IAEA Singapore 32nd Annual Conference

Title: Taking learning objects in new directions: models for assessment.

Authors:
Susan Atkins, Director Online Initiatives, The Learning Federation, Curriculum Corporation Australia
Gayl O'Connor, Manager, Science and ICT Test Development, Curriculum Corporation Australia

Abstract: The Le@rning Federation (TLF) project employs emerging technologies to produce online curriculum content to encourage student learning and support teachers in Australian and New Zealand schools. TLF has adopted the learning object model for its online interactive content. Learning objects are 'chunks' of digital material - for example graphics, text, audio, animation, interactive tools - specifically designed to engage and motivate student learning. Several assessment models are proposed to demonstrate how these chunks can be re-purposed to specifically assess student learning. The models have the common purpose of assessing targeted teaching and learning outcomes: students are afforded opportunities to develop and demonstrate these learning outcomes as they interact with the learning object. Capturing and assessing the learning that has taken place as the student interacts with the learning object is the principle that underpins each assessment model proposed. It is by capturing students' responses as they interact with the learning objects that insights into student learning can be gained. By establishing what the learner knows – and is able to do – through engaging with a learning object, the next appropriate learning task can be identified: to either extend learning, or to target areas requiring additional support for students in their learning.

Several assessment models are outlined demonstrating how learning objects within the TLF repository can be re-purposed for assessment purposes, where we are making a distinction between a learning object created for teaching and learning purposes and ***the assessment of*** the teaching and learning outcomes targeted by that object. As Atkins (2003) notes in *Achieving educational soundness in the digital age:* 'Good pedagogy allows students to deconstruct and reconstruct and make meaning of their learning. One important aspect of learning is providing the facility for student to communicate what it is they know [and can do].' Although the learning objects have not been explicitly designed to provide assessment experiences, assessment of learning by the students can be demonstrated through their interaction with the learning objects. This principle underpins each assessment model we have proposed. It is by capturing students' responses as they interact with the learning objects that insights into student learning can be gained.

E-stimulus task model

One such model - the e-stimulus task model (Atkins. S, & O'Connor, G. 2005) - was presented at the 10th Annual Roundtable Conference 'AR+t-Assessment Reporting & Technology'. The focus of the e-stimulus task model was to demonstrate in principle how learning objects could be re-purposed for use, primarily, in large-scale assessment programs for summative assessment and reporting purposes. For the specific purpose of use in large-scale assessment programs, it was anticipated that the electronic medium would replace pencil and paper test booklets to at least some extent. We defined an e-stimulus task as 'electronic stimulus material consisting of one or more chunks of digital material with associated assessment items, based around a common theme or context' (Figure 1). Such assessment tasks would assess specific student learning or a specific level of competence. We see the e-stimulus task model as a subset of a range of potential models that describe a suite of assessment learning objects (ALOs), where an ALO is defined (Adams, A. 2004) as a learning object designed for assessment. For the purposes of this paper the e-stimulus model is referred to as ALO Model 1.

