



**Draft v0.9**

# Writing effective e-assessments

## Hints and tips from practitioners

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# 1. Introduction

## 1.1 The EASiHE project

This booklet has been produced as part of the e-Assessment in Higher Education (EASiHE) project commissioned by the Joint Information Systems Committee (JISC). The EASiHE project is being conducted by the School of Electronics and Computing Science at The University of Southampton. It focuses on formative e-assessment and will provide:

- an open source e-assessment repository
- services for the contribution and migration of assessment questions, tests, and peer assessments
- services for the delivery of tests and peer assessments
- documentation supporting the pedagogical design of e-assessments at higher levels of Bloom's taxonomy
- dissemination material for the wider sector dealing with institutional change using the processes of co-design and co-deployment.

### EASiHE project websites

For more information about the EASiHE project, please see the project website: http://easihe.ecs.soton.ac.uk/.

From this site you can access the project blog: http://blog.lsl.ecs.soton.ac.uk/easihe and the project wiki: http://wiki.easihe.ecs.soton.ac.uk/index.php/Main_Page.

## 1.2 Contributors

We wish to thank the following for their contributions to this booklet. Their points were gathered during a workshop held on 10th February 2010.

- Trevor Bryant, E-assignment Project, University of Southampton
- Robyn Drinkwater, Asset Project, University of Reading
- Mary Gobbi, University of Southampton
- Nikki Kelsall, Wessex Deanery
- Jenny Mackness, JISC Support Project
- Mike Wald, University of Southampton
- Roy Williams, University of Portsmouth

## 1.3 JISC/QCA definition of e-assessment

This project uses the JISC/QCA definition[1] of e-assessment:

"E-assessment is the end-to-end electronic assessment processes where ICT is used for the presentation of assessment activity, and the recording of responses. This includes the end-to-end assessment process from the perspective of learners,

[1] JISC e-Assessment - An overview of JISC activities, Version 2: July 2008. Retrieved March 2009 from http://www.jisc.ac.uk/whatwedo/themes/elearning/assessment.aspx

tutors, learning establishments, awarding bodies and regulators, and the general public."

In this booklet we use the terms 'e-assessment' and 'computer-assisted assessment' (CAA) to include feedback that is presented by computer from instructions and material pre-prepared by the author.

### 1.4 Sharing good practice

Three UK surveys of computer-assisted assessments (CAA) in higher education:

- 1993 (Stephens & Mascia)
- 1999 CAA Centre (Bull)
- 2003-04 (Warburton & Conole)

found concerns that computer-assisted assessments were easier to pass than their more traditional counterparts. However several studies have concluded that CAA is appropriate for HE generally, provided sufficient care is taken in their construction (e.g., Duke-Williams and King, 2001 p.12; Boyle et al., 2002 p.279).

This booklet offers hints and tips from practitioners on constructing effective e-assessments for higher order learning outcomes.

# 2. Intended learning outcomes

The starting point for writing an e-assessment is one or more of the intended learning outcomes (ILO) for the course. The following description of an ILO is quoted from The Report on E-Assessment Quality (REAQ).[2] The basic form of an ILO is specified below.

| |
|---|
| "The student will be able to X" |
| where X is a performance. |

**Figure 1: The form of a basic ILO**

Whether explicitly stated or merely implied, an ILO begins with a standard phrase "By the end of the course, the student will be able to...". A statement of the performance that the student will be able to undertake completes the ILO. The performance involves an ability that the student has learned, expressed in behavioural terms. This means it must be possible to observe and assess whether the student can actually exhibit the ability in question. It is exactly this feature of an ILO which makes it central to assessment and e-assessment in particular.

The statement of the performance begins with the ability and concludes with one or more measurable or assessable actions by which it can be observed that the student has learned the ability in question. The ability generally comprises a verb denoting the learned capability followed by the object or subject matter of the learned capability. Table 1 lists these basic components of an ILO along with an example of each.

| Component | Example |
|---|---|
| **ILO** | The student will be able to analyse target audience characteristics by listing those characteristics pertinent to the e-learning under consideration. |
| **Performance** | … to analyse target audience characteristics by listing …. |
| **Ability** | …analyse target audience characteristics… |
| **Learned capability verb (LCV)** | …analyse… |
| **Object (subject matter)** | …target audience characteristics… |
| **Assessable behaviour** | …listing those characteristics pertinent to the e-learning under consideration. |

**Table 1: Components of a basic ILO**

The statement of a performance in terms of an ability and assessable behaviour with respect to some subject matter content provides the minimum form of an ILO. It may be important, however, to more closely define what is intended as the learning outcome, and attention may then be given to the supplementary components of a

[2] http://www.jisc.ac.uk/whatwedo/projects/reaq.aspx

fully specified ILO: the situation or scenario within which the student needs to be able to perform; the standards of the performance; any constraints which may apply to the performance; and the use of any tools.

| Capability | Standard LCV | Assessable behaviours |
|---|---|---|
| Knows facts | Recalls | Writing, drawing, indicating |
| Knows concepts | Defines | Writing, selecting |
| Knows procedures | States steps | Writing, drawing, flowcharting |
| Knows principles | States cause-effect relationships | Writing, drawing, graphing, specifying formula |
| Uses concepts | Classifies | Writing, selecting, sorting, arranging |
| Uses procedures | Demonstrates | Manipulating, calculating, measuring, constructing |
| Uses principles | Predicts | Calculating, drawing, graphing |
| Finds concepts | Invents | Sorting, specifying |
| Finds procedures | Devises | Experimenting, analysing |
| Finds principles | Discovers | Experimenting, analysing, observing, demonstrating |

**Table 2: Observable ability verbs after Merrill**

Reference to Bloom's work identifies a rich set of verbs that can be used as required for both the learned capability and for the assessable behaviours by which that ability is demonstrated. These are shown in Tables 2 and 3 for the cognitive domain. Other verbs and formulations are available for the affective and psychomotor domains.

