Invention is the daughter of necessity: generative learning objects in the making

Dawn Leeder, Howard Chase, Raquel Morales
University of Cambridge, UK

Introduction

Universities' Collaboration in eLearning (UCeL) is a partnership between a number of UK higher education faculties and is pioneering methods of collaborative and interactive eLearning content creation by actively exploring ways in which high quality content can be unlocked and made reusable across the many disciplines. For the first two years since its inception, UCeL collaborators have created, developed and evaluated a range of RLOs and these resources have proved valuable in the understanding of many fundamental concepts that HE students need to learn (Leeder et al, 2004).

Interactive multimedia is expensive and time-consuming to produce yet evidence shows that if made and deployed effectively it can enhance the learning experience (e.g. Wharrad et al., 2001). Student evaluations show that, provided the materials are high quality, they are well received and valued); consequently if material can be collectively made and shared across courses the deliverables will be significantly more cost-effective (Tope, 1996). This first generation of RLOs whilst engaging, interactive and educationally effective, is limited. The basic unit of reuse is the object as a whole. There is a clear need to develop a more flexible format for developing learning objects which will support both increased productivity in development and flexible repurposing by local tutors (Boyle et al, 2004). Thus the next generation of learning objects.has been necessitated.

Generative Learning Objects (GLOs)

For GLOs to be truly adaptable, the underlying general structure of the material needs to be separated from the specific content. How this is achieved depends to a large extent on the nature of the material itself: the concept that needs to be understood; the process, procedure or code that must be stepped through; the dataset that requires application of a statistical method. The act of making a GLO is one of deconstruction where the higher levels of content are separated from the deep structures at the core. It is these deep structures that form the basis for reuse with lecturers providing their own instance of material for their particular teaching and learning purposes. The challenge then, is to make the GLO powerful enough for general reuse whilst keeping it simple to modify in as many different ways as possible.

A range of GLOs is currently being explored. The first stage has been to identify the generic concept that a) is based on actual educational need; b) has a common core that can be readily adapted; c) will be of use to a broad educational base and across a number of disciplines. Secondly, these themes require prototyping and testing.

Complex Decision Making

This learning object takes the learner through a series of vignettes that form the decision making process. The case is presented as a series of characters or 'players'. The central player is the decision maker themselves and this is the person who is faced with having to make a difficult choice, for example whether or not to terminate a pregnancy. The learner takes an interactive journey through the decision-making process. By interrogating the various players - the decision-maker and the decision influencers - the learner builds up a complete picture of the complex decision-making process. As each player offers their view, the learner records their own thoughts and votes on what they think the final decision will be. The learner's reflections are recorded at each stage and the learner receives a printable output at the end of the process documenting all the views, their reflections and the final outcome.

The teacher builds the learning object using a web-based template or proforma. By responding to a number of questions on the form they are prompted to provide all the information required that will lead the decision-maker to produce their decision. Each player can have up to four views on the matter and these views are ranked according to how closely they concur with or deviate from the default position. So in the case where the decision is whether to terminate a preganancy, the view that she should would score 3. A view that she should not would score 0. There are also two intermediate views scoring 2 if slightly in favour of the intervention and 1 if slightly against. The decision-maker also has a response to each of the possible views they are presented with and up to four final decisions, selected depending on the scores of the views presented. This leads to a large number of possible routes through a single learning object.

The main deliverable of the learning experience (for both learner and teacher) is a complete

printable transcript of the process containing all the opinions and responses together with the learner's reflections at each stage and the final decision and learner's concluding comments. The learning object itself is generated automatically from the teacher's input. This would be in text format initially, but with further development could contain audio and/or video vignettes. As the collection of GLOs expands, the best ones can be selected for audio-visual development and showcasing.

Applied Statistical Methods

Statistical issues arise as important natural parts of the process of reaching conclusions. From astronomical to zoology, statistical methods are required for data analysis across disciplines. The same terminology, graphical representation and statistical tests can apply to different data sets. Depending on the type of questions we want to investigate, the learner would need to apply different tests.

The STEPS project (STatistical Education through Problem Solving: The STEPS Project 1999) brought together nine departments in seven universities throughout the UK to develop problem-based teaching and learning materials for statistics. In all, 30 or so academic statisticians and programmers helped to develop the STEPS materials.

Taking these materials as the starting point, different statistical tests can be used as the core for Applied Statistical Methods GLOs. Tutors can adapt these GLOs to their own subject specific needs by using different data sets relevant to their courses (see Diagram 1). Interdisciplinary workshops explore analogous data sets across subjects and create the core materials that will subsequently be developed and tested. Using this approach lecturers can rapidly apply an appropriate data set to a particular method to customise the GLO for their own particular discipline to make the material more relevant and engaging for learners.