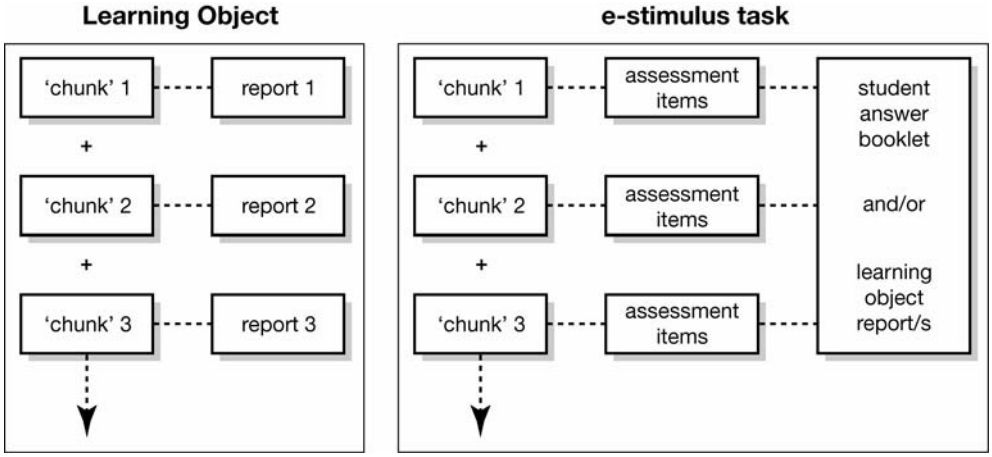


Figure 1 Relationship between a Learning Object and e-stimulus task

Further models

The further models proposed focus on classroom-based formative assessment. Formative assessment is 'generally defined as taking place during a course with the express purpose of improving pupil learning' (Torrance and Pryor, 1998).

ALO Model 2: Formative assessment of learning outcomes

As students interact and respond to the learning objects, the capacity for their responses to be captured by inbuilt tools is already in place for many learning objects. The report generated can be seen as an example of a student work product (or artefact) that is then to be assessed by the teacher. For the purpose of provision of teacher feedback to the student (or indeed as a student self-assessment tool), the existing inbuilt report format will be extended to include a list of the learning outcomes matched to each aspect of the learning object within a suitable scaffold for this purpose. There are many assessment methods by which information about student learning can be collected and reported upon in a structured way, using devices such as rubrics[1] and checklists. When using these, teachers (or students in the case of self-assessment) judge the quality of a piece of student work against specific criteria. Masters and Forster (1996) make a distinction between assessing student work analytically and holistically:

- In analytical assessment, a number of specified criteria are applied to the student's piece of work. Typically, performance on such criteria can be rated as (once categories have been defined) as High, Medium or Low performance.
- For holistic assessment, a single set of rating categories is developed, with the purpose of making an overall judgement of the quality of a piece of work.

The inbuilt reports generated as a result of a student interacting with a learning object can be examined for evidence of student performance against the specified criteria as identified in the scaffold constructed for a particular learning object. The following example (Appendix 1) illustrates how the report generated from the TLF learning object *Environmental evaluation project: frog pond*

[1] A rubric is generally a table containing a set of criteria specifying the relevant learning outcomes and the levels of potential achievement, against which judgements of aspects of student work can be made.

habitat can be assessed using an analytic rubric by which the teacher would provide feedback to the student on performance on the assessment task.

Potential 'Performance Categories' are best informed by examining a range and number of actual student work samples, followed by construction of applicable degrees of performance. In some cases, it will be most appropriate to limit the levels of performance to 'Shown/ Not shown': for example the student demonstrates that they can make simple standard measurements or they do not; in others, High, Medium, Low may be appropriate. The teacher would judge the student work sample against the performance categories, and complete their assessment for each criterion in the column 'Quality of response' by selecting and recording the appropriate category. It would also be beneficial for the teacher to provide some holistic feedback to the student by summarising performance on this task in a box provided for this purpose beneath the rubric. The feedback could include areas requiring further development and opportunities for skill-building or practice; and areas in which the student is progressing well. The feedback may also include suggestions as to the next appropriate learning task/activity the student should complete: either to extend learning, or to target areas requiring additional support for students in their learning.

This model varies from the e-stimulus model in that

- the purpose of collecting information is formative, rather than summative;
- in this model, assessment is classroom-based, and takes place **during** a teaching and learning sequence;
- there is a critical role for the teacher in providing feedback to the student on completion of the learning object task. This feedback informs the teacher (and student) as to the next appropriate step in the teaching and learning sequence for that student. The teacher might direct the student to complete another learning object in the repository which the student has the opportunity to practise and consolidate particular skills, or to another appropriate learning activity, which may be either an electronic or non-electronic teaching resource or strategy; and
- student responses captured entirely within a report generated as an integral component of the learning object (rather than with a potential mix of responses in accompanying paper and pencil test answer booklet).