| | Cognitive ability | Assessable behaviour |
|---|---|---|
| **Knowledge** | Knows terms, specific facts, rules, trends, categories, criteria, methods, procedures, principles, concepts, theories. | Name, label, define, state, recognise, list, recall, identify |
| **Comprehension** | Translates and paraphrases communications; interprets, summarises, and explains relationships; extrapolates from given data. | Explain, classify, summarise, extrapolate, interpret, convert |
| **Application** | Applies concepts, principles, rules, procedures. | Calculate, solve, construct, use, prepare, predict, demonstrate |
| **Analysis** | Analyses elements, relationships, or organisational principles; analyses connections, relationships, or arrangements. | Compare, contrast, infer, explain |
| **Synthesis** | Produces new arrangement or new result. | Compose, originate, design, create |
| **Evaluation** | Judges on the basis of criteria and evidence. | Appraise, argue, evaluate, criticise, assess, discriminate |

**Table 3: Performance verbs for the cognitive domain after Bloom**

## 2.1 Formative intended learning outcomes

The EASiHE project focuses on formative assessment. For these tests Bloom et al. (1971) distinguished a hierarchy of levels of behaviour parallel to the cognitive taxonomy. It added value to the cognitive taxonomy by making it easier for teachers to identify 'mal-rules' – flaws in reasoning.

| | **Assessable behaviour** |
|---|---|
| **Knowledge of terms** | Use appropriate vocabulary, determine suitable use of terms, recall technical names for items, recognise synonyms, who, what ...? describe… |
| **Knowledge of facts** | Memorise something, recognise something, recall of information or identity, who, what, when, where, how ...? describe… |
| **Knowledge of rules and principles** | Memorise and recall a general rule, what, when, where, how ...? describe…<br>Describe interrelationships among many items, memorise and recall applications of a rule, memorise and recall exceptions to a rule, does *not* deal with application of a rule |
| **Skill in using processes and procedures** | Steps along the route to mastery, accuracy in use, expression of (justified) confidence |
| **Ability to make translations** | Put idea in own words or use new examples of what is learned, transform a term, fact, rule, principle, process or procedure from one form to another, take a phenomenon presented in one mode/form and represent it by an equivalent form/mode, move from a verbal to a symbolic form, determine when a new illustration is appropriate or not, move from a concrete to a more abstract form, or from a general to a more specific illustration, and vice versa |
| **Ability to make applications** | Recognize the essentials of the problem, use of a rule/principle learned in one context to solve a problem presented in a new or unfamiliar context, identify rules/principles/generalisations relevant to a problem, use ideas to solve a problem which is different from those previously encountered in the instruction or instructional materials |

**Table 4: Formative assessment hierarchy after Bloom**

The 'skills in using processes and procedures' category is not formally represented in Bloom's Taxonomy of the Cognitive domain but is important for assessing mastery.

The 'ability to make applications' is the most complex of the formative categories. It depends on other classifications but requires the application of ideas in new situations or to new problems.

## 2.2 Some examples of assessments for higher learning outcomes

### Testing analytical skills

This example tests a participant's ability to classify data according to specific criteria:

**Q. Which countries' statistics are being reported in A, B and C?**

| | GNP per capita 1991 ($ USA) | GNP growth p.c. p.a. '80-'91 | Pop. growth 80-91 | Total employment 1980-85 (%) | | |
|---|---|---|---|---|---|---|
| | | | | Agriculture | Industry | Services |
| A | 500 | 2,5% | 1,5% | 51 | 20 | 29 |
| B | 1570 | 5,8% | 1,6% | 74 | 8 | 8 |
| S.A. | 2560 | 0,7% | 2,5% | 17 | 36 | 36 |
| C | 25110 | 1,7% | 0,3% | 6 | 32 | 32 |

**1**. A=South Korea; B=Kenya; C=Canada **2**. A=Sri Lanka; B=Germany; C=Thailand

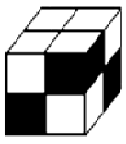
**3**. A=Sri Lanka; B=Thailand; C=Sweden* **4**. A=Namibia; B=Portugal; C=Botswana

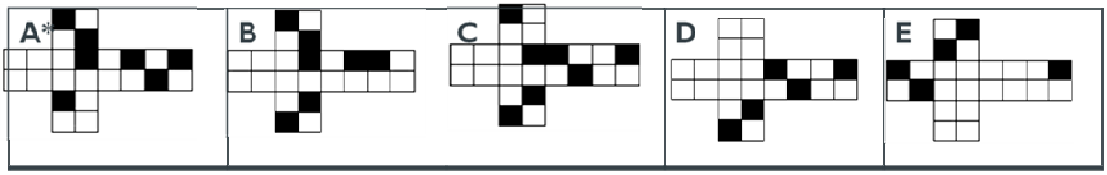
(CASTLE project, University of Leicester)

### Testing synthetic skills

Testing a participant's ability to predict/infer the 3D appearance of a 2D net. Requires the abstract abilities to accurately reconstruct solids, rotate them about three axes and combine the results with a predicted model

Q. The picture shows a cube that I have made. Which one of the shapes below, if cut out and folded, could make a cube the same as mine?






(Thinking Skills Admission Test, University of Cambridge)

### Testing evaluation skills

FACT: The number of shareholders in most large corporations has increased considerably during the last 30 years.

CONCLUSION: Control of corporations has become more democratic in the last 30 years

A: The fact is good evidence to support the conclusion
B: The fact is good evidence to disprove the conclusion
C: Neither A nor B applies clearly

(Bloom et al, 1971)

# 3. Competency

Recent work in lifelong learning, e-portfolios, and work-based learning has emphasised the concept of 'competence' or 'competency'. We interpret this concept as a 'contextualised ILO', where a learner demonstrates a learned capability in some subject matter within a context, and the context provides localisation or instantiation of what can otherwise be an abstract skill. An example comes from medical training, where the learning outcome, 'the student can undertake an appendectomy', has significantly different implications if the context is, 'at 10,000 m on a transatlantic flight in an emergency', rather than, 'in a fully equipped and staffed hospital operating theatre as a pre-planned procedure'. Other contexts include the level of mastery which needs to be demonstrated, the availability of relevant tools, the time available, and so on. A UML-oriented conceptual model of 'competence' is shown in Figure 1.

