key student characteristic and can have a very significant impact on the success of an e-learning programme (Allen, 2003). In a non-mandatory context adoption and completion of e-learning may also become an issue.

E-learning requires self-directed, engaged learners - while instructional design plays a key role in preventing learner boredom, student motivational factors should also be considered. Some learners may require mentoring or a dedicated supervised learning centre to motivate and support them. The wider 'learning culture' of an organisation is also critical in supporting e-learning.

The wider instructional management environment and management strategy characteristics can have a strong mitigating influence on some of the negative implications caused by learner motivational issues. Student mentoring and student support/supervision considerations are critical to offset these potential issues is less motivated and less self-directed learners.

6. Media attributes

Media attributes have been discussed in some detail previously - in summary it refers to the characteristics of training media that determine the type of instructional experiences that can be supplied to the learner. E-learning with its support for a wide range of embedded media – video, animation, and sound - makes it very well equipped for transmission of information. The provision of designed interaction within the instructional medium also allows for a good level of interaction with the instructional materials.

The support for collaboration tools/CMC enables support for learner-learner interaction and learner-facilitator interaction, which helps substitute for the (potential) removal of a human facilitator. There are positive and negative learning implications for transferring from a direct, to a computer mediated form of communications, which are outside the scope of this paper. The quality of the instructional experience (independent of message) deriving from interaction is determined by: (1) The type of stimulus can be sent and received (text, audio, video etc.) (2) The media quality of that stimulus (frame rate, audio quality etc) (3) Whether the stimulus is synchronous/asynchronous.

It should be noted that new potential dependencies are introduced with CMC – these include:

- Are learners be able or confident to use this form of technology? (student factors)
- Is the organisation equipped to support this form of activity? (instructional management)
- Cost factors (learning context factor)
- Will the network support the required bandwidth? (learning context factor)

7. Instructional management considerations

The basic consideration is whether the organisation is able to integrate e-learning efficiently within the wider training system, and operate, maintain and evaluate e-learning solutions over a number of years.

Introducing e-learning brings about changes to how courses are developed, supported and managed. There are many cultural and organisational enablers that will help to improve the effectiveness of operation of a piece of e-learning, post-delivery. Changes in the role of the instructor, potential learner isolation, potential changes to a highly regimented training environment (which can follow if you are going to allow students to learn when and where they like) and alteration in the details of training administration and evaluation are all factors that can be addressed by a clearly defined instructional management strategy for e-learning.

INTERDEPENDENCE OF DECISION FACTORS

The seven key areas are highly interdependent, the key dependencies as illustrated in Figure 5. The learning task is the primary driver, both grouping strategy and media attributes are driven directly the requirements of it. It should be noted that e-learning does not necessitate an individualised learning strategy - the synchronous virtual classroom (SVC) is an example of a group (grouping strategy) supported through CMC technologies providing the necessary transmission of information and support for interactions (media attributes). Support for skill practice through interaction is a critical consideration and necessitates external dependences if such practice cannot be

