E-learning Instructional Design Guidelines

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1 Introduction

These guidelines are intended to help support best practice in implementing an e-learning solution within UK Defence, which is instructionally sound, and makes best use of the advantages offered by e-learning as an instructional medium.

This document is intended to be used by instructional designers, and project managers to support best practice in instructional design as it applies to e-learning solutions, and enable a quality assessment of an e-learning solution according to an objective set of criteria in a number of distinct areas.

1.1 External Dependencies

This document does not stand alone and is meant to support "Production guidelines for SCORM" which outlines the UK Defence interpretation of the ADL SCORM e-learning specification. Related documents are the DSAT quality standard (DSAT QS 001:2003), DTSM5 (Technology Based Training Solutions), and DTSM4 (Evaluation of Training). All of the recommendations within this document are fully in alignment with these quality standards and best practices, and are referenced to external documents where necessary.

A related document "E-learning project management and documentation guidance", covers a recommended e-learning design process and documentation set to ensure best practice and potential standardisation of internal e-learning documentation. The recommendations within "E-learning documentation guidance" are fully in alignment with DSAT QS and the other service documents referred to above.

1.2 Document Contents

The primary focus of this document is 'instructional design guidelines for e-learning'.

This document is split into the following major sections:

- The fundamental components that facilitate learning are defined and discussed, as are the differences between learning, reference materials and instructional materials.
- The characteristics of e-learning are discussed with reference to other instructional media.
- Key learning task considerations for judging the appropriateness of e-learning for a specific training objective are given.
- Principles underpinning effective e-learning are discussed.

- The principle disciplines within e-learning design and development are defined, as are the overlaps between them.
- A framework for e-learning evaluation is outlined.
- A set of recommendations for e-learning materials is given.

2 Learning, Instruction and Reference Material

2.1 Learning

Before looking at e-learning we need to define what learning is, and what its characteristics are. Learning is defined as follows:

Learning (*noun)*
- the process of acquiring a modification in a behavioural tendency by experience (as exposure to conditioning) in contrast to modifications occurring because of development or a temporary physiological condition (as fatigue) of the organism; *also* - the modified behavioural tendency itself.

(referenced from dictionary.com)

Another way of describing this, is that learning is any change in behaviour not simply ascribable to growth or a temporary physiological condition. Learning may be intentional or unintentional, in the case of intentional learning the learning process may be supported by what is termed instruction (it should be noted that instruction is not the only way of supporting the intended facilitation of learning).

Learning is an internal human process and not an external object, document or file. Learning is a process experienced by the learner and not something that is 'done' to them, though these internal learner processes may be supported and facilitated by external processes and products. As an example of intentional (but unsupported) learning, one can learn to drive between two points by trial and error. Learning to do this may be facilitated and supported in a variety of ways. A map for example may accelerate and enhance the learning process. A map would fall into the category of a job or performance support aid, or would be described as learning support material. Eventually the driver will learn a number of routes (and hopefully will no longer get lost); at this point the map will no longer be needed to support navigation across town.

The learning process may also be supported by a designed process called instruction.

2.2 Instruction

Instruction is the intended facilitation of learning toward identified learning goals.
(Smith and Ragan, 2005)

Instruction may be formally designed or informal – informal learning is generally unstructured, may not be supported by formally designed instructional products and may not be assessed. While much informal learning may be effective (such as one student informally explaining a concept to another student), it should be supported by formal assessment.

What determines whether formally designed instruction is suitable or not, generally depends on the importance of the learning objective, and the consequences of learning failing to take place. Effective learning may, or may not take place "informally" and without congruence between formally stated objectives and assessment, one has no way of assessing if:

1. Student learning has taken place

2. The quality of the instruction given to the student is adequate

In this sense, the uncertainty of the degree of student learning and of the quality of instruction that is inherent in informal learning, makes it unsuitable as an exclusive type of instruction for a military context. One of the reasons the Defence Systems Approach to Training (DSAT) was adopted, was to put in place a formal assurance framework for UK Defence training, and 'formalise' instruction so that instructional process and products have defined quality criteria.

The 2 critical features of instruction as a designed process and product are that;

1. Instruction has intended goal, audience and context

2. Instruction has intended facilitation to that goal

To ensure that instruction is effective we need to verify that the instructional goal is satisfied by the learner, and that the instruction itself is facilitating the attainment of the learning goal.

2.3 The 3 Principle components of instruction

There are 3 principal components of instruction, these are:

1. The learning objective

2. Instructional materials - which include the opportunity for student practice through interaction

3. Assessment - which confirms that student learning has taken place

2.3.1 Learning Objective

In instructional terms, goals are termed learning objectives and there are 3 principle components to a learning objective:

Performance	–	Statement of the goal in terms of behaviour that will demonstrate learning
Conditions	–	Statement under which conditions the goal will be attempted
Standards	–	The measurable standard (or criterion) that indicates degree of satisfying the goal.

These 3 components of a learning objective ensure that the goal is verifiable. For example:

'Given ten drawings of triangles, correctly label all of them as equilateral, isosceles or scalene.'

In this example the performance description is 'label the triangles as equilateral, isosceles or scalene', the conditions of demonstration are "given ten drawings of triangles" (this in a broader course context might be 'in the classroom' or 'in the field'). The standard or criterion in this case is 'correctly label all of them'. This learning objective contains both a measurable and specific goal and specifies the conditions under which the objective is to be attempted.

2.3.2 Instructional Materials

Instructional materials have a number of principal characteristics which are discussed later, one of the main principals that underpins the design of instructional materials is that interaction is as important, as presentation of text, graphics, audio and video to the learning outcome. Interaction supports 'active learning' (or 'learning by doing') an important principle of instructional design – as interaction stimulates learner thought processes and increases retention. The characteristics of instructional materials as opposed to reference materials are discussed in Section 2.4 of this document.

Another key characteristic of instructional materials is that they contain a designed sequence of events to facilitate learning – these events are referred to as the 'events of instruction', and include: gaining attention, statement of objective, statement of pre-requisites, presentation of materials, learning guidance, performance/practice, feedback, assessment and summary (including retention and transfer). While these are generally described in the context of something that is 'done' to the student, it is more correct to consider what the learner is thinking (and doing) in these phases.

2.3.3 Assessment

Without assessment we have no guarantee that the learner has benefited from the instruction, or the quality of the instructional materials. Assessment is critical as it enables us to assess whether the instructional materials are doing their job and whether learners are learning. Both of these checks are important, as without it we have no way of assessing the effectiveness of instructional materials. The components of assessment and the broader concept of instructional evaluation are discussed in Section 7

2.4 Reference Materials and Instruction

Reference materials may support the learning process or user performance (as in help pages or 'Frequently Asked Questions'); however reference materials are not instruction, and do not have the design characteristics that instructional materials have.

Terms like 'informal learning' may be applied to digital reference materials and may be defined as a type of e-learning (such as an 'electronic book'), however it should be noted that such types of e-learning do not constitute designed instructional materials and do not conform to the standards set out in DSAT QS or DTSM best practice documents.

Key differences between instructional materials and reference materials (also known as 'informal learning', 'electronic book' or 'document repository') are outlined in the table below:

	Instructional Materials	**Reference Materials**
Statement of Objective	✓	–
Instructional materials		
Events of instruction	✓	–
Materials presentation	✓	✓
Interaction with materials	✓	–
Employs Instructional Methods	✓	–
Assessment	✓	–

In summary - while reference materials can support the learning process, they in their own right do not constitute formal instruction or instructional materials; unless they contain the features described above (these features however may be provided externally by learning support systems).

3 Instructional media characteristics

In judging e-learning a potential instructional medium it is useful to characterise the general characteristics of instructional media and then specifically the characteristics that may be supported by e-learning.

Instruction may be characterised as provision of instructional information ("stimulus materials"), and the provision of instructional interactions (Caladine, 2003). These interactions may be with learning materials, other students, or the learning facilitator. There is also what may be termed "intra-action" which can be equated to internal learner cognitive, metacognitive or affective processes (for example 'internal reflection, or 'thinking about thinking'). Intra-action may be triggered by external stimulus or any type of interaction.

Instructional media characteristics include:

1. Transmission of information via instructional materials
2. Interaction with instructional materials
3. Interaction with facilitator
4. Interaction with other students
5. Intra-action (reflection)

These relationships are summarised in Figure 1.

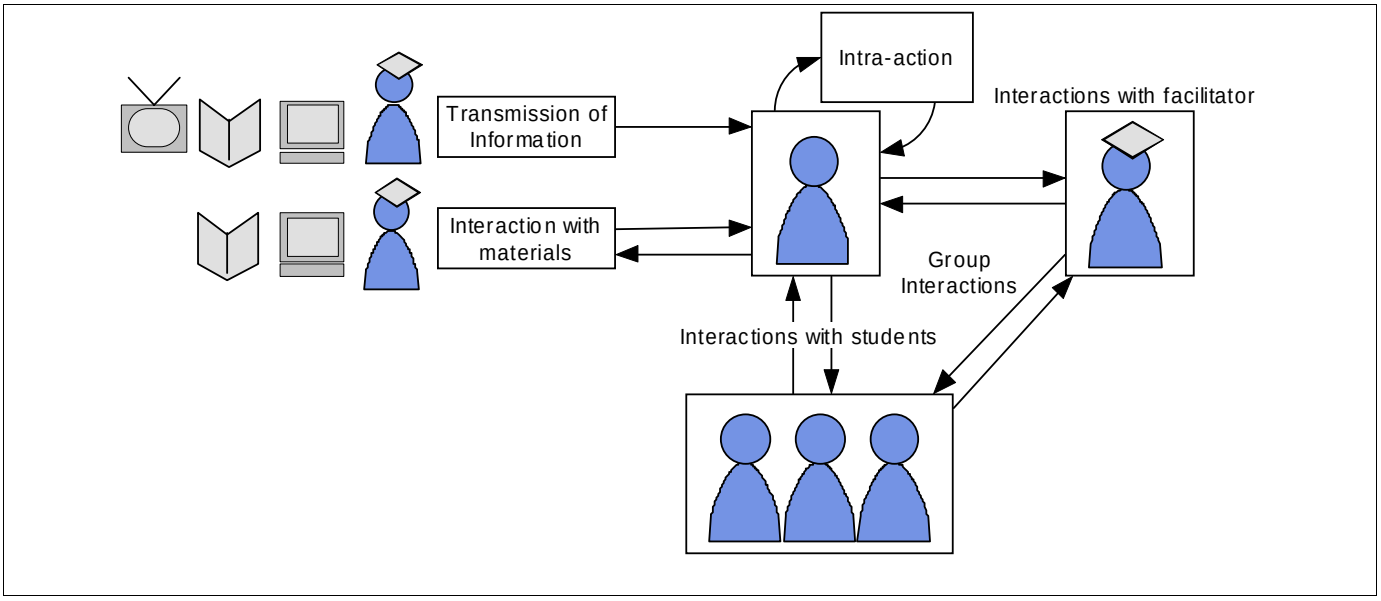

Figure 1 - Instructional Media Characteristics

In the case of face-to-face instruction in the classroom the human instructor plays a multiplicity of roles:

- Transmission of information (e.g. spoken voice and control of a PowerPoint presentation),
- In asking questions and discussing answers with the class the instructor fulfils both the role of interaction with materials and interactions with facilitator.
- The instructor as facilitator may also moderate class discussions (interactions with students) and direct student interactions with other instructional materials (e.g. workbooks).

Technology in training has a tendency to enable the functional separation of the various roles described above – for example the facilitator may be connected by email rather than being directly present. Transmission of information may be by self-paced e-learning courseware, with interaction with materials handled by quizzes within the courseware and marked coursework which is submitted on paper.

3.1 Forms of Interaction

E-learning is a highly flexible instructional medium that supports student interaction with instructional materials, interaction with other students and interactions with the learning facilitator. The types of interactions are however limited to what a standard desktop computer can supply and provide via standard peripherals (mouse, keyboard) and display technologies. It is likely in the next few years that advances in voice recognition may open up a new avenue for audio as an input channel. Learning outcomes in the cognitive domain are less impacted by this limitation than learning outcomes in the psychomotor domain - this means that we must be able to generate the conditions for practice and demonstration required by the TO (Training Objective). With TOs involving computer skills, or equipment controlled through a computer type interfaces the TO conditions can often be met. In other situations however, e-learning cannot support the conditions required, these situations are discussed in Section 4.

3.1.1 Direct and Mediated interactions

Any form of instructional interaction may be direct, or mediated through an instructional medium. As an example - as a learner you may directly interact face-to-face with a learning facilitator in a tutorial situation, or this may be mediated through a chat room facility or through other non-digital means (such the postal system in a ‘traditional’ correspondence course).

3.1.2 Synchronous and Asynchronous interactions

Synchronous interactions involve a simultaneous open communication channel between the two parties (such as a telephone call or a video conference), whereas asynchronous interactions involve the use of an intermediate store for the information being transmitted

(for example; text in an email, or paper for coursework being marked). The use of an intermediate store allows the two parties to process information at their own convenience and does not necessitate both being available to communicate at the same time.

Interactions	Direct	Mediated
Synchronous	Face-to-face conversation/ demonstration	Telephone Call Audio/Video conference Synchronous Virtual Classroom, Chat, Application sharing.
Asynchronous	—	Email, On-line discussion forum, Bulletin Board, Asynchronous Virtual Classroom, 'Telephone Tag', Post-it note left on desk.

Asynchronous interactions are always mediated and may involve paper, computer mediated communications, audio, video or any medium capable of transmitting information. An example of an asynchronous interaction with the learning facilitator mediated through paper would be a teacher marking homework. Returned homework may be handed out with a written comment (feedback) and this may be supported by verbal stimulus.

3.2 Group Size and its impact on Facilitator and Student interaction

3.2.1 Interaction with facilitator

The degree of interaction with a facilitator is limited by the group size when using synchronous communications as illustrated in Figure 2. As the group size increases the amount of time a facilitator may spend with any student (assuming time is divided equally) declines in a linear relation. For example if a teacher is teaching a class of 5, he or she may spend 1/5th of the time with any one student, if the class doubles in size to 10, the teacher may only spend one 1/10th of the time with any single student.

Where interaction with the facilitator is asynchronous, the group size will effect the latency (delay) in interaction response. At some point a facilitator will become 'saturated' – i.e. is responding to answers as fast as they arise, beyond this point unprocessed emails (or homework in a non-digital situation) will simply start building up in a backlog.

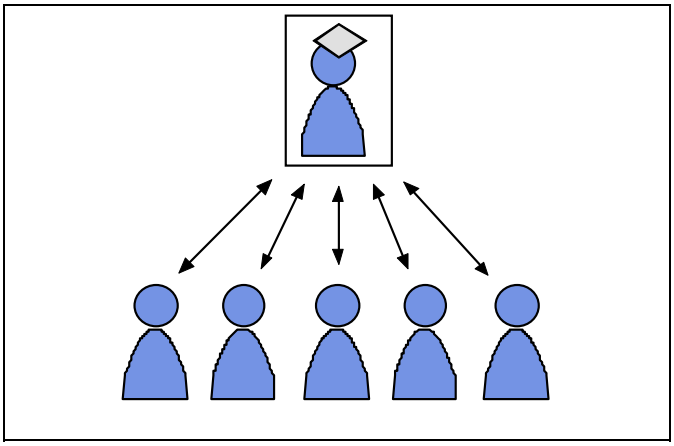

Figure 2 - Interaction with facilitator

3.2.2 Interaction with students

The degree of individual interaction within a group is negatively related to group size (i.e. the larger the group the lower the degree of individual interaction). As the group expands the number of potential interactions within the group becomes very large – with 3 individuals there are 3 potential interactions, with 12 individuals there are 66 potential interactions (the scaling of the number of interactions follows Metcalfe's Law/2). This is illustrated in Figure 3. Potential interactions = (N x (N-1)) / 2.

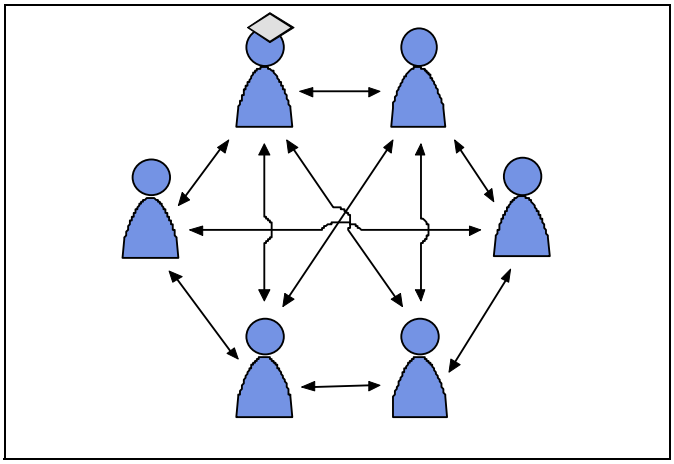

Figure 3 - Interaction with students

In the synchronous situation, at any one time only one person may be talking ('transmitting') to any other one person within the group, this means that the majority of the group are listening to a single conversation. It rapidly becomes unworkable to have a tutorial style structure with synchronous interactions, (even when supported by technology) for more than 8-12 people in a single group. There are two principal reasons for this: (1) The facilitator cannot monitor and respond appropriately to points being made in individual conversations. (2) Each conversation takes finite time, therefore there

can only be a certain number of conversations within a given timeframe (unless we allow multiple concurrent conversations). The result of this is that some individuals may say nothing, whereas others will tend to communicate more than the average. The solution to this is to split the group which has the effect of allowing concurrent conversations, but at the (potential) cost of having to add another learning facilitator.

3.3 Direct and Mediated Instructional Stimulus

One of the great strengths of e-learning is its support for a wide variety of instructional stimulus and its ability to synchronise these media together in a seamless navigable environment. Just as interactions may be direct or mediated, so instructional stimulus may be direct or mediated – as an example this is the difference between directly watching someone perform a procedure, and watching a video of the procedure. In some cases there is no real difference between watching a 'live' demo, or watching it on video – however for some tasks the ability to see the scene in 'true 3-D', to move one's viewpoint and/or change the focus of one's attention, introduces both a richness of experience and level of interactive control over the stimulus which is often not available through mediated stimulus. For some learning tasks a complete environmental experience is needed – for example judging the relationships of people distributed over a wide area.

Conversely some instructional stimuli can only be experienced indirectly – this encompasses anything that cannot be directly visualised or experienced by the learner (for example visualising how electricity flows through a system, visualising the course of a historical battle or the process of continental drift)

Instructors have relied on teaching aids such as blackboards to illustrate concepts during class teaching, and much time historically was taken up with rote copying of information. With face-to-face courses supported with digital teaching aids (PowerPoint), the student can now be given a perfect copy of the materials delivered in the class – allowing them to explore the material at their own pace.

3.4 Methods and Media Properties

The table below outlines the key properties of:

- Instructional media
- Instructional communications technology

Instructional media and communications are characterised by what they supply or support in terms of instructional characteristics. Instructional methods are based on the requirements of the instructional task, and other associated properties (such as the grouping strategy required by an instructional task). As such instructional methods define characteristics that should be supported by instructional media in teaching a task. Instructional media covers the transmission of information and (potentially) the interaction with instructional materials. As such instructional media are generally concerned with the storage of instructional stimulus and interactions (if the medium supports it).