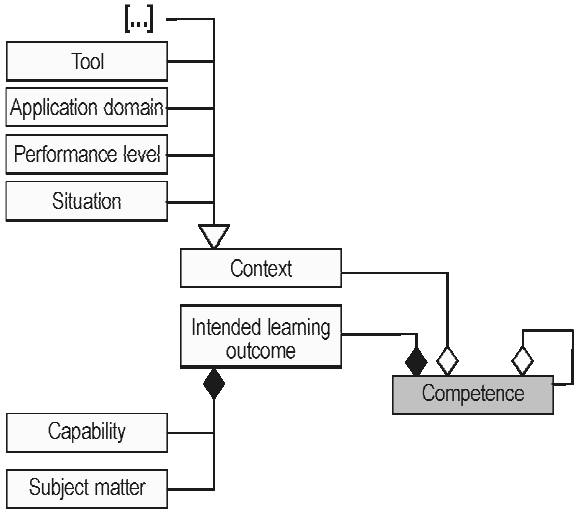



**Figure 1 Competence conceptual model**

Apart from conceptualising a competence as a contextualised ILO, the model also illustrates the idea that a competence can consist of other, usually lower-level, competences. In this case, the model describes a tree, network, or hierarchy (technically, a directed acyclic graph) of competences as being the domain of a particular course, module, or programme of study.

## 3.1 Teaching and learning

Figure 2 illustrates a network of competences as the target of learning and teaching activities, noting that some competences would typically be prerequisites for such activities.

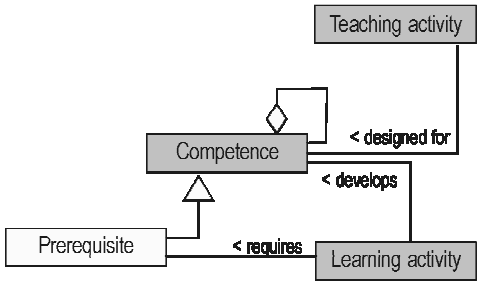



**Figure 2 Learning and teaching using competences**

Learning activities may be modelled as in Figure 3, where the learner undertakes some activity, intended to develop one or more competences, which results in an artefact that would typically be deposited or its outputs realised in an environment. In terms of an e-assessment, the learner characteristically would be demonstrating their learned capability in the competence in question, and the assessment outcomes would be captured in a technology-supported environment such as a VLE or MLE.

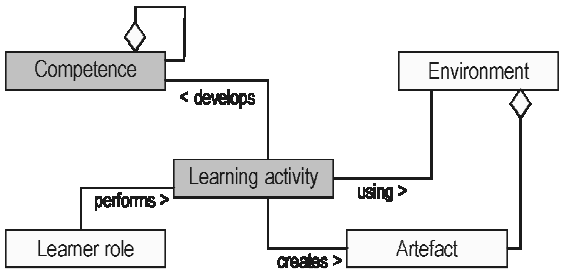



**Figure 3 Learning activities model**

Teaching activities designed to teach the competence or competences in question are conceptualised as comprising two types, as illustrated in Figure 4. One kind of teaching activity involves what might be called 'show and tell' – the presentation of information and examples – whose tangible outcome consists of teaching resources. The other kind of teaching activity involves the assessment and evaluation of learning activities, whose outcome is feedback to the learners concerned. In terms of an e-assessment, the teacher characteristically asks a question, sets a test or examination, or assigns an item of coursework as a resource, and then provides feedback to the learners on their work, where both elements are captured in a technology-supported environment such as a VLE or MLE.

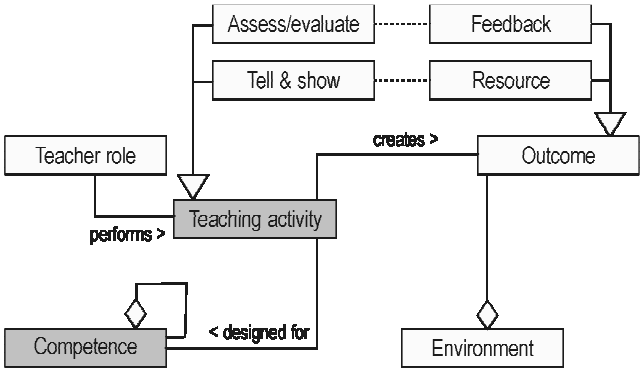



**Figure 4 Teaching activities model**

These models of the learning and teaching of competences can be assembled into the 'big picture' of Figure 5. Some of the features of this model are that it provides for a machine-processable description of learning and teaching, integrates well-established pedagogical principles with e-learning and technological support for e-learning, and provides integration and consistency with the IMS Learning Design standard.