ALO Model 3: Formative assessment of generic skills

The focus of this model is on generic skills, such as students' ability to use process skills in science. This model is similar to *ALO Model 2: Formative assessment module*, but with a focus on 'chunks' of learning objects that most lend themselves to the assessment of process skills such as (eg for scientific literacy assessment) making simple standard measurements, identifying trends in data, and making suggestions for improvement of experimental design. It is envisaged that teachers would then be able to search (via appropriate metadata) for such specific assessment modules within a repository of assessment objects, and so provide targeted learning opportunities for their students with regard to this subset of learning outcomes.

Assessment items representative of this model are included in Appendix 2. The series of TLF learning objects 'Wild Ride' forms the basis for this assessment task. The learning outcomes for this task include the process skills of collecting and recording data involving two or more variables, and identifying variable to be changed or measured in an experimental design.

ALO Model 4: Transfer of learning module

The focus of a transfer of learning assessment module is on students' ability to transfer and apply knowledge – and/or skills - gained (through engagement with previous learning objects in the

repository) to a new context. Modules of this type are most likely to be appropriate to assess students' higher order thinking skills (eg critical analysis, formulate hypotheses, draws evidence-based conclusions). Such modules can potentially be used within the classroom to assess student learning either during (formative), or at the end (summative), of a teaching and learning sequence.

This model is illustrated by the assessment task 'Direct a cleaning robot'. Students would complete this assessment task after having completed the TLF learning object 'Direct a robot.' Assessment items representative of this model are included in Appendix 3. The context has changed from one in which a robot is directed (according to student input) to collect rock samples from the surface of the Moon to one that of a robot being directed to pick up objects from the floor of a bedroom. The outcomes addressed relate to the student's ability to represent location and movement (e.g. by interpreting a simple given pathway using direction and number of distance units); and to the ability to interpret 2D representations of a 3D environment (e.g. constructs most direct pathway on grid provided).

Trialling the assessment models in the classroom

As an interim step in producing electronic versions of assessment tasks for the models, paper-based student worksheets have been developed based on the interactivity and functionality present in existing learning objects within the TLF repository. Students interact with either entire or chunks of existing objects then complete the worksheets. The purpose of administering these worksheets to students is to determine that the assessment tasks based on the models proposed enable the collection of appropriate assessment information about student learning. An examination of student responses to the assessment items will allow refinement of the assessment instruments in their current form, including the draft marking criteria contained within the rubrics. Student and teacher feedback will also be collected as part of the trialling process. We anticipate presenting preliminary findings from the trial during our paper session.

References

Adams, A. et al (2004). The Effectiveness of Assessment Learning Objects Produced Using Pair Programming.
Electronic Journal of e-Learning Volume 2 Issue 2 (245-256).

Atkins, S. (2003) Achieving educational soundness in the digital age.
Accessed 11 October 2005 http://www.thelearningfederation.edu.au/tlf2/showMe.asp?nodeID=66

Atkins, S. and O'Connor, G. (2005) Re-purposing Learning Objects as assessment instruments. Paper presented 10th Annual Roundtable Conference 'AR+t-Assessment Reporting & Technology', Melbourne. http://www.vcaa.vic.edu.au/roundtable/papers.html

Masters, G. and Forster, M. (1996) ARK (Assessment Resource Kit) Developmental Assessment, Australian Council for Educational Research (A.C.E.R).

MCEETYA Performance Measurement and Reporting Taskforce
http://www.mceetya.edu.au/taskfrce/task224.htm

Torrance, H. and Pryor, J. (1998). Investigating formative assessment: teaching, learning and assessment in the classroom. Open University Press.