Instructional communications technology covers the nature and method of delivering both instructional media and interactions with the facilitator, and interaction with other students. The nature of the stimulus that is transmitted and received is characterised by the type (text, audio, video). As an example a video-conferencing suite could be used by an instructor to deliver a small lecture (where transmission of information might be emphasised), or it could be used to run a tutorial where student or facilitator interaction is more important.

Instructional methods are descriptions of ways of teaching that are dependant on certain situations (for example small group size), or emphasise a particular instructional characteristic (for example student interaction). A tutorial may be described as an instructional method, however there are numerous ways of supporting a tutorial using technology – one could run a tutorial face to face, or via a video conference, or feasibly over the telephone. However, one could not support a tutorial through writing letters – the reason being that a tutorial to be effective demands synchronous group interaction which is unsupportable through writing letters (which is an asynchronous form of interaction)

Methods and Media Table

	Transmission of information (presentation of instructional materials)	Interaction with instructional materials	Interaction with facilitator	Interaction with students
Media (stored)				
Textbook/workbook (print)	Stored - Text, Static images.	Limited - looking up definitions, index, contents, internal links, answering questions, checking answers.	No	No
Audio tape	Voice, Audio.	Limited – pause, rewind, repeat and compare.	No	No
Video tape	Video, Animation, Voice, Audio Text	Limited – pause, rewind, repeat and compare.	No	No
Interactive Video / DVD	Video, Animation, Voice, Audio Text	Moderate - pause, rewind, repeat and compare, simple navigation, subtitles, multiple language encoding	No	No
Communications technology				
Face-to-face classroom	Direct voice Teaching aids (video, animation, voice, text) – Whiteboard/Blackboard, OHP, Computer Presentation Physical models and Equipment	Limited	Yes – Synchronous Direct Direct voice Teaching aids (video, animation, voice, text) – Whiteboard/Blackboard, OHP, Computer Presentation Physical models and Equipment	Yes – Synchronous Direct
Audio teleconference	Voice, Audio.	Limited	Yes – Synchronous Mediated	Yes – Synchronous Mediated
Video teleconference	Video, Voice, Audio	Limited	Yes – Synchronous Mediated	Yes – Synchronous Mediated
Web-based	Stored - Video, Animation, Voice, Audio Text.	Yes	Yes – via computer moderated communications	Yes – via computer moderated communications

	Transmission of information (presentation of instructional materials)	**Interaction with instructional materials**	**Interaction with facilitator**	**Interaction with students**
Computer moderated communications – includes • Email • Bulletin boards • Threaded Discussion Groups • Chat/ Instant messaging • Audio Conference • Video Conference	Broadcast - Text, Audio or Video	No (but can be linked to)	Yes - Synchronous or Asynchronous mediated	Yes - Synchronous or Asynchronous mediated

4 Learning Task Suitability

In a military context there are many courses where a portion of the course is taught in a classroom (theory), but other components are practical and have to be practiced 'in the field', in a workshop, laboratory or in other situations which have external constraints that make them unsuitable for e-learning conversion.

The limitations of e-learning to act as an instructional medium for certain Training Objectives (TOs) are generally characterised by the conditions of demonstration of the training objective, or by the required training method not being supportable within e-learning delivery. For example; one cannot use e-learning as a total solution to teach or assess golfing ability, as the types of interaction required and the conditions of demonstration are not supported within e-learning without going down the route of a golfing simulator. This is not to say that e-learning (or a book or video) does not have a role to play in developing golfing ability; but that to really get better at golf one has to actually hit a golf ball with a golf club. Similarly, the real environment is needed to assess a student's golfing ability.

The key consideration is the type of interaction involved. Maintaining the power pack of an armoured vehicle will require a high degree of psychomotor interaction with the equipment; whereas operating a keypad of a radio is primarily a cognitive skill (one doesn't actually have to press the buttons for real to learn to operate it). The primary consideration is what the TO requires (and defines) as the conditions of demonstration.

It is outside the scope of this document to discuss the 7 primary decision criteria that inform a decision to convert a course to e-learning (these being Learning Task, Grouping Strategy, Media Attributes, Learner Characteristics, Instructional Management, Learning Context and Cost Effectiveness). However it is useful to summarise the primary characteristics of a learning task (i.e. the training objective) that lead to it not being amenable for treatment by e-learning.

The 6 primary questions that need to be considered are:

1. Does the TO require the operation of computers, or use of equipment controlled through an interface?
2. Does the TO require interaction with equipment?
3. Does the TO require direct interaction with external environment?
4. Does the TO require physical/psychomotor practice?
5. Does the TO require human communication to generate practice conditions?
6. Does the TO require direct human interaction or leadership/supervision of others?

There are also less commonly encountered considerations which rule out conventional e-learning – these include as a need for gustatory, olfactory or haptic feedback, or

interaction with external objects which are not strictly equipment in the conventional sense (such as working animals), but which fulfil an equivalent role.

When considering a learning task envision what conditions of demonstration would be required by the TO.

Example – Cross cultural soft skills training

For example, there are many cases of cross-cultural communication skills being taught through e-learning, in these examples the user is placed in a virtual scenario (usually including video and audio) and is presented with a situation where a number of preset answers are offered. The user works through a form of 'conversation' with a computer represented respondent, where the system has pre-scripted reaction to previous student answers given.

Now consider the same situation being role-played face-to-face with a member of that cultural group – the same instructional situation could be presented, but with both parties able to gauge tone, body language and facial expressions.

The e-learning example is more practical to deliver (and probably cheaper), and has the ability to record the time to answer questions and the options selected – however as an instructional method it is more distantly removed from the real situation or environment where the skill will be used. The method of interaction used in the e-learning situation (clicking on buttons with preset speech snippets) is a surrogate for the real mode of interaction, which is spoken word, with all of the associated non-verbal forms of communication. Likewise, in the e-learning example, the user only has to *recognize* the correct answer forms, whereas in a live role-play scenario the user would have to *recall* the correct answer form - which is a different level of memory. In a real skill application situation there is an issue because the cues that prompt recognition may be absent, and so transfer to the real environment is not guaranteed.

While not detracting from the usefulness of the e-learning example given above, in this example we can see that it only takes us so far down the road to the real skill transfer, we therefore need to aware of what measurable performance outcome we require, what exactly we are teaching, and what is practical in the situation.

The critical point for consideration is the conditions of demonstration of the TO. Many subjects have theory and practical components and one will generally find that theory TOs are more amenable to e-learning conversion as they deal with learning outcomes in the cognitive domain (facts, principles, concepts, procedures, problem solving). The decision logic that is applied to the answers to these questions is shown in Figure 4.

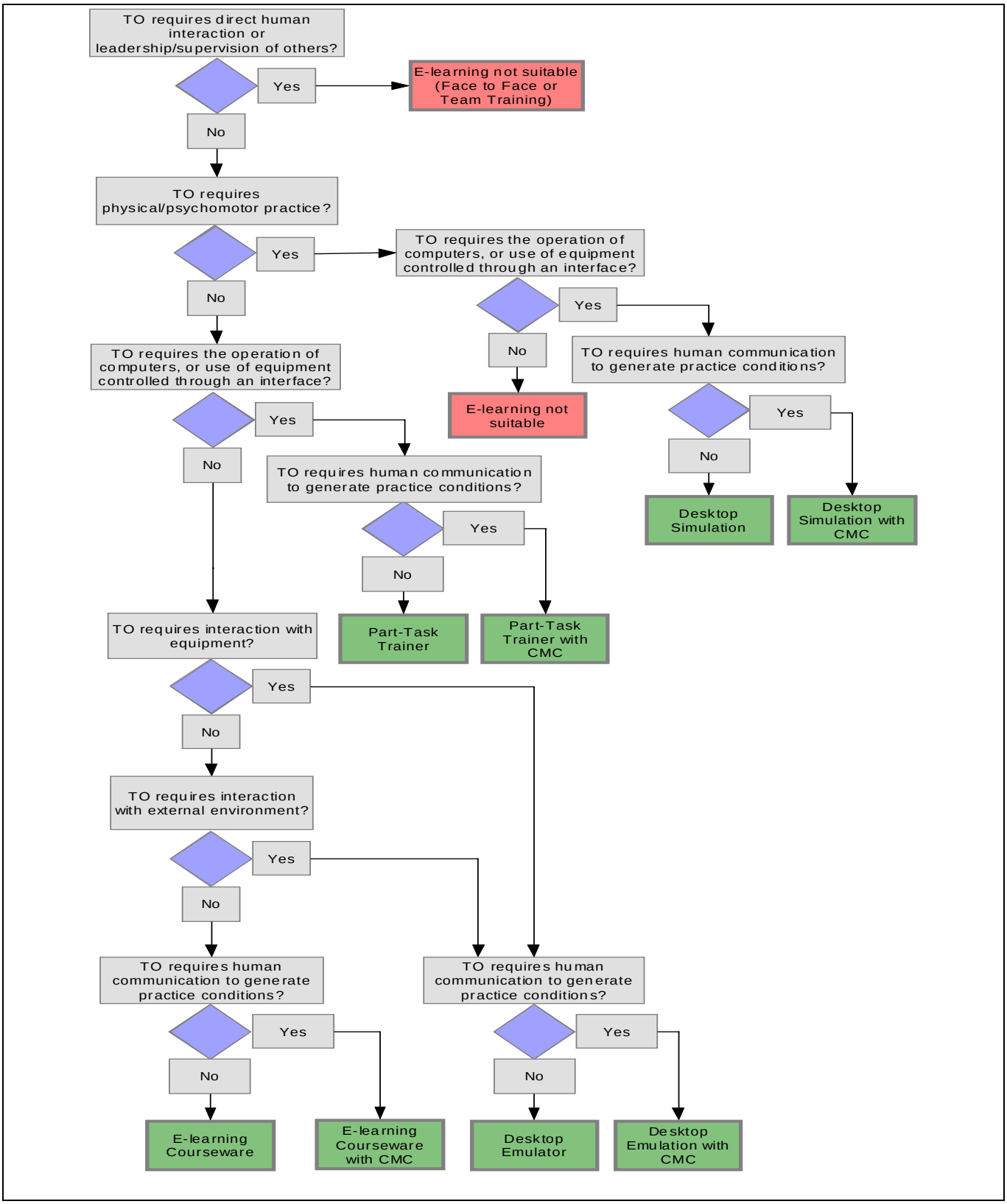

Figure 4 - Assessment of suitability of Learning Task to e-learning

Characteristics that make a TO unsuitable for conversion to e-learning, can be split into several areas which may overlap. Primarily these concern a TO dependence on direct

face-to-face human interaction or a dependence on psychomotor skill practice that cannot be handled through a PC interface.