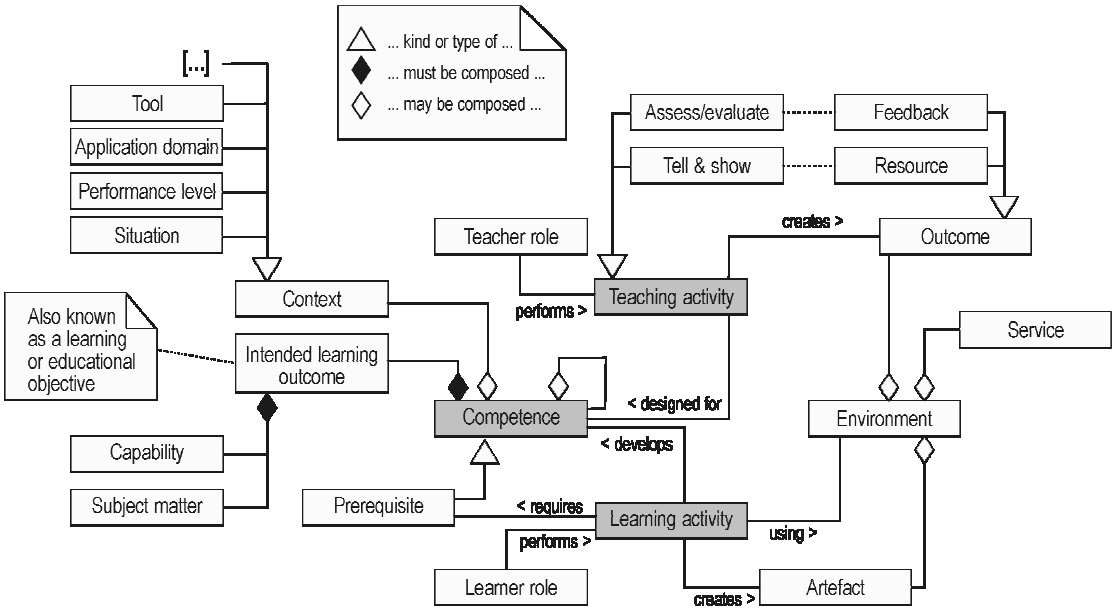



**Figure 5 A 'big picture' conceptual model of learning and teaching competences**

From the point of view of the EASiHE project, the conceptual model of Figure 5 locates a formative e-assessment as a teaching resource, the learner's responses to the assessment as an artefact, and the teacher's response to the artefact as feedback, all supported within a VLA, MLE, or similar, and designed for the learning and teaching of a structured network of competences.

# 4. Hints and tips from practitioners

## 4.1 The process of moving from an ILO to effective assessments

The steps involved are:

- analysis (specifying what the assessments need to achieve and how the results will be used)
- design (writing the e-assessments and gathering supporting materials such as images)
- validating the designs
- constructing the assessments using e-assessment tools (including proof-reading and program testing)
- piloting formative assessments (allowing time for changes to be made, as required)
- implementation
- review and evaluation

This booklet focuses on the analysis stage as it relates to question design; the design of e-assessments and individual question items; and the piloting of formative e-assessments.

## 4.2 Analysis

- Identify what the assessments need to achieve (e.g., how they will be used to help students learn) and how the outputs from the assessments will be used (e.g., in determining tutorial topics). This information can be used to gauge the effectiveness of the assessments after they are taken.
- Start the process of creating e-assessments immediately after constructing the ILOs. This helps ensure that all assessments address the ILO. It also helps ensure that the ILO is sufficiently precise and testable.
- When developing formative assessments it is helpful to map all the knowledge and skills needed to show the desired competency for the overall ILO. This map will include underpinning knowledge and lower order skills than the ILO itself. Students may be expected to have some of this enabling knowledge and skill before starting the course. If so, these foundation or pre-requisite skills would fall outside of the assessment design.
- Following the competency map, it is useful to write ILOs for each underlying knowledge and skill item so that these can be used to create formative assessment questions/question banks. Using a hierarchy such as Blooms (see previous page) helps determine the type of assessment question that will address each of these ILOs effectively.
- The assessment design for a course may include a mixture of e-assessments and more traditional methods. It is useful to specify the overall assessment needs and then decide where e-assessment methods will be used.
- Decide what information is required from the e-assessments such as student scores, statistical data on students' results, and other information such as the number of attempts. Then plan how to use this information to ensure that all the required data will be requested.

- For each e-assessment identify the learning outcome(s) that is addressed; the level(s) of mastery required; how feedback will be given (e.g., text and/or visuals); whether or not scores will be used and if so, what the pass level will be; and how the assessment links to other learning activities, e.g., pre-requisite and post-assessment activities for those who pass and those who fail.

## 4.3 Design

There are two levels to design: ensuring an e-assessment contains a mix of questions that together address the needs of the assessment objective, and writing the individual questions (items).

### 4.3.1 The e-assessment as a whole

When constructing an e-assessment, you may wish to check that:

- The e-assessment is tailored for its ILO and the purpose of the assessment is explained to the student.
- There are clear instructions to the student concerning:
    - the number of questions to answer·
    - the time limits or recommended amount of time to allow
    - the resources available and where to get them·
    - how to record their answers and change these answers if they need to
    - how to respond to the different question types used in the assessment
    - how to get feedback.
- The balance is appropriate between the number of questions that address the main ILO and the number of questions that address related knowledge and skills.
- The competencies addressed are at relevant levels of abstraction (using a system such as Bloom's taxonomy).
- If the assessment is scored, the marking scheme for the assessment should be explicit for the students.
- If the assessment is used more than once during the course, that students are given a target number of marks that they should aim for at this stage in their learning.
- The marking scheme rewards competence in the ILO being addressed.
- Items have varying levels of difficulty so that less-able students can achieve some marks and more-able students are challenged.
- There are a number of questions on a key learning point to reduce the effect of guesswork.
- The stem of one question does not provide clues to the correct answer for other questions.
- The items are written to the same presentation standard and use the same conventions for displaying information and inputting a student response.
- The data you require from the e-assessment has been specified.

### 4.3.2 Individual questions

When designing individual questions, the e-assessment will be more effective if:

- The ILOs, scenarios, questions and responses are phrased consistently.
- Questions are properly matched to ILOs.
- A question is focused on one key learning point regarding the ILO and that the question type is appropriate to the knowledge/skill being assessed.
- The reading level is appropriate to the students' abilities and any technical terms used are appropriate to the students' subject knowledge at this stage in the course.
- The e-assessment environment provides all the supporting material (e.g., case studies) and tools (e.g., calculators) that students need to answer the question.

Some tried and tested ways to increase the difficulty of four commonly-used problem types:

- Premise – Consequence: provide more than one premise.
- Case Study/extended matching: increase the sophistication of the case study.
- Incomplete Scenarios: increase the sophistication of the scenario, create additional gaps.
- Problem/Solution Evaluations: increase the complexity of the problem and/or solutions.