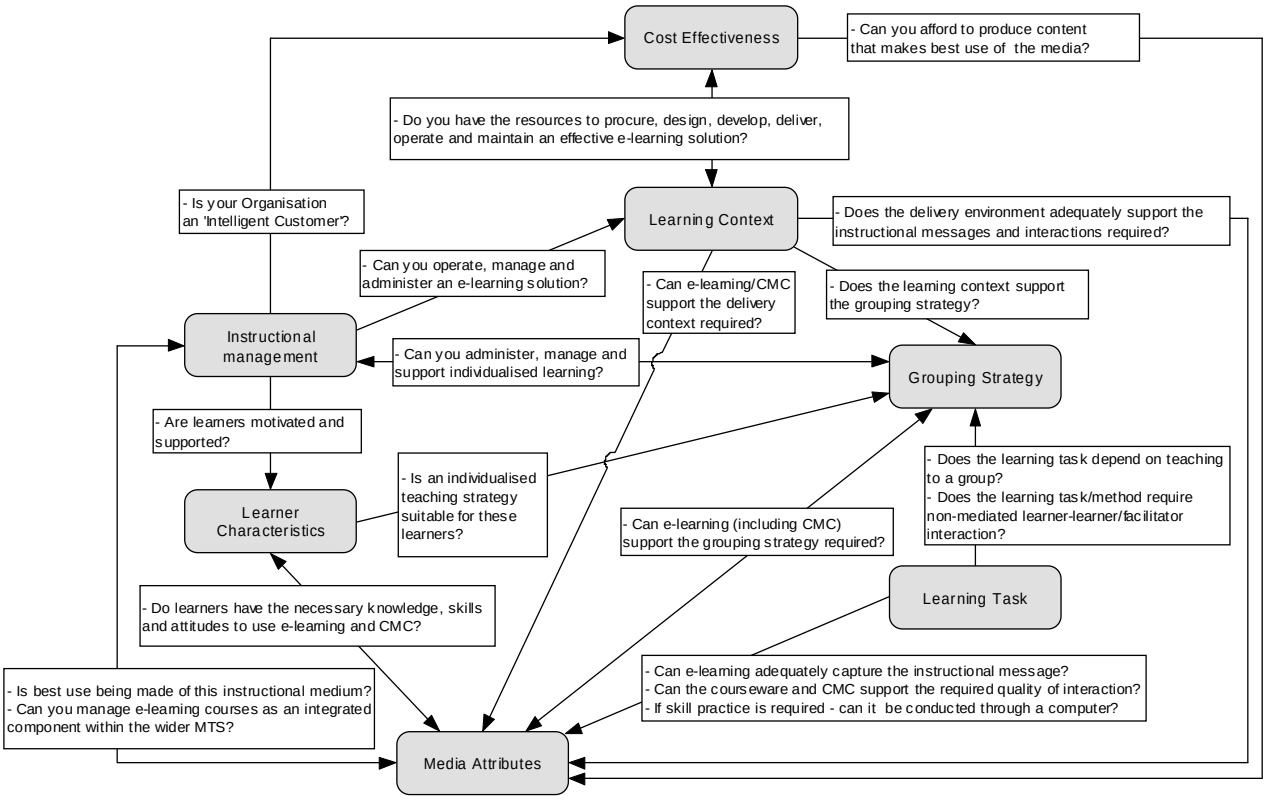

Figure 5. Media Selection factor interdependence

performed through a computer interface. Attitudinal objectives may have skill practice dependencies and in the affective domain may benefit from direct non-mediated human interaction.

Some instructional tasks by their nature necessitate a grouped strategy – teamwork is a good example. Whether direct human contact is required by the instructional task is a different matter - for example teamwork between forward air controllers and close air support pilots could be taught through CMC - provided the quality and type of interactions (including the types of stimulus) were replicated in an instructional situation.

Grouping strategy and media attributes are co-dependant – if a grouping strategy requires a form of interaction then the technology must be able to supply the required functionality. Conversely new technologies offer new potential grouping strategies.

The learning context determines both media attributes and grouping strategy – if personnel are scattered across the world, remote delivery must be supported (media attributes), if the learning is 'on-demand' then an individualised strategy is required.

The interaction of learner characteristics and media attributes means that learners must have the core skillset, motivation and confidence to use the technologies that support the instructional experience. Conversely the attributes of the learner inform design decisions in which forms of media are used (as an extreme example there is no point including text if the learners cannot read) .

Instructional management is co-dependant with grouping strategies used within the organisation – required grouping strategies impact on course scheduling, instructor numbers, the role of the instructor and types of student support provided. Once instructional management is configured for a specific form of delivery, there will be a degree of institutional inertia that will predispose grouping strategies that the organisation can most effectively support (i.e. if the organisation has classrooms there will be a natural tendency to deliver instruction through them).

Instructional management competencies will drive the adoption of particular forms of learning while new forms of learning (especially when driven by centralised policy) will necessitate new skills, processes within instructional management. In these situations a degree

of change management is required. Instructional management also ensures that best practice is followed in mapping sound instructional design principles to the advantages offered by new forms of technology.

Instructional management has an impact on learner characteristics – both in terms of the entry requirements for courses, and student selection. The messages sent out by instructional management have a critical impact on student motivation and reflect the organisations support (or lack of it) for certain forms of learning (for example, being expected to do e-learning in one's own time, while doing a classroom course in work time). The integration of different forms of learning in this context is critical – as an example giving an early completer of a piece of self-paced learning 2 days extra guard duty as a reward, because course scheduling doesn't allow for anything else, might send out the wrong message.

