

Visual representations: Setting contexts for learners

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We have created a novel project on 'Ebola virus' for "The Virtual Laboratory" online learning environment using an imaginative visual approach to set contexts, develop research skills and enhance memory retention. The project develops the environment supporting the teaching and learning of biology at year twelve level using constructivist approaches. We have moved beyond the strategies of authentic learning used previously in the environment by incorporating a fantasy based scenario and using audio, images, and animations with text layered throughout to encourage learners to search for information. The dual modality of images and text in both delivery and activities addresses multiple levels of visual constructivism, reduces cognitive load and engages learners. Learners are introduced to the project through the fantasy scenario which they research and either develop further as a case study or devise a new imaginative context. The development of their case study is guided by themes common to all infectious diseases thereby revealing and articulating underlying principles of Immunology. Learner evaluation data indicates that setting contexts at disease and learning levels using visual representation has engaged learners, modeled strategies for searching and learning, and facilitated integration and retention of information.

Keywords: Constructivist, learning environment, authentic learning, visual representation, biology, integration, information retention

Introduction

We have previously described the creation of an online learning environment, "The Virtual Laboratory", to enhance the teaching and learning of year 12 Biology units (