1. The first question is whether the TO requires direct human interaction or leadership/supervision of others. 'Direct' in this sense refers to the fact that the interaction cannot be mediated by technology such as video conference delivered by computers, or by the telephone - it must be 'face-to-face'.

   Direct human interaction may be with the learning facilitator or other students and includes both communication and physical interaction or demonstration. There are a number of causes for this dependency – the instructional method may require it to generate conditions for instruction or practice, or it may be required by the TO itself. Gaming is an example of an instructional method which may depend on human interaction, which may have to be direct. Instructional methods such as role-playing, group problem solving, or role-modelling (used in attitudinal objectives) all tend to require face-to-face contact.

   Alternatively there may be a dependency on social interaction that must be direct (i.e. face-to-face), these may include situations where role modelling or cognitive dissonance is to be generated (such as learning outcomes in the affective domain), or where skill practice/demonstration depends on a face to face experience – such as verbal examinations for languages where inflection or pronunciation is being assessed.

   In other situations such as the development of interpersonal skills or team training, the situation may require face-to-face contact. Teamwork may be involved in either conditions of the demonstration of the skill (i.e. the TO itself requires teamwork), or alternatively teamwork may be involved in generating the instructional method required to teach the skill (such as in a gaming exercise or role-playing). Whether teamwork can be supported within an e-learning context depends on the instructional task, the nature of the interaction between the members of the team (i.e. is communication inherently mediated or direct), and the stimulus sent and received. Two examples – teaching small unit tactics for fighting in built up areas and fighter control training. In the first example, training requires the real situation or an adequate life-sized mock-up; whereas the interaction between a fighter controller and pilot could be handled more easily through a computer environment as the members of the team are not co-located in the 'real' environment and communications between them is inherently mediated by communications technology.

2. The second primary question is whether the TO requires physical or psychomotor practice (i.e. is a psychomotor skill). If the TO does involve psychomotor practice, the next question becomes; 'can this practice be handled through a computer interface?'

   TO's involving computers and equipment controlled through a standard computer interface (keyboard, mouse and possibly joystick) can generally be supported through a PC interface. The dividing line that defines what e-learning can support in this area is slightly blurred - as one could start adding non-standard peripherals

and display technologies (3 linked screens for example, or a non-standard keyboard) and start to move into the realm of limited simulation. However, psychomotor skills not involving computers (e.g. practicing karate, trauma surgery etc.) cannot generally be taught through e-learning because of the limitations on practice and feedback which cannot be handled via a conventional computer interface.

If the TO does involve computers, or equipment that can be simulated through standard PC interface devices then desktop simulation is appropriate. We could conceive a situation where pilots were taught how to fly Unmanned Aerial Vehicles if the interface and visual cues can be replicated within an e-learning context at an appropriate level of accuracy.

Once we have eliminated direct human interaction dependencies or non-computer mediated psychomotor dependencies, we are in a situation where we must select the most appropriate form of technology supported types of instruction. It should be noted that there is a blurring between where one type of technology supported instruction ends and where another starts. The 3 remaining flavours of technology supported instruction are:

1. Part-Task Trainers – these are used in non-psychomotor skill situations where operation of computers or equipment through interfaces is involved. Tasks are generally procedural and skills either cognitive or perceptual (or both). It should be noted that due to a lack of physical/psychomotor dependency the interface concerned could be replicated 'on screen' rather than through directly replicated physical inputs, though where possible these should be replicated.

2. Desktop Emulation – is used in situations where the TO requires interaction with equipment (not including computers, or equipment interfaced through computers) or the external environment. Because these interactions are non-psychomotor they are cognitive or perceptual. Emulation is characterised by a trade-off in physical or functional fidelity. Emulation represents a higher degree of abstraction of a situation or environment than a part-task trainer which are differentiated by the closer alignment of interface technologies. For example one could teach map reading given a suitable engine to replicate the environment, or features in it. The actual control mechanism for walking could be abstracted into mouse or keyboard controls that would move the character in the environment, and allow reference to maps, compasses etc. Emulation requires forms of stimulus provision, interaction and gaming that are generally of a complexity or sophistication that sets them apart from courseware.

3. Courseware – is used in situations where there are no dependencies on equipment, environment or computers (one could characterise part-task trainers with courseware as 'conventional' e-learning).

A lack of availability of equipment/environment, or equipment/environments which are hazardous, (or involve great cost) may be simplified for some of the training to ensure that hazards and costs are minimised. In such situations some form of technology supported instruction can be considered as part of the instruction continuum, but should

not ultimately replace the conditions of demonstration in the real environment (or as close as possible to the real environment).

5 Effective e-learning

The design of any form of instruction is to some extent a mixture of art and science – as such there is no set prescriptive formula that can be followed, if only because of the variety of instructional goals, contexts and students. This said, there are some general principles that should be considered when developing e-learning, just as there are certain reactions that we would wish our students to have when studying these materials.

These considerations are concerned with what the student should be thinking, feeling and doing when conducting the e-learning course, these are often expressed in structural terms as the features that the instruction should contain – however, one should remain focussed on the actual purpose of these instructional features, which is to affect an experience within the learner.

The features below will generally be found associated with effective e-learning. While listed under separate headings, there are significant overlaps between them.

5.1 Learner Engagement

For the learner to learn, they must be engaged with the e-learning, this means that it must gain and hold their attention, and direct attention to the most important parts (and therefore not distract them), while at the same time not compromising instructional quality. Engagement however is not sufficient on its own, but does provide the vehicle to make all of the other components possible.

5.2 Learner Motivation

Learner motivation is absolutely essential in e-learning. In an e-learning context learners are potentially; working in isolation, not necessarily under direct supervision, and learning in an environment where there are distractions (such as learning in the work place). Without learners choosing to learn or being self-directed, the learning is unlikely to be completed, or if it is it will have been a negative experience. Motivation can be thought of as “energy to learn”, it helps the learner by providing the reason to focus on the materials beyond the initial introduction. Motivation is centred on the learner seeing some concrete benefit or interest in the materials, this in turn helps the learner to filter the information. Motivation also supports the process of directing the learner’s attention and helps recall.

Well designed, engaging e-learning with a clear focus on job-performance and job-context, external learner support and management support - all boost motivation and make a successful learning outcome more likely.

5.3 Contextualised Content

Learning materials need to be based around meaningful goals and job tasks which are expressed in practical language. The learner should not be straining to see the relevance

of the materials to what they do or might be doing. Contextualised content is directly relevant to the learner and is practically situated – the application environment for the materials should be obvious at all times.

5.4 Meaningful Interaction

Interaction is not navigation, nor is it browsing or scrolling. With navigation one is merely controlling the flow of information, instructional interaction is directly connected to the content and involves the user in thinking, making choices and reflecting on the consequences and feedback from those choices. Instructional interaction can be defined as follows:

"Instructional interactivity is interaction that actively stimulates the learner's mind to do those things that improve ability and readiness to perform effectively" (Allen, 2003)

Good instructional interactivity has 4 components:

- it offers genuine challenge and opportunities for practice to the learner and is based on application of learning rather than rote regurgitation.
- it is strongly aligned with the job context (which is what makes the interaction meaningful to the student),
- the activity is easy to perform functionally and strongly associated with the learning task,
- lastly the feedback should be specific to the learner's response and consequences of interaction should be context related and emphasise correct or incorrect features of the response (i.e. reinforce the underlying learning points).

5.5 Support for Retention and Transfer

Retention and transfer of learning are supported where:

- a close association is made with prior learning
- learning materials are presented according to a learner centric approach (for example focussing on the elaboration of job goals or problems, rather than an elaboration simply based on the structure of the content)
- opportunities for consolidation and reflection exist
- assessments are performed
- metacognitive strategies are encouraged

6 Principle e-learning disciplines

Instructional design is one of the principal disciplines within e-learning design and development (the other disciplines being Subject Matter Expertise, Digital Media Design, Programming and Project Management):

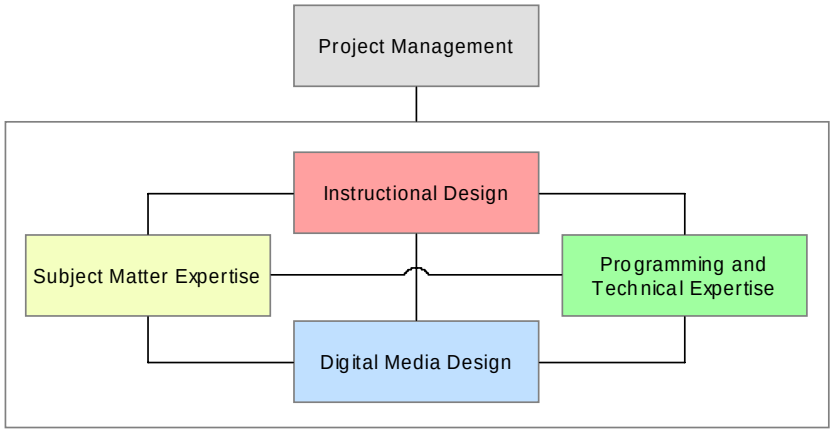

Figure 5 - Principal disciplines within e-learning

While Figure 5 shows these components as separate disciplines there is a high degree of interaction between them. All of these core disciplines interact to some extent, and all must be present for the best possible learning experience to be delivered to the user. A defect in one area can easily affect another area, such as a technical bug or problem impacting on the instructional experience.