Cost effectiveness and instructional management meet in the procurement and development of a training solution. Effective instructional management in this context means that the organisation is an 'intelligent customer', and only proceeds with e-learning when it is both instructionally suitable and cost-effective.

Cost effectiveness and learning context are co-dependant in that available resources determine whether an e-learning solution is possible (i.e. it may be cost effective, but you may not have the money or resources to procure a solution). Conversely learning context such as number of students, course lifetime, degree of content revision, support costs etc. directly feed into cost effectiveness calculations. Cost effectiveness also drives the media attributes that can be used – costs of procuring video for example, or the richness of experience that may be supported.

CREATION OF DECISION SUPPORT TOOL

The key criteria outlined in this paper were implemented into a decision support tool to aid staff in the Training Options Analysis process. The evaluation output was captured, to inform the subsequent design process and to identify any potential risks and recommend mitigation or avoidance action through design decisions. Where e-learning must be supplemented with other forms of instruction or external practice, or if a particular instructional task recommends a particular mix of embedded media or form of delivery, the dependencies and recommendations are clearly identified.

The overall structure of the model was based on a number of positive, negative and neutral factors to consider in each criteria rather than attempting to create an arbitrary weighted scheme based on points. Some factors are "show stoppers" no matter how positive other factors may be – for example if you don't have the budget, don't have the time or don't have computers to deliver the training through, it doesn't matter how positive any other factors are. This is not to say these issues are insurmountable – only that the constraint has to be removed before the project is possible. Other factors can have a significant cost or risk impact, these include projects which are have intrinsic dependencies such as the development of physical equipment proceeding in parallel with the training.

The user initiates the process by conducting an approximate costing in the cost-effectiveness section. Course production costs are roughly estimated from duration of course with a few variables to determine costs per deliverable hour (based on the authors' personal experience of developing and procuring defence e-learning). This rough estimate is intended to set the 'upper limit' for what a solution might cost, and allows projects which are obviously not cost effective to be eliminated from a more detailed consideration.

The user then works through the remaining six "instructional factors" areas of the decision tool. This is an interlinked set of classified criteria in each section. Answering a question in one section may transfer a requirement to a different section, as an example a very low potential learner motivation score (learner characteristic) will suggest specific instructional management remedies.

The tool is driven through pull down lists, checkboxes and radio buttons – feedback for each item is presented alongside the question and outlines potentials design implications or external dependencies that may impact on a solution.

The toolkit uses a colour coding system – green for positive factors, yellow for neutral factors, orange for mitigatable/avoidable issues and red for factors that are potential showstoppers. The summary screen summarises the factors considered in a single printable 'stop-light' table, with additional factors exposed in each individual decision area.

The toolkit has been evaluated by a range of SMEs within the three armed services to ensure its content validity, and is now being trialled by a number of typical users to evaluate its usability. We anticipate these trials and accompanying data analysis to be complete over the summer of 2005.

CONCLUSION

The aim of this piece of work was to provide guidance on the suitability of e-learning as a training medium for elements of military training, The target audience was experienced military training specialists who may not have detailed knowledge of e-learning but were required to make decisions on media selection.

Following a review of literature and Defence standards, and consultation with military SMEs, the following seven key decision factors for the selection of e-learning were identified: cost effectiveness, learning context, learning task considerations, grouping strategy, learner characteristics, media attributes, and instructional management. Each of these factors were rigorously analysed to yield a set of detailed questions which could be asked to develop a detailed picture of the properties of an e-learning proposal. A number of "show stoppers" were identified, such as financial constraints, which could significantly affect the viability of a proposed project. Significant interconnections between factors also emerged, such as the connection between the nature of the learning task and the grouping strategy.

A set of interconnected spreadsheets were developed to facilitate the capture of all the essential data necessary to make a decision about the suitability of e-learning in a given context, whilst ensuring that key relationships between factors were not overlooked. A final summary sheet captured the essence of the data. The response to this decision support tool has been very positive and it is currently being trialled by a sample of users.

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