You could also:

- Ask the student to justify their choices (via a multiple-choice question or short free text entry).
- Ask students to identify how confident they are that their answer is correct.

### 4.3.3 Defined response questions

Including multiple-choice, true / false, yes / no, sequencing and matching questions. As well as the general points made above, here are some characteristics that make these types of questions effective:

- The student has clear instructions about how to answer, such as the number of options to be selected and how to record their response.
- The different question types used in the assessment are distinguished from each other so students understand when the response needed from them changes.
- It is easy for the student to answer the question, e.g., tick the box.
- Distracters are plausible e.g., based on common student mistakes.
- There are no unintentional clues that help students guess the correct answer such as:
    - grammatical clues like ending the question with 'a' or 'an', or mixing singles and plurals in the stem and options.
    - making the correct answer longer, more qualified or more sophisticated in language.

- The response options are homogenous in content.
- Response options are placed in a logical order.
- Options are as short as possible.
- The position of the correct answer within the option list is varied.
- If you ask which is the best option, ensure that the criteria for selecting it are given and that sufficient detail is given in the question stem for the student to make this judgment.
- The intervals between numeric options are logical.
- In a sequencing question, a maximum of 5 or 6 steps are offered.
- There is only one correct answer in a sequencing question.
- That the statement in a true / false or yes / no question is either entirely correct or entirely wrong.
- Abbreviations or other short forms are explained in the question stem (unless the purpose of the question is to check this knowledge).

It is also good practice to **avoid** the following:

- Negatives.
- Options which are obviously incorrect.
- Ambiguities such as sometimes, often, rarely, probably, usually.
- 'All of the above' and 'None of the above' options, unless they clearly address the learning points / ILO.
- Multipart questions, where the student has to answer all parts to gain any mark.
- Options that overlap such as 1-10, 10-20.
- Patterns of correct answers (e.g., b, c, b, c, etc.).
- Items that students perceive as trick questions.

### 4.3.4 Questions based on case studies

It is often useful to use the same scenario for a number of questions so that students can build up a detailed picture of what is happening. A challenge with e-assessment is providing sufficient information about the case or situation on the screen.

One of the main drawbacks with a case study followed by defined response answer options is that each option has been pre-prepared. To overcome this limitation, consider offering a free text box that students can use to add to their answer (such as assumptions they have made) or to provide a different answer from the pre-prepared list. You might wish to offer extra marks for appropriate comments and consider penalties for mistakes. Students need to be made aware of the 'rules' in advance.

To design a written case study it is often effective to base the case on a real example which demonstrates the competency concerned. Then the details of the case will be consistent with one another. A difficulty in making up a case study from scratch is that some of the finer details may be contradictory or unrealistic. The following method is suggested for the design of case studies with one or more questions:

- Draft the questions that you will require the student to answer to demonstrate mastery of the ILO.

- Select the real case to base the case study on, using the criteria that it must be a typical situation which demonstrates the ILO being assessed.
- Change some of the details to protect private information.
- Identify what are the key characteristics of the case that need to be presented in order to assess the components required by the assessment objective.
- Clarify information as required to make the student able to identify the appropriate response. For example, some real life cases will not be clear cut examples. If the assessment is to be used for learning, you may wish to make it more obvious what student response is required by exaggerating certain case characteristics.
- Remove as much extraneous information as possible.
- Ensure that all the information needed for the students to get the correct answer is provided.
- Ensure there is a logical progression through the case and that there is continuity of information such as giving the 'present' time in the case description.
- Fine-tune the framing of the questions. Ensure that each question addresses only one key point and satisfies the general question standards discussed earlier in this section.
- Ensure that each question is credible.
- Define what is at stake for the case participants.

### 4.3.5 Role play questions

Students may be asked to play a role to demonstrate a skill. Many of the hint and tips for questions based on case studies (above) apply here as well. These types of questions are more effective when:

- The question focuses on a specific part of the competence and this is made clear in the student instructions.
- The situation presented is realistic and typical of the ILO being assessed.
- The brief on the situation is short and easy to read.
- Time is given to students to study the situation and their part in it.
- The boundaries of the question - for example how far in an analysis process the student should go - are clearly defined.
- The role play is placed in the context of the complete task or skill.
- The brief is presented in a manner that the student is likely to be familiar with (such as an analysis sheet) or one which allows him / her to find the information they need quickly.
- All criteria are provided before asking for an evaluation and if you are assessing the application of an interpersonal skill, that the criteria for success are made explicit.
- Feedback reinforces all behaviours that work well in the role.
- If the role is a complex one to perform correctly, that the students have practice in the role play method with an easier example first.

### 4.3.6 Group work and e-media

Students are often asked to work on cases and role plays in groups with the group's answer being input to the e-assessment. You may like to consider:

- Allocating specific roles to individuals in the group and asking the rest of the group to give these individuals feedback on how well they performed the role via a computer-based survey.
- Asking the group to complete a wiki entry as their answer.
- Asking each group to keep a blog of the discussions and processes they followed to reach their conclusion.
- Encouraging group interaction through an online discussion. It is useful to assign the role of facilitator to one member of the group and task them with eliciting contributions from all participants. Another group member can be tasked with writing up a summary of the discussion and the outcome for circulating to other groups.
- Encouraging each person in a group to contribute by setting an output such as an online video presentation in which everyone must appear and make points or explain the group's reasoning.
- If the work is to be marked:
    - Giving everyone in the group the same mark. This is often seen as unfair by the students and therefore needs to be justified in terms of meeting the ILO before the activity begins.
    - Giving the group a total number of marks and asking them to allocate the marks between participants based on their contribution. This works best if there is a general discussion between the group about how they will decide the relative merits of contributions followed by a secret ballot. Online tools can facilitate this vote.
    - Beware of simple measures such as using the number of typed entries to an online discussion. A participant may have worked on the problem but made few contributions beyond 'I agree' statements.
    - Use an individual e-assessment as a follow-up to the group activity to ensure that each student has mastered the key learning points.