The components and interactions between these areas are described below:

Instructional Design (instructional design) is defined as “the systematic and reflective process of translating principles of learning and instruction into plans and products for instructional materials, activities, information resources and evaluation.” (Smith and Ragan, 2005). Instructional design is concerned with the design of the instruction that facilitates the students’ learning process.

6.1 Instructional Design

Instructional design defines the objectives and the application (learning transfer) environment, selects the appropriate subject matter for the course, contextualises it to the audience and situation, sequences it appropriately and ensures congruence between objectives, learning content and interactions and assessment.

Instructional design impacts on the efficacy of the final instructional project from every perspective; structural, cognitive, contextual, motivational, and from an overall quality perspective.

From a structural perspective instructional design is responsible for the definition of learning objectives, determination of session length, establishment of curricular taxonomy and establishing the course sequence, structure, inter-linkages and dependencies.

From a cognitive perspective, instructional design presents and supports the users' cognitive strategies that are invoked by instructional information and interactions – example cognitive concerns involve the degree of cognitive support that should be provided ('scaffolding') and the size of the instructional components delivered ('chunking').

From a contextual perspective instructional design transforms, selects and applies the original source material to the specific instructional situation for the particular audience in mind. In this situation instructional design establishes the congruence between learning objective, instructional materials and assessment. Instructional content is contextualised to audience – teaching plate tectonics to undergraduates is different from teaching it to 8 year olds – though some of the base information might be similar (a map of the 'circle of fire' in the pacific for example). The contextualisation of content is also needed to ensure that the subject matter is applicable in the transfer environment (i.e. where the learning outcomes will be realised in the external world). Instructional design also creates the learning activities and interactions that are specific to the task and audience.

Instructional design is also critical in motivating and supporting the user through the learning process and is critical in assuring the final quality of the instructional product through a clear statement of quantifiable programme goals, student assessment and evaluation of the final instructional product.

6.2 Subject Matter Expertise and Subject Matter Content

Subject matter expertise and subject matter content is the second major discipline within e-learning. Subject matter expertise is usually supported by external reference information ('content') – such as technical manuals, checklists, instructional videos and other media components. Content is the starting material that feeds the instructional design process. Although content is sometimes viewed as the raw material for instructional design, it should be noted that most content is contextualised to a particular purpose, audience and application environment. Most reference content will need a degree of instructional interpretation to transform content into useful and appropriate learning materials.

Subject matter expertise is much more valuable than pure reference content, as human expertise also embraces knowledge of context (i.e. where this information is applied), audience (who uses it) and purpose (what is the wider purpose or significance of this information), in addition to a detailed knowledge of the reference information itself. It should be noted that subject matter experts may also have considerable expertise in the teaching of the subject which will include:

- awareness of key learning points

- a detailed awareness of context (both of learning and learning transfer environments)
- audience considerations from an instructional design perspective
- specific teaching strategies that have been effective in the past

Subject matter experts may also have some experience in Digital Media Design from the preparation of classroom delivered learning materials, using tools such as PowerPoint.

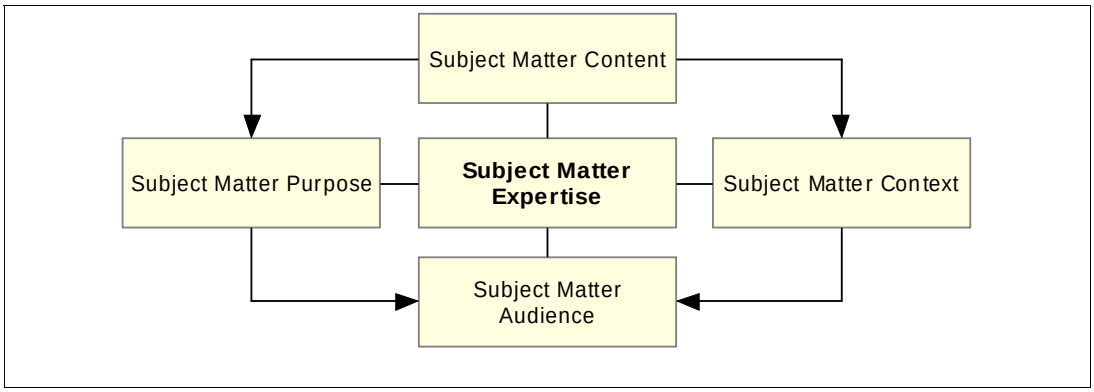

Figure 6 - Subject Matter Expertise

6.3 Digital Media Design

Digital media design is concerned with the "Look and Feel" of an application, both from the perspective of the:

1. Instructional information and instructional interactions

2. General interface these elements are embedded in

The aim of digital media design (which includes terms such as 'Content Design', 'Media Design', 'Interaction Design' and 'Interface Design') is to create a simple, clear, integrated, intuitive 'look and feel' for both instructional content and interactions, and the broader interface (which includes items like navigational controls).

The general colour scheme, typography and the style in which graphics and controls are presented is referred to as the 'treatment', this together with the layout (the placement, size, and shape of items on the screen) determines the appearance of the integrated whole to the student.

Digital media design is a discipline where specific software program competence is supported by an awareness of good underpinning design principles.

6.4 Programming and Technical Expertise

Programming and technical expertise is foundational in that e-learning as a discipline is totally dependant on what the technical environment can support in terms of user experience. Programming and technical expertise goes beyond ensuring an error-free,

high performance user experience – it also is concerned with issues that impact on maintenance and operation of an e-learning solution (i.e. how the solution has been constructed, how easy it is for training staff to update learning materials themselves and how instructional materials can be located and recombined).

Programming and technical expertise also is concerned with learning standards and specifications (such as SCORM) and the operation and delivery of a piece of e-learning in a wider environment (the DLP). The assignment of metadata falls within this discipline, but is also dependant on instructional design, subject matter expertise or digital media design depending on the type of metadata in question, and its intended function.

Programming competence is specific to a particular application or technology, though certain common principles and concepts are shared in programming. Some tools, such as Flash are used by both designers and programmers, so in some situations there is no clear cut division between digital media design and programming. This said development personnel will usually be stronger in either the media design or programming aspects.

6.5 Major Areas of Overlap

The four main disciplines that comprise e-learning are all heavily interdependent on each other – and it is essential that project managers have an overall appreciation of the impact of one requirement in another area.

6.5.1 Instructional Design and Subject Matter Content

Instructional design and subject matter considerations are highly overlapped, but co-dependant. Without instructional design there are no defined learning objectives, no alignment of information with objectives, no selection of relevant content (and no removal of irrelevant content), no emphasis of critical points, no instructional interactions or learning activities, no assessment, no awareness of context, transfer environment or audience. Instructional design is to subject matter information, what a course on car restoration is to a Haynes car manual.

Without subject matter content there is no starting point for the instructional design process, or source of material to reconstruct to facilitate learning. Without subject matter expertise it is more difficult for instructional designers to interpret subject matter – especially where the subject is ‘applied’. For example; one could find a section in an aircraft manual on lighting, but without learning objectives we have no awareness of what the significance of a piece of knowledge is (the light might be so bright as to be hazardous, or might by its materials need special procedures or equipment to maintain) - one cannot generate instructional materials without learning objectives. In some situations even with well defined instructional objectives, the alignment of subject matter with objectives is not always clear cut - this is why subject matter expertise is critical in helping instructional designers in the instructional design process.

Certain subjects may be considered to be shared by instructional design or subject matter expertise, depending on the knowledge of the individuals and the specific instructional

situation. These areas include knowledge of how the subject matter is applied in real situations or what the application area is (for more conceptual subjects).

6.5.2 Instructional Design and Digital Media Design

The connection between instructional design and digital media design is absolutely critical as it is digital media design that expresses the messages contained within the instructional design. It is also essential that digital media design does not obscure any potential learning points. As an example; if it is critical for a learning point that the learner sees all of a particular diagram at once, the digital media designer must not place the image in a scrollable box, just because it doesn't fit within a specified sized image frame - as this will not satisfy the instructional requirements.

Digital media designers need to have a good awareness of the key messages being expressed and the best way to facilitate them. This may range from briefing a cameraman on the best shots to take in a particular scenario, to the best method for illustrating flow through a system in an animation.

Appropriate media design also covers the controls associated with media elements (e.g. scrolling controls, VCR type controls), as well as navigation controls which take the learner from screen to screen, controls that enable interaction with the learning content itself and controls associated with assessment questions.

From an interface perspective there is a direct connection between the structure of the course and the interface controls required to move from section to section. It is impossible to design the 'look and feel' for a piece of e-learning without having an awareness of the controls that are required, this in turn requires knowledge of course structure and functionality that the user needs. Instructional design determines these features, so indirectly influences interface design.

At the most basic level, digital media must be capable of delivering the instructional stimulus and interactions specified by the instructional design. If a teaching point requires a moving image in colour, then digital media must provide this. This is where the role of programming and technical expertise is involved – if the operating system of the target hardware doesn't support the plug-in required, or if bandwidth is too narrow then the user experience will suffer or worse the file may not playback at all. In some cases the situation is less clear cut – for example will a highly compressed image or sound file (of poorer quality) be sufficient to make the instructional point required?

6.5.3 Instructional Design and Programming/Technical Expertise

The interaction between instructional design and programming and technical expertise is critical in that instructional designers must understand the implications of object based learning from the contextual aspect (i.e. the need to create self-contained, standalone objects). Conversely programmers must understand the instructional requirements of the course (for example the need to track the answers to every question individually, or the need for remedial branching) as this has an implication as to how the course is structured at a technical level.