APPENDIX 1: Draft analytic rubric for Environmental evaluation project: frog pond habitat learning object

Chunk	Student artefact/work product	Aspect of scientific literacy addressed [1]	Performance categories (H = High; M=Medium; L=Low)	Quality of response
Photographic record	Student completes text field to record observations.	Makes comparisons between objects or events observed.	Shown/Not shown	
Data tools	1. Student uses tools to complete data column.	1. Makes simple standard measurements.	Shown/Not shown	
	2. Student completes text field to record observations (water quality).	2. Identifies and summarises patterns in the science data.	**H** Statement indicates that in general all indicators of water quality have remained relatively stable. **M** Statement refers to more than one specific aspect of the data (eg dissolved oxygen went up a bit compared to last year, but the temperature went up a bit), but does not generalise across data set. **L** Statement limited to comment on one aspect of the data only. Not shown	
Food web builder	Student constructs food web/s then completes text field to describe relationship (identifies predators of the frog).	Describes the relationship between individual events.	Shown [Indicates that the frog is vulnerable as prey at all three stages of its life cycle: cause and effect] /Not shown	
Population Modeller	Student completes text field to describe relationship (which predators have the most impact on the Green and Gold Bell Frog?)	Describes the relationship between individual events.	**H** Identifies the key relationship likely to have the *most* impact on the Green and Gold Bell Frog. **M** Recognises there are a number of feeding relationships. **L** Limits response to specific examples of feeding relationship. Not shown	

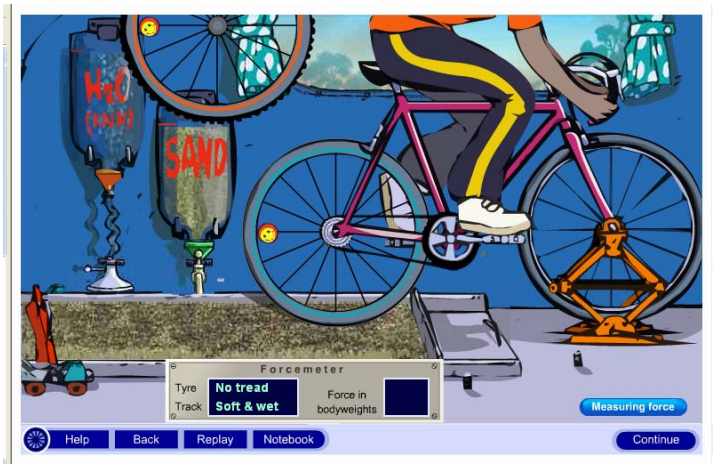
Population counter	1. Student uses tools to complete data column.	1. Makes simple standard measurements.	1. Shown/Not shown	
	2. Student completes text field to record observations.	2. Not recorded in report.	2. Not assessed	
Report Builder	Student completes text field to explain how data supports conclusion (the most likely cause of the decline of the Green and Gold Bell Frog).	Conclusions explain the patterns in the data using science concepts, and are consistent with the data .	**H** Supports conclusion (the most likely cause of decline is increased predation by mosquito fish) by eliminating changes in physical environment (as evidence by photographs and water quality analysis) as the cause, and by explaining that the introduction of mosquito fish has had a large impact on all stages of the frog's life cycle. **M** Supports conclusion by referring to fact that the mosquito fish has been introduced to the area, but does not refer to evidence of lack of change in physical factors. **L** Simplistic statement that refers only to the fact that the number of mosquito fish have increased. Not shown	