### 4.3.7 Feedback

Some points to consider when designing e-assessment feedback:

- If students are to learn from the e-assessment they need appropriate and sufficient feedback for their response to each question.
- Feedback needs to be provided as soon as possible so that students can relate the feedback to their thought processes about the question. A big advantage of e-assessments is that the tools can display feedback immediately. The drawback is that this feedback usually needs to be 'pre-prepared' for the responses students can make (e.g., in a multiple-choice question) or are likely to make, (in a free-text entry question).
- Ideally, feedback is provided immediately after students answer the question so they can correct any misunderstandings they have or reinforce the correct

answer. If this is not possible, students need to know when they will receive feedback e.g., at the end of the assessment or at their next tutorial.

- It is easier for students to learn from a question if they can see the question, their response and the feedback on the same screen.
- If a large amount of information is required for the student to be able to analyse, synthesize or evaluate effectively, consider the use of pop-up boxes. These can be closed by students so they can see the question, their response and the feedback clearly.
- To make feedback as helpful as possible consider which of the following are needed:
    - whether the student's response is correct or not
    - a discussion of the student's response
    - the correct answer
    - an explanation of why the incorrect options are incorrect
    - remedial help or
    - an elaboration of why the correct answer is correct
    - what the student's next learning step should be e.g., studying a reading, taking part in a discussion etc
- If the question is not clear-cut enough to have a 'right' and 'wrong' answer, or is complex consider:
    - not scoring the answers
    - giving an 'expert's' advice on the best option
    - discussing the merits and drawbacks of all the different options in the question
    - providing a model answer or demonstration (this could be optional for students that got the question 'correct')
    - providing a range of sample answers and a discussion about the criteria for judging the best option
    - asking a follow-up question on the rationale for the student's response.
- Use the same key words as the learning resources in the feedback explanations. This way the students can make a link between the two.
- Add references back to the learning materials or guidelines for further information so that students can get further detail if they need it.
- Offering extra information in the feedback for the correct response to reward and motivate these students.
- If responses will be scored, the criteria by which assessments will be marked. This may be simple as in 'each correct answers gains one mark'. Or it could be more complex if questions with multiple response formats are used e.g., students are asked to select three priority items from a list of six. In these cases, marks may be awarded for each correct item chosen or only when all three responses are correct. However, students can feel cheated if correct choices are not acknowledged with marks.
- Feedback need not be text alone. For example, suppose the question asks students to evaluate a case and choose the quickest way to lower a patient's

temperature. Feedback could be provided by a visual showing the temperature lowering and a clock showing the number of minutes/hours this takes.

### Some pitfalls to avoid with feedback:

- Minimal feedback such as 'correct' or 'incorrect'.
- Feedback that makes the student feel as if they have made a stupid mistake e.g., avoid terms like 'obviously' in the feedback.
- Repetitive feedback comments such 'Yes, you are correct'. The student may lose interest and disregard the feedback.
- Feedback which simply refers students back to learning resources without engaging their thinking about the question.
- Putting additional information in the feedback to some but not all options.
- Putting information in the feedback to one question that gives clues to the answer to a subsequent question.

### 4.3.8 Encouraging student reflection

To encourage students to think of the e-assessment as a learning activity and reflect on their approach to the problem/answer, you could consider:

- Offering a free text box for students to record their rationale for an answer. These entries can be offered to the whole class or a group of students and each person is asked to give a rating for how useful the individual rationales are.
- Particularly useful student rationales can be made available to future students as part of the feedback. They may also help tutors improve the assessment question and feedback.
- Asking students to complete an online 'log' entry for the assessment stating what they have learned from the activity and how they will use this knowledge next time they are faced with a similar problem. These logs can be kept private and the student is encouraged to review them before taking the next formative assessment or final assessment for the course.
- Students can be encouraged to use social networking techniques to ask each other for advice on tackling similar problems, telling others of insights gained from the activity or useful sources of information and posing questions for general discussion around the topic.

## 4.4 Piloting e-assessments

When creating formative assessments, it may be possible to pilot the questions with representatives from a similar student group such as students who have recently completed the course. Colleagues may also be willing to pilot-test the e-assessment. Someone who understands you subject will be able to comment on the content and someone from another department will be able to focus on the instructions and layout of questions.

Here are some tips from practitioners about pilot-testing:

- Before piloting the e-assessment make sure the technology works and that all content has been proof-read and corrected as necessary.

- Give pilot reviewers very clear instructions about the comments you want (e.g., when they were uncertain how to answer a question, when a question stem was unclear etc) and a simple form to fill-in. Allow room on the form for 'any other comments' as reviewers may have an unanticipated reaction or useful comment.
- Observe reviewers using the e-assessment if possible. You will be able to see where they seem to find a question puzzling or if they can go through the questions very quickly (and get them all right.) You will also be able to see if someone has to ask for help on how to answer a question.
- If reviewers agree, ask someone who is not involved in the project to interview them about the e-assessment and how it can be improved.
- Allow time in your schedule to make improvements to the e-assessment.

# 5. Summary

This booklet provides hints and tips from experienced practitioners for creating effective e-assessments for higher order ILOs. It places these hints and tips in the context of taxonomies for higher order ILOs, and competences.

As there are many hints and tips here, we asked our workshop participants to highlight what is most important. Their response was to highlight:

- Match questions to intended learning outcomes that are sufficiently precise and testable.
- Present credible questions and realistic problems.
- Use a scenario for several questions, building a logical and consistent story with continuity between one question and the next.
- Explain to the students what is at stake in a scenario
- Give students clear instructions, marking schemes and rules.
- Make distinctions between different question types so students know how they are expected to input their answer.
- Provide sufficient feedback and guidelines on how to find more information.
- Reinforce the reason(s) for the correct answer in all feedback.