6.5.4 Subject Matter Expertise and Digital Media Design

The shared concerns of subject matter expertise and subject matter content and digital media design are mainly connected with issues of moving from one form of media type to another. Moving from print to screen does far more than change the viewable aspect ratio of an image.

Challenges of converting a high resolution static image on paper to an image on screen (which is much lower resolution), may need digital media designers to make modifications and be selective with what is represented. An interactive environment also makes it possible to conceal labels on diagrams, or pull up close-ups – which otherwise couldn't be accommodated on screen all at the same time.

Subject matter experts must be aware of media conversion issues and be prepared to take best advantage of the new medium, while minimising the disadvantages - just as media designers must engage with subject matter experts and information in a way that best captures the essence of the message.

6.5.5 Digital Media Design and Programming/Technical Expertise

Digital media design and programming and technical expertise meet in a number of ways – the technical environment (screen resolution, colour depth, playback hardware, bandwidth etc.) will all act as constraints to what can be done with digital media design. Digital media design may be delivered through Flash (which may require a plug-in), or streaming media such as 'Real Player' or 'Windows Media Player', so an awareness of what the technical environment can support is essential. Bandwidth has a large impact on how animations play back and how quickly pages load, in this respect programming and technical expertise considerations may (for example) specify an upper size limit for files, which may impact on how long an animation is, or how compressed a specific image must be. It is essential that such issues are understood at the outset to avoid costly rework.

Navigation and other technical functions that are linked to digital media design are shared areas of interest for both disciplines – usually digital media design specialists will do basic programming tasks to ensure pages link, and design/develop the interactions within the page/screen. The technical lead may construct the overall course and ensure that data is passed between the learning application and the Learning Management System (the DLP in this situation) correctly.

6.5.6 Subject Matter Content and Programming/Technical Expertise

This is the least significant overlap as Subject Matter Content issues are largely mediated through instructional design and digital media design, and their interactions with the technical sphere. As an example if we have 3 hours of source video (content) to place on a CD-ROM, we will make some decisions regarding digital file compression/encoding (programming and technical expertise), frame-rate or window size (instructional design/digital media design) and which sequences are selected (instructional design).

One area where programming is significantly involved in subject matter content is where complex interactive programming is required to replicate systems behaviour – such as in complex scenarios or part-task trainers that are simulating system behaviour.

7 E-learning Evaluation

Instructional Evaluation is thoroughly covered in DTSM4 and there is no point repeating information that exists elsewhere, the following section outlines one interpretation of DTSM4 from an e-learning perspective.

The following checklists cover the DSAT training evaluation Stages 1-4 as outlined in DSAT QS001:2003.

7.1 DSAT Stage 1 – Training Evaluation Strategy

DSAT Stage 1 - Training Evaluation Strategy	**Source**	**Comment**
	DSAT QS	**Mandatory Requirements**
E-learning falls under the umbrella of the DSAT Quality Standard	[Foreword] & 1.	[The DSAT QS is the minimum required QS for individual training across Defence sponsored by Directorate General Training & Education, MOD.] It is applicable to any activity, provided by or on behalf of the MOD, which has the objective of developing the knowledge, skills and/or attitudes on an individual...
E-learning will incorporate an evaluation strategy	4.3.h)	DSAT QS training shall incorporate an evaluation strategy.
E-learning will be evaluated	4.3.i)	DSAT QS training shall be evaluated for the efficiency and effectiveness of the analysis, design and delivery of training in meeting the operational/business requirements in accordance with the evaluation strategy.
The results of evaluation will be used to correct potential defects or improve the quality of e-learning	4.3.j)	DSAT QS training shall be kept current by applying the results of evaluation.
The Management of Training System will include a quality manual	5.2.1.a)	The Management of Training System (MTS) will include a quality manual.
The quality manual will include an evaluation strategy section	5.2.1.a)5)	The training quality manual will include the evaluation strategy.
The evaluation strategy will include documented procedures for the evaluation of e-learning	5.2.1.a)3)	The training quality manual will include documented procedures for the evaluation of training.

There is an individual responsible for the implementation of the MTS	6.4.2.	A member of management will have responsibility for the implementation of the MTS.
Management reviews will contain the results of training validation/evaluation	6.5.3.a)	Management reviews contain results of training audits and evaluations.
The evaluation strategy will include guidance as to which stage of evaluation to apply to a specific training activity	11.3.1.	The evaluation stages applied to a specific training activity shall be determined by the organization's documented evaluation strategy.
A decision not to evaluate e-learning will be accompanied by a rationale behind this decision	11.3.2.	The evaluation strategy shall include, when appropriate, the rationale behind a decision not to apply a specific evaluation stage.
Training needs are identified and reviewed against operational goals	11.3.3.	The evaluation strategy shall specify that training needs are to be identified and reviewed against the business/operational goals.
All relevant stakeholders are involved in the evaluation of e-learning	11.3.4.	The evaluation of training shall involve all relevant stakeholders, at the appropriate management level.
The roles and responsibilities of all evaluation personnel are identified	11.3.5.	The evaluation strategy shall identify the roles and responsibilities of all personnel involved in the evaluation process.
	DTSM 4 1.7.c	A training evaluation strategy should state: The responsibilities of the various stakeholders at each stage of evaluation
Performance indicators and Key Targets (KTs) pertinent to e-learning are identified	11.3.6.	The evaluation strategy shall include the performance indicators and KTs pertinent to training activities.
All e-learning activities are checked to see that they are necessary for operational/workplace performance	11.3.7.	Only training activities that are necessary for operational/workplace performance shall be carried out.
The results of evaluation are applied to check currency and validity of e-learning	11.3.9.	The currency and validity of all individual training shall be maintained by the application of the results of evaluation
The e-learning evaluation strategy is targeted to the needs of the business	11.3.8.	The evaluation strategy shall be responsive to and targeted at the needs of the business
	11.3.8. Note 2	Existing evaluation processes may be incorporated within the evaluation strategy.

	DTSM4	Recommendations for implementation
A e-learning evaluation strategy should state:		
Which stages should be applied to each training activity on the basis of defined criteria	1.7.a	The evaluation stages to be applied to each training activity.
The frequency and timing with which each evaluation stage should be applied	1.7.b	The frequency with which each evaluation stage should be applied.
The sources of evaluation data to be used	1.7.d	The sources from which information will be obtained.
Where evaluation data should be recorded	1.7.e	The methods of data recording and analysis.
Who and how data analysis will be performed	1.7.e	The methods of data recording and analysis.
The types and structure of reports raised	1.7.f	The reports that will be raised.
Who will act on report recommendations	1.7.g	The staffing chain for addressing report recommendations.
All individual training (including e-learning) is subject to DSAT Evaluation Stages 1 - 4	1.9	All individual training should be subject to DSAT QS stages 1 – 4 of evaluation but stages 5 and 6 should be more focused in their application.

7.2 DSAT Stage 2 – Identify Training Needs

DSAT Stage 2 - Identify Training Needs	Source	Comment
	DSAT QS	Mandatory Requirements
Training Performance Indicators (TPIs) and Key Targets (KTs) are established and documented	6.2.1.	Management shall ensure that TPIs and KTs, including those needed to meet requirements for the trained output, are established for relevant functions and levels within the organization.
	8.1.2.a)	[The organisation shall determine as appropriate:] TPIs and KTs
TPIs and KTs are articulated in performance, conditions and standards format and are measurable	6.2.2.	The TPIs and KTs shall be measurable and consistent with the training quality policy.
	8.1.2.	[The organisation shall determine as appropriate:]

Operational/workplace performance requirements are established and documented	8.1.2.a)	Operational/Workplace performance requirements
Training requirements are established and documented	8.1.2.a)	Training requirements
Evaluation activities are determined with respect to the form of e-learning and the standards required	8.1.2.c)	Required evaluation […] activities specific to the trained output and the standards to be achieved;
If e-learning is not to be assessed this is stated, with a justification for the statement	10.1.e)	If training is not to be assessed then a statement to that effect, including the reasons) for not assessing, shall be made.

7.3 DSAT Stage 3 – Student Reaction

DSAT Stage 3	**Source**	**Comment**
	DSAT QS	**Mandatory Requirements**
An after-action review of e-learning delivery is conducted and documented	10.1.f)	An after-action review of the training delivery (e.g. through post-course discussion and/or questionnaire) is carried out and documented;
Recommendations arising from the after-action review are used to shape improvements in the e-learning?	10.1.f)	Any resulting recommendations relating to the conduct of training and training content shall be considered to ensure the continuing efficiency and effectiveness of the training activity.
(Recommendations)		
Answers to questions in the following areas are being captured from the students immediately following e-learning delivery		**Notes**
e-Learning administration & student support factors		Questions in this area involve student pre-joining instructions, Learning Management System (DLP) log-on and student support considerations.
Access to e-Learning factors		Questions in this area concern learning context factors - physical and virtual access to the learning environment.
e-learning usage factors		Questions in this area cover student usage patterns - number of sessions, total time over which the e-learning was completed, interruptions and breaks taken.
Technical performance factors		Questions in this area relate to technical performance of the e-learning - speed, stability and overall technical quality.

General usability		General usability questions cover screen design, navigation design, interaction design and usability of navigation controls.
Student expectations		Questions on student expectation factors - subject matter interest, relevance, anticipated learning application and if the course held their attention throughout.
Content and instructional design		Instructional design of the content - objectives, breakdown of the content, depth of detail, context, clarity of explanation, media quality and level of interaction.
Testing and Assessment		Students reaction to testing and assessment within the course.
Overall course rating		Overall course rating - useful to correlate to other measured variables
Recommendations for course improvement		Open ended questions to capture recommendations for future improvement of the courseware.