Teacher Comments

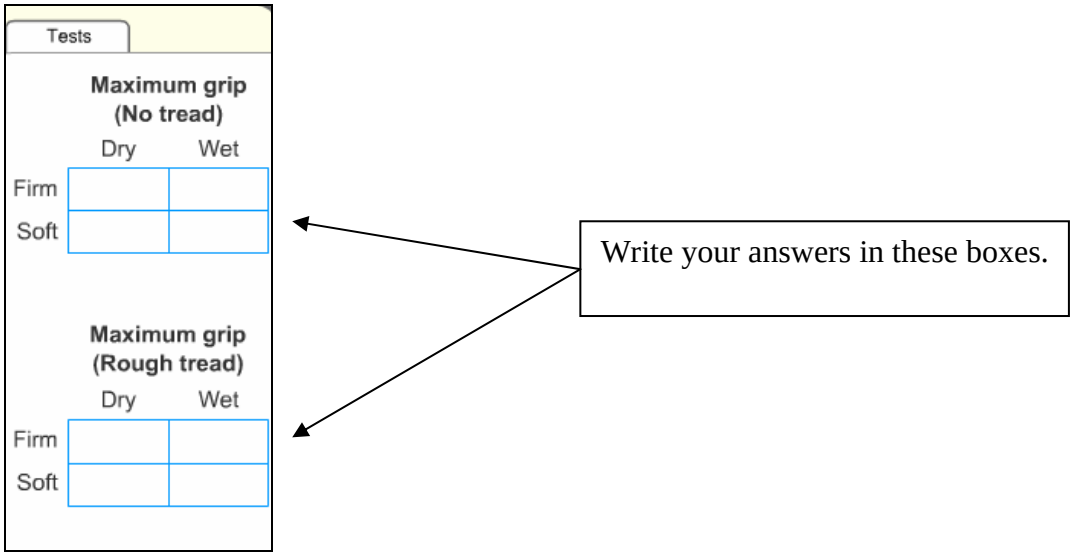
[1] Outcomes as matched to Scientific literacy framework (MCEETYA, 2006): National [Australia] Assessment Program – Science Literacy.

APPENDIX 2: Generic skills assessment items (Wild Ride)

Using the Forcemeter
Go to the Forcemeter in the Learning Object called *Wild Ride – Get at grip*. The screen looks like this:



a). Perform a series of tests to complete this table. Make sure you fill in all of the boxes.



b). Answer these questions about the tests you have performed.

Q1. Shade the test results you would need to compare to find out if tyres with 'no tread' have less, more or the same grip on a firm surface when it is raining.

Q2.
Circle the correct word(s):

(i) In general, you would get the same amount / less / more grip on a firm surface if you use tyres with 'no tread' instead of 'rough tread'.

(ii) In general, you would get the same amount / less / more grip on a soft surface if you use tyres with 'no tread' instead of 'rough tread'.

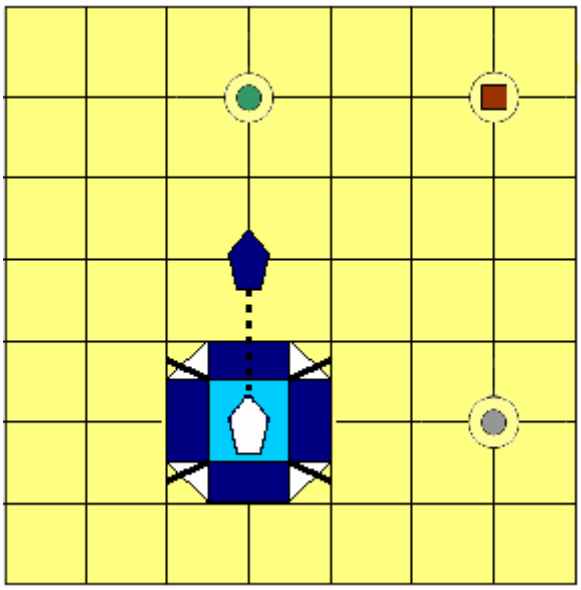
APPENDIX 3: *Transfer of learning assessment items (Direct a cleaning robot)*

Direct a cleaning robot

When you used the learning object 'Direct a robot' your mission was to give directions for a robot to collect rock samples on the moon. You created pathways for the robot and decided on the direction (left, right, forward, back) and distance travelled for each step in the pathway. You had to plan the most direct route to save fuel.

Your task
Use what you have learnt about directing a robot to complete a new mission called 'Direct a cleaning robot'. You will complete this mission by answering the questions on these worksheets.

Mission 1: Clean the floor by collecting all of the objects and returning to the capsule.



Answer these questions about this mission.

Q1. This diagram shows the robot has started moving towards the mouldy orange.
Fill in the direction and steps the robot has taken so far.

Q2. If the robot continues moving in the same direction, how many **more** steps does it need to take to reach the mouldy orange?

_____ steps.

Q3. Draw a pathway on the map from the mouldy orange back to the capsule, collecting the book and then the CD on the way. Your pathway should use the least amount of fuel.