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# Appendix A: Worked example

The following is a poor question that was discussed at the workshop on 10th February. It is followed by an improved version of the same question.

## A.1 Intended learning outcome

The question is intended to address this ILO:

At the end of the course the student will be able to analyse an emergency situation, evaluate alternative courses of action and make a decision that will ensure the survival of all involved for the longest time.

## A.2 Question text seen by all students

### Q1: The situation

You are the captain of a yacht with three crew, Rudy, Clare and Ali. You are sailing around the Azores when a storm blows you off course. You don't know where you are and you have not seen land or another vessel for three days. The yacht is holed by debris at 2300 hours and starts to sink rapidly. You launch the inflatable lifeboat and all the crew board it. The lifeboat is equipped with 3 flares, 1litre of water, 2 energy bars, a first aid kit, tinder and a box of matches, four life jackets and 2 small paddles. You have 7 minutes to grab supplies before you have to board the lifeboat yourself.

You can only take one of the following. Which one?

a. Eight tins of food and two litre bottles of water
b. Four x 4 litre containers of water and one knife
c. Four space blankets and one fishing rod
d. One mobile phone and two torches

### Feedback seen by students who chose that option

| | | |
|---|---|---|
| a | Do you have a can opener? Probably not, so it will be difficult to get into the tins. It is good that you chose some water. The most important consideration is keeping everyone alive for as long as possible. Ideally each person needs 2 litres a day. Option b is better. | 1 mark |
| b | Good, you have maximised your chances of survival. | 3 marks |
| c | I can see why you went for the blankets – it can get chilly at night. And the rod would let you catch fish. But water is the biggest problem. Option b is best. | 0 marks |
| d | A fully-charged mobile would help if you can get reception. Unfortunately you can't. Although the torches are useful at night, they won't help when you get thirsty. | • marks |

### A.2.1 Positive aspects of question

- Interesting and engaging situation.
- Sense of urgency and an idea of what is at stake.

### A.2.2 Problems with this question

Some of the problems with this question are:

- Case study description contains information that is not needed now (such as the names of the crew) but does not give key information needed to answer the question correctly (e.g., about mobile phone reception).
- Scenario seems unrealistic, e.g., it is not clear why all the crew left the vessel without taking items such as these and how one person would be able to carry all the items in option a). Further, in seven minutes, a person could load more than one of these combinations, depending on how they were packaged.
- The lifeboat survival kit does not include a torch or a fishing hook. These should be standard items.
- The list of items in the lifeboat could be placed in a pop-up, so there is enough space on the screen to show the question, the student's response and the feedback on one screen.
- No clear instructions about how to answer the question.
- The question does not explain that the choice of items is to maximise the survival of the group.
- The stem specifies 'one of the following' yet all the answer options have two or more items.
- Water appears in two options. This gives an unintentional clue that water is the most important item.
- The learning point that water is the most important item for survival is so central to a survival course, that it seems unlikely that any student would get it wrong.
- The case description does not specify important information such as that there is no land in sight now, or you did not have time to send out a distress call.
- The text for the options is smaller than the case study description, yet is of as much if not more importance.
- The information in the response options is insufficient e.g., what type of knife is it?
- The question assumes the student knows information about the Azores e.g., that it gets relatively cold at night.

The feedback:

- Option a) the query about the can opener can be read as sarcastic.
- Option b) does not explain how the student has maximised their chances of survival.
- Options c) does not explain why option b is best. Option d) gives further information that was needed in the case description. It does not explain what is the best option and why.

The marks:

- Seem unfair. Although the feedback for option c) gives praise for choosing blankets, no marks are awarded.

## A.3 Improved version of the question

### Introduction screen

The following assessment is based on a real scenario. You will be asked five questions. You need to answer every question.

Each question gives you details about the case study and asks you to make a decision. You can get further information by clicking any words that are underlined like this: Far Islands.

Once you have answered, you will get feedback on your choice. This feedback has been prepared by a survival expert.

Every answer that is correct, fully or partially, will earn you marks. The maximum score is 15 marks. These marks do not count towards your final grade for the course. The purpose of these questions is to help you check what you have learned so far.

Click Next when you are ready to start.

[On next screen]

### Question 1

You are the captain of a yacht with two crew members. You are sailing around the Far Islands when a storm blows you off course. Your radio is broken and you have no mobile phone reception. You cannot see land or another vessel. The yacht is holed by debris at 2300 hours and starts to sink rapidly. You are all wearing rain gear and life jackets. You launch the inflatable lifeboat and all the crew board it. The lifeboat has a survival kit.

Type the letters of the following options in the order you plan to grab them (most important first). Your goal is to keep everyone alive as long as possible.

To change your answer, overtype your current response. When you have finished, click Done.

a. Compass
b. Cooking pan
c. Mora knife
d. Pack of six food tins
e. Six litre barrel of water
f. Two blankets

#### *Pop-up for Far Islands*

The Far Islands are a group of islands in the Atlantic Ocean. Many are small and uninhabited. Temperatures at this time of year: high 20.4°C, low 10°C. Average rain fall for month: 3.84 inches.

#### *Pop-up for survival kit*

3 flares, 2 litres of water, 2 energy bars, a first aid kit, tinder and a box of matches in a water-proof bag, 2 small paddles, 1 wind-up torch, 2 fishing hooks, utility knife: (includes two sharp blades, tin opener, spoon and screw driver), billy can.