A sample post course "Reactionnaire" is defined below:

7.3.1 Sample of Post-Course Stage 3 (Reaction) Questionaire

e-learning administration & student support	**Response Type**
I received comprehensive course pre-joining instructions	Likert Scale
I received comprehensive DLP registration/log-on instructions	Likert Scale
Help was available in resolving issues connect to DLP access	Likert Scale
Help was available in resolving issues in running the courseware	Likert Scale
An instructor or mentor was available to support the course	Likert Scale
Line management was aware of my e-learning activity	Likert Scale
Line management fully supported my e-learning activity	Likert Scale
Please add any other comments here:	Open field
Access to e-learning	
It was easy getting physical access to the learning environment	Likert Scale
It was easy logging onto the DLP	Likert Scale
It was easy to access the courseware	Likert Scale
Everything required was already installed on the machine	Likert Scale

Speakers or headphones were available	Likert Scale
Support was available on encountered problems	Likert Scale
The support helped resolve the problem	Likert Scale
Please add any other comments here:	Open field
e-learning usage	
At what location did you undertake the e-learning course?	Checkboxes
I completed the course	Yes / No
In how many sessions did you complete the e-learning?	Pull-down List
Over what time period did you complete the e-learning? (elapsed days from first log-on to course completion)	Pull-down List
What was the estimated course duration? (total number of hours spent in front of the computer)	Pull-down List
Approximately how often did you take breaks?	Pull-down List
Was an instructor physically present when you completed the e-learning?	Pull-down List
I was able to go at my own pace	Likert Scale
I was free from interruptions during the e-learning	Likert Scale
I was allocated work time to take the e-learning	Likert Scale
The allowed time was sufficient for the program content	Likert Scale
Please add any other comments here:	Likert Scale
Technical performance	
The courseware ran quickly on my machine	Likert Scale
The courseware ran without any technical glitches (e.g. stuttered video, black areas of the screen, or voice and text on screen out of synch)	Likert Scale
The course never crashed or 'froze up'	Likert Scale
Please add any other comments here:	Open field
General usability	
The screen layout was clear	Likert Scale
Text on screen was legible	Likert Scale
The navigation controls were explained	Likert Scale

The controls were straightforward to operate	Likert Scale
It was easy to navigate around the course	Likert Scale
It was easy to return to pieces of content already viewed	Likert Scale
I never accidentally exited the DLP or courseware	Likert Scale
Please add any other comments here:	Open field
Student expectations	
The course was consistent with my expectations	Likert Scale
The course is known to be a difficult course	Likert Scale
The subject-matter of the course was interesting	Likert Scale
The course held my attention	Likert Scale
This course is relevant to my job	Likert Scale
I anticipate using what I learnt on this course	Likert Scale
I would be confident in applying what was learnt in the course	Likert Scale
Please add any other comments here:	Open field
Content and instructional design	
Course and session objectives were clearly stated	Likert Scale
Course sessions were well structured	Likert Scale
The breakdown of content within the course was logical	Likert Scale
The content of the program was at an appropriate level of detail	Likert Scale
The content of the course was presented in the right context	Likert Scale
The content was presented and explained clearly	Likert Scale
The content was up to date	Likert Scale
Still images were of good quality	Likert Scale
Video and animation were good quality	Likert Scale
Content sequencing was logical	Likert Scale
There was a high degree of interaction within the course	Likert Scale
The interactions within the course were meaningful	Likert Scale
There was enough opportunity for skill practice	Likert Scale
The length of the course was sufficient for the course	Likert Scale

objectives	
I feel I achieved the overall course objectives	Likert Scale
Please add any other comments here:	Open field
Testing and Assessment	
Was the courseware formally assessed?	Yes / No
The test instructions were easy to understand	Likert Scale
The mechanism for answering questions was straightforward	Likert Scale
The assessment was fair reflection of content covered in the course	Likert Scale
Notification of whether test results were recorded (or not) was given	Likert Scale
I was informed as to how the test results were used	Likert Scale
There was post-test feedback	Likert Scale
Please add any other comments here:	Open field
Summary	
Overall course rating (out of 5)	Radio Buttons
Please list 3 recommendations to improve this course	Open field
Please list the 3 things you disliked about the course	Open field
Please add any other comments here:	Open field

7.4 DSAT Stage 4 – Student Learning (Assessment Strategy)

DSAT Stage 4	Source	Comment
	DSAT QS	**Mandatory Requirements**
		[Where assessment has been identified as a requirement.] The organisation shall ensure that;
e-learning is subject to assessment		Assessment is not a mandatory requirement, however the decision not to assess should be documented and should be in accordance with the organisation's evaluation strategy.

A decision not to evaluate accompanied by a rationale behind this decision	11.3.1	The evaluation stages applied to a specific training activity shall be determined by the organization's documented evaluation strategy.
This rationale determined through criteria defined within the evaluation strategy	11.3.2	The evaluation strategy shall include, when appropriate, the rationale behind a decision not to apply a specific evaluation stage.
Trainee assessment results are recorded with pass/fail criteria?	10.1.e)3)	Records of trainee assessment results are established and maintained to show clearly whether the trainee has passed or failed the assessment according to the criteria specified by the assessment strategy and assessment specification;
Pass/fail criteria is specified by an assessment strategy and assessment specification?	10.1.e)3)	Records of trainee assessment results are established and maintained to show clearly whether the trainee has passed or failed the assessment according to the criteria specified by the assessment strategy and assessment specification;
Remedial actions are defined in documented procedures	10.1.e)4)	Appropriate remedial action, including reassessment of students deemed to have failed, has been instigated in accordance with documented procedures;
Assessment Strategy	DTSM4	Appendix P
The overall aim of the assessment strategy is stated		
The types of tests to be used are described		
Entry standards are stated		
Entry formative tests are outlined		
Summative tests are outlined		
The tests criterion referenced or norm referenced		
There is a failure policy		
There is a maintenance record for test results		
Assessment Maintenance		
Instructors can update tests, and test questions to help prevent assessments being compromised		
Training documentation clearly links criterion referenced questions to the relevant TO/EO,		

to enable training/assessment maintenance		

8 Recommendations for e-learning materials

This section outlines a set of best practice 'quality' guidance criteria for e-learning materials that are to be delivered through the DLP. This guidance covers the attributes of the final instructional product and is split into a number of discrete areas.

8.1 General Principles

Development of e-learning materials for UK Defence should:

1. Conform to what is mandated by DSAT QS001:2003
2. Assessment and Evaluation strategy follows best practice recommendations in DTSM4 (as summarised in this document)
3. Follow the specific technical criteria of the UK Defence interpretation of SCORM ('DSCORM'); outlined in DSCORM producers guidelines and DTSM5.
4. Follow DLP Upload procedures
5. Be in alignment with any service or unit or school quality manual or specific service requirements (for example Army SAT PAM8 or similar)
6. Utilise the principles of good e-learning;

    - learner engagement
    - learner motivation
    - contextualised content
    - meaningful interaction
    - support for retention and transfer

8.2 Instructional Product Characteristics

8.2.1 Access to e-learning

- Support, help or other forms assistance are provided to students accessing the e-learning course. This may include:

    - using a browser
    - logging onto the LMS
    - accessing the course components
    - using Computer Moderated Communications (CMC) technologies (such as chat, bulletin boards, email) which are used or invoked in the course

- The student is provided with contact information to:
    - obtain technical help during the course, or to report technical problems
    - contact the course facilitator, or tutor to report problems or submit queries with the instructional content of the course
- Minimum hardware specifications are stated, to include optimal screen resolution and colour depth, required and optional peripherals (e.g. speakers/headphones) and bandwidth.
- Required software components such as browser version and potentially non-standard plug-ins required (such as Acrobat Reader, Flash Player, Media players).

8.2.2 Course Introduction

- A technical check is made of user settings and hardware/software specification, where these are not suitable for course playback the user is informed of the problem and suitable remedial action recommended.
- The overall goal and purpose of the course is stated.
- The intended target audience for the course is stated.
- The performance outcome for a successful completion of the course is stated.
- Course pre-requisites are stated.
- The course assessment strategy is stated, which includes details as to:
    - formative and summative testing
    - storage and use of results
    - remediation strategy
    - course failure policy
    - tutorial support policy
- Required materials to accompany the e-learning are stated (this could include training performance aids, books or documents, calculators or other tools).
- If audio is used - a statement as to whether all of the course content is presented through text (transcript button or similar) is given.
- An outline of the course is given to include:
    - Structure of the course, including the breakdown of the amount of time to complete (including the breakdown of offline study periods if applicable)
    - How this course will benefit them

- How to:
  - navigate the course
  - use navigation controls and configuration features (e.g. sound volume, glossary, help, setup)
  - answer questions and exercises
- Study guidance or advice / 'Getting the best from the course'

8.2.3 General Course Architecture

- The 'access to learning' and 'course introduction' (sections previously outlined) should be perpetually available throughout the course. [Access to learning will probably exist outside the course structure to avoid redundancy, but should still be accessible from within the course.]

- Learning is constructed in modular elements centred on clearly articulated learning objectives.

- Adaptive learning:

  - The learner controls content sequencing (topics can be view in any sequence)
  - The learner controls content presentation speed
  - Access to learning support is not constrained
  - The learner may repeat sections as required prior to undertaking summative assessments
- Instructional units are organised such that the user can bookmark and return to the last previously visited unit

- Learning events are clearly and closely coupled to the learning objectives and are sufficient to allow the learner to reach the learning objective.

- Learning materials are designed around learning sessions of 15-40 minutes delivered duration (shorter is generally better)

- The learner will have the amount of time for an instructional unit indicated (preferably before they start the unit)

- Learning sessions will be designed to be as self-contained as possible given the constraints and dependencies of learning objectives. External dependencies and linkages (including web-links, use of external materials etc.) should be minimised except where currency of information takes primacy.