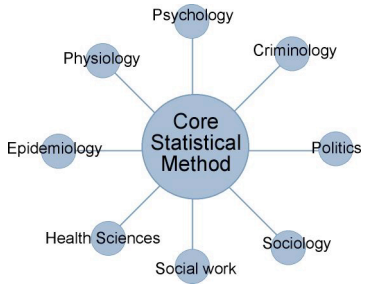


Diagram 1. Core statistical method with subject specific adaptations

Principles of Conservation (The General Balance Equation)

There are many instances of systems where a fundamental property inherent within that system is conserved. Examples include many "scientific" systems in which the properties of, for example, the mass or the number of certain atoms entering, leaving or remaining within the system are conserved. However, the same basic principle also describes many situations that would not conventionally be considered to demonstrate analogous tendencies.

The universal equation that describes conservation under such circumstances can conveniently be written as:

In + Made (Net) = Out + Accumulation

The four terms that constitute this equation allow all the intrinsic features that characterize the behaviour of the system to be accounted for. This GLO therefore, exploits the universal applicability of the fundamental equation, but allows each of the four terms to be tailored to the desired and particular learning outcome. Intriguingly, the applicability of this equation touches a multitude of applications in diverse areas of study; so this may be a prime example of a GLO that can be re-utilised in a range of hitherto unconnected disciplines.

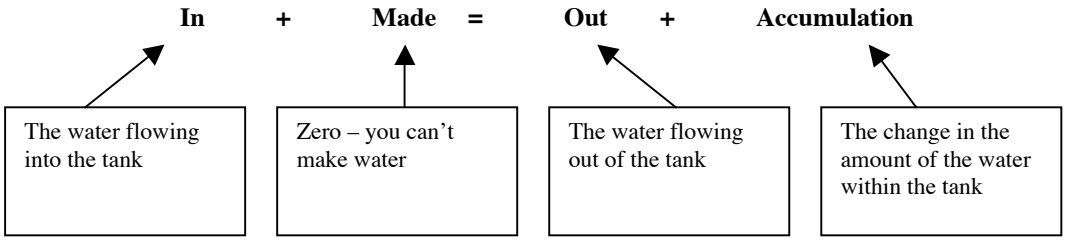
Examples, including situations that lie beyond the more obvious applications in the natural sciences or engineering, include the following:

- **Coins in a currency in a country over a time period**

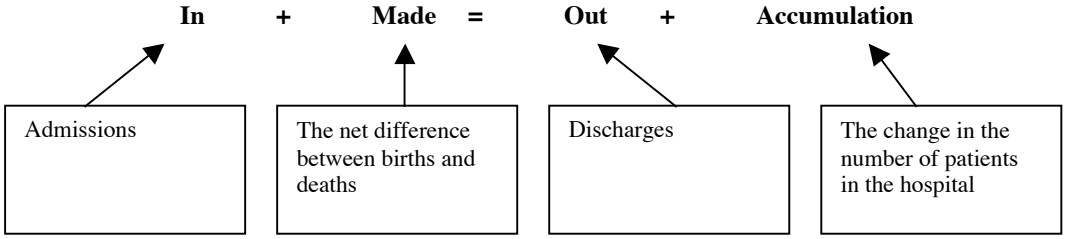
In + Made = Out + Accumulation

The number of coins brought into the country by arriving travellers	The number of coins made by the country's mint – the number destroyed	The number of coins taken out of the country by departing travellers	The change over the time period of the total number of coins in the country

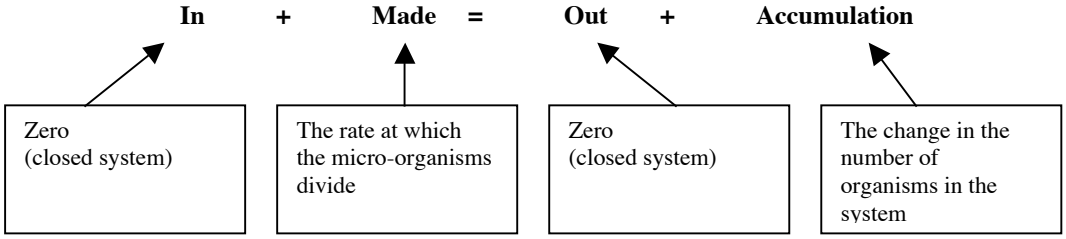
- **Water in a tank fitted with supply and exit pipes**



- **The number of patients in a hospital**



- **Micro-organisms within a closed fermenter**



Conclusion

Generative learning objects are in their early stages of conceptualisation and production. They already have a number of aspects and a set of features depending on the subject areas they serve. The main objective in producing them is to satisfy real and individual teaching and learning needs, which can only be achieved through encouraging lecturers, students and developers alike to rise to the challenge and respond to it in creative ways, hence the notion that invention is the daughter of necessity.

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