**Feedback**

| | | |
|---|---|---|
| edcfab | Well done, you have chosen the order that our expert advises will maximize your chances of survival.<br>1. Water: ideally every person needs 2 litres a day.<br>2. Food: important if you don't find land soon.<br>3. Mora knife: strong enough to gut fish, cut wood for and defend you from animals.<br>4. Blankets: it gets chilly at night. The body needs more water if it gets cold.<br>5. Compass: if you decide to row, you'll need the compass to head in one direction.<br>6. Cooking pan: this could be used to collect condensation. As you have a billy can it is not a priority.<br>See chapter 2 of 'Survival Now' for more details. | 3 marks |
| e appears in first or second position | Good, you placed water high in your priorities. This is the order our expert recommends and why:<br>1. Water: ideally every person needs 2 litres a day.<br>2. Food: important if you don't find land soon.<br>3. Mora knife: strong enough to gut fish, cut wood for and defend you from animals.<br>4. Blankets: it gets chilly at night. The body needs more water if it gets cold.<br>5. Compass: if you decide to row, you'll need the compass to head in one direction.<br>6. Cooking pan: this could be used to collect condensation. As you have a billy can it is not a priority.<br>See chapter 2 of 'Survival Now' for more details. | 1 mark |
| Any other order | Our expert recommends water is placed first. Compare your order and rationale to the order he recommends:<br>1. Water: ideally every person needs 2 litres a day.<br>2. Food: important if you don't find land soon.<br>3. Mora knife: strong enough to gut fish, cut wood for and defend you from animals.<br>4. Blankets: it gets chilly at night. The body needs more water if it gets cold.<br>5. Compass: if you decide to row, you'll need the compass to head in one direction.<br>6. Cooking pan: this could be used to collect condensation. As you have a billy can it is not a priority.<br>See chapter 2 of 'Survival Now' for more details. | 0 marks |

# Appendix B: Templates for constructing defined response questions

The table below illustrates a selection of templates (sampled from Bloom & Hastings, 1971) designed to address one or other objective drawn from Bloom's cognitive domain. These are illustrated simply to provide ideas for readers wishing to use MCQs to assess higher cognitive skills.

**Example templates for Bloom's cognitive domain**

| Domain | Scenario or case | Distractors | Possible questions |
|---|---|---|---|
| **Comp-rehension** | Show a diagram, picture, scenario, vignette, or statements.<br>For each of the following questions, use the above information to make a decision and indicate your answer using a single letter as follows: | A True<br>B Probably true<br>C Insufficient information<br>D Probably false<br>E False | Q1 The [X] shows [Y].<br>Q2 There are N [F]s.<br>Q3 Most of the [Z]s are [W]s. |
| **Application** | The following are some basic procedures for [X]ing: | A Procedure [1]<br>B Procedure [2]<br>C Procedure [3]<br>D Procedure [4]<br>E Procedure [5] | For each of the following questions or statements, indicate (by using a single letter) the procedure involved or the most useful procedure to involve.<br>Q1 An [X] which includes a [Y].<br>Q2 The [X] uses the tool [Z].<br>Q3 Situation [W] applies while [X]ing.<br>Q4 The goal of the [X] is [G]. |
| **Analysis** | Text, diagram etc illustrates a situation or phenomenon [X].<br>For each question, indicate how the statement of the question illustrates: | A The fundamental purpose of [X]<br>B Achievements incidental to the fundamental purpose of [X]<br>C Evidence of how [X] is regarded by [Y]<br>D Evidence of the involvement of [Z] in [X]<br>E None of the above | Q1 [M] assured [N].<br>Q2 [X] became associated with [U].<br>Q3 [P] did much to improve [R].<br>Q4 [T] was organised around [F].<br>Q5 [J] demonstrated [K]. |
| **Synthesis** | The facts [X], [Y], [Z] etc have been found to be the case.<br>Some procedures to follow include: | A Procedure [R]<br>B Action [S]<br>C Procedure [T]<br>D Action [U]<br>E Procedure [V] | For each question, indicate the appropriate procedure or action:<br>Q1 [G] is required.<br>Q2 Because of [H], [J] is to be avoided.<br>Q3 [K] is required as well as a good [L]. |

| Domain | Scenario or case | Distractors | Possible questions |
|---|---|---|---|
| **Evaluation** | Text, diagram, etc outlines a situation or scenario [X].<br>Views on [X] could be: | A It is thoroughly improper<br>B Proper as regards [Q] but not as regards [W]<br>C Proper as regards [W] but not as regards [Q]<br>D It is thoroughly proper<br>E None of these views clearly applies | In discussing [X], various speakers made the following statements. For each statement, indicate the view that the speaker is likely to hold.<br>Q1 Hobbs said [V].<br>Q2 Plato noted [H].<br>Q3 Mill was right to say [G]. |

## Example using the evaluation template

This question is a continuation of the survival scenario in Appendix A.

### Situation

The current has carried the three of you and your lifeboat to a small island overnight. You have all swum ashore safely and dragged the lifeboat onto the beach. It is now daylight and the weather is fine and warm. You can see no buildings, roads or fresh water. All you can see of the interior of the island is dense jungle. In discussing what to do, it could be:

a. A good idea to walk along the coast but not to enter the jungle.
b. A good idea to walk into the jungle but not along the coast.
c. A good idea to walk along the edge of the jungle.
d. A bad idea to walk along the coast and a bad idea to enter the jungle.
e. Walking along the coast or entering the jungle is irrelevant, some other action is required.

Q1. Joe wants to search for fresh water. Which option should Joe suggest?

Q2. Lizzie suggests searching for food. Which option is Lizzie's best action?

Q3. You suggest getting a safe base is the first priority. Which option are you likely to suggest?

### Feedback for Q1, 2 and 3 on completion of Q3

| | |
|---|---|
| To find water, survival experts recommend you walk around the coast and look for a river or stream entering the sea. Walking into the jungle is a bad idea as you could get separated or surprised by dangerous animals. | a: 1 mark<br>b-e: 0 marks |
| To find food, survival experts recommend you explore the jungle edge first. Walking into the jungle is a bad idea as you could get separated or surprised by dangerous animals. Walking around the coast is unlikely to yield food that does not need cooking. | c: 1 mark<br>a, b, d, e: 0 marks |
| A safe base is usually elevated, isolated, or has a single approach. It seems unlikely that you would find such a feature soon. You will probably need to build your base on a nearby edge of the jungle using materials scavenged from the coast. | e: 1 mark<br>a-d: 0 marks |