- The general events of instruction are contained within a single learning session. This includes at a minimum;

  - Clear statement of objective(s)
  - Overview of instructional materials
  - Recall of prerequisites/context setting
  - Optional [Pre-tests] [Recall and refresher questions from previous sessions] [Other forms of reinforcement of prior learning]
  - Delivery of instructional materials (instructional content and instructional interactions/activities)
  - Provision for learning practice or formative assessment
  - Session summary
- Within the course there should be congruence between learning objectives, instructional materials and formative and summative assessment (i.e. each objective is supported by instructional content and interactions, and is assessed)
- Summative assessment is sufficiently detailed to ensure the learner has achieved the learning objectives.
- [Where glossaries are employed the user can access them from any point of the course]

8.2.4 Learning Objectives

- Goals and Objectives of each session are clearly stated
- Goals and Objectives can be referred to at any time during the course
- Learning objectives are articulated in terms of performance statement, conditions of demonstration and criteria (required standard)
- Applicability of learning objectives to users' job role is clear

8.2.5 Instructional Content

- General:
  - Instructional content is directly relevant to learning objective (and job role where applicable)
  - Layout of information on the screen was simple, clear and free from clutter
  - Visual elements within the screen are well separated with adequate white space (this is used to separate different functional areas of the screen and allow the user to clearly distinguish between screen elements)
  - Instructional materials are accurate, current, and where necessary, referenced and copyright cleared

- The subject is written with respect to the target audience (use of terms, language, readability, clarity)

- Multimedia presentation:
  - Where possible multimedia presentation is used (for example: use text with graphics together) – with the exception of generating information redundancy across visual and auditory channels (e.g. duplicating voice over audio as text on screen)
  - Messages presented in multiple media are complementary (note: this does not mean that the messages have to be identical, one can be the summary of the other)
  - Where messages are presented in multiple media, where one media type follows another the temporal separation of media should be minimised (this also applies with feedback in interaction)
  - In presentations using multiple media, the separation of the complementary elements is minimised as much as possible
  - There are no conflicts between the information provided by differing media
  - Media is used to reduce learner cognitive load through scaffolding (reinforcing, supporting and summarising instructional content to support learner cognitive processes)
  - Media is used to cue retrieval on previously presented topics (reinforcement)
  - The learner is not distracted or confused by having to focus on two separate areas of the screen simultaneously.
  - The learners' attention is focused on the section of the screen that must be attended to
  - Media control mechanisms are standard, simple and consistent across the course – and allow the user the degree of control that the instruction requires
- Text:
  - Lists and other visual organisers are used to reduce dependencies on large quantities of text on screen
  - Lines of text do not exceed 60 characters including spaces
  - Instructional materials are free of bias, discriminatory or defamatory material
  - Instructional materials are free of spelling, punctuation and grammatical errors
  - Acronyms and abbreviations are consistently represented and explained in full where first used
  - Capitalisation is consistently applied to titles, acronyms and units

- Links:
    - Where applicable references, ‘further reading’ or other information sources may be provided to support the learner.
    - Instructional materials are free from broken links. A feature exists within the course to report broken links and bugs
- Audio, Video and Animation:
    - Animation is restricted for instructional content, and the background is free of distracting images or animations
    - Audio is recorded such that background noise is minimised
    - Voice quality is sufficient to understand speech clearly (voice playback is not muffled or distorted)
    - Sound may be turned on or off, and the volume control is accessible immediately from within the course
- Playback:
    - The application is runs without error, technical bugs or features
    - Playback on the stated target platform is error-free and provides the necessary conditions of instruction. This will include:
        - Video/Animation plays without stutter or dropped frames at the stated bandwidth, audio remains synched with the video images
        - Screens/Pages load quickly, where required plug-ins are absent - automatic prompts for installation is provided (if this facility is supported)
        - All text characters and symbols render correctly on playback machines
        - Text is readable at the stated optimal screen resolution (considerations include size of text, contrast with background, choice of font and spacing)
        - Images and diagrams are legible at the recommended screen resolution

8.2.6 Instructional Interactions

- The learner is actively mentally engaged with the instructional content through instructional activities.
- Instructional materials contain meaningful interactions (this may be interaction with the materials, interaction with the facilitator or interaction with other students).
- Interaction is focussed on learning content, and should cause the learner to reflect on learning content. Interaction (wherever practical) should directly involve the

learning content rather than being mediated through standard interface elements ('windows buttons' etc.).

- Interaction should be focussed to allows users to gain confidence that they are learning and reinforces content presentation through active manipulation.

- If remote student interaction is required suitable Computer Moderated Communications must be provided. Formal student interaction, required by learning objectives should be focused on the learning objective and should be moderated as appropriate.

- Asynchronous student interaction with learning facilitator should occur within predefined time windows and latency periods (i.e. where email support is given for courses, the service period and reply period should be outlined).

- Collaborative Learning:

    - Collaborative learning through computer moderated communications technologies should be designed with expected student concurrency in mind
    - Anchor learner collaboration in formal assignments
    - Organise learners into groups of 2-4, where groups are of mixed experience or ability
    - Do not allow groups to self select members (follows from the point above)
    - Require group deliverables to be concrete products or process outcomes
- Interactions that support learner practice should:

    - Accurately reflect the context of real world skill application (for example applying the skill in a real job situation)
    - Should explain what the reason for the interaction is (why the learner is doing this)
    - Where complex or extended, be broken into sub-components
    - Be interspersed through the instructional session as opposed to concentrated in one particular section of a session.
    - Follow a designed elaboration strategy - for example should build from simple to complex, or may support skill practice with worked examples prior to scenario based learning.
    - Should feature reinforcement, or multiple examples
    - Should include examples as to where the learning might be applied.
    - Should be paced to allow learner reflection and consolidation
- Assessment questions are to:

  - be constructed in such that the mechanism for answering questions is straightforward
  - be focussed on testing knowledge through application to a [job] relevant task (and avoid the student simply 'parroting' the information back in a rote fashion)
  - cover areas and learning objectives that have been previously taught
  - be pitched at a suitable level of difficulty for the audience
  - be clearly worded (i.e. avoid negative constructions)
  - have clear instructions as to how to answer
  - question constructions should be varied, and suitable for the type of question being asked (e.g. if in a question one or more answers are true – the question construction should be a multiple select multiple choice)
  - employ plausible distractors, with no 'trick' distractors
  - be programmed to prevent invalid questions answers
  - give the learner the opportunity to change their mind (this is normally achieved through a <confirm> button or similar which is pressed following question answering)
  - where questions or assessments are timed this is to be clearly stated at the beginning, and an indication of elapsed or remaining time to be displayed
- In formative assessment questions, feedback is to be:
  - Specific to the users answer (where possible)
  - Is focussed on the learning goal
  - Preferably contain information relating to the question and the answer to stimulate user recall (this may be additional information or this may be supplied in a remedial loop)
  - Comprehensive and suggest a further cause of action to the user (if applicable)

8.2.7 Elaboration Techniques

- The structure of learning materials presentation follows an accepted elaboration strategy which is learner centred (for example elaboration of work goals) or content centred.
- The elaboration or 'unpacking' of information is logical.
  - Simple to complex
  - Addition of rules to a system
  - Whole – Part –Whole presentation sequence
- Scaffolding (learner cognitive support) is provided, as appropriate

- Chunking breaks content into 7±2 chunks of information

8.2.8 Intra-action (Reflection) and Metacognition

- User internal reflection should be encouraged.
- Self-questioning skills should be developed.
- The user should be encouraged to develop metacognitive strategies for retention and retrieval (such as keywording, mnemonics etc.).

8.2.9 Extended Learning Support

- Where the e-learning course continues over an extended period of time appropriate learning support from an e-tutor/e-facilitator is provided.
- Where terminology is not defined in the course a link or reference should be provided. Links should be described and periodically checked for continuing validity, the user should have the ability to report broken links.

8.2.10 Navigation and Usability

- Menu structures should be 'shallow and wide' (i.e. have a few levels but with many selectable items at each level) in preference to 'narrow and deep'.
- The user is protected from accidentally exiting the course (to the maximum extent possible)
- Each screen should ideally have a unique title
- The position of the learner within:
    - a sequence of screens within an instructional unit, should be indicated (this may be 'Page x of y' or may be indicated graphically)
    - the overall course, should be indicated (this may be through a course map or exposed hierarchical menu or similar)
    - [Optional] time remaining to complete the instructional unit may be provided (the utility of this is dependant on the degree of variation with in the student population)
- The status of instructional units (not started, started, completed) should be clearly visible to the learner.
- Clear signposting should allow learners to keep track of where they are in the course, course structure should be fully exposed to the user.

- Navigation controls should be simple, intuitive and consistent in naming, behaviour and screen location placement
- In general, navigation operations should be reversible
- Controls should exist to allow the user to:
    - Move forward and back a screen (and replay the current screen if required)
    - Move up to the menu that presents multiple units of instruction
    - Control video with play, pause, stop and volume controls
- Perpetually available controls such as help, glossary or configuration/setup should operate on a 'call and return' principle where the user is returned automatically to where they were in the course on completion of the operation (rather than forcing the user to manually navigate back to their place in the course)
- Appropriate accessibility guidelines are followed (if applicable)
- Long latency events (such as downloads and streaming media buffering) should be accompanied by indications of what is happening and how long it will take. In situations where the delay may be significant the user may be offered alternative media, and/or have the ability to terminate the event in a graceful manner.
- Scrolling content should be avoided wherever possible – and preferably restricted for embedded media (such as PDFs), rather than forming the basis for screen design – on the basis that it can potentially conceal content from the user and allow content to be missed.

8.3 Metadata

- Learning objects should include the following metadata
    - Details as to the content ownership within the organisation
    - Learning Objective reference to enable linkage with external training documentation (so that updates may be made when TOs are modified)
    - Information as to the audience for which it was designed (this informs the transferability assessment when moving a learning object to a new learning event)
    - Information on dependent Learning Objectives (and Objects) this also informs the transferability assessment, as learning objects with dependants cannot be freely transferred.

- End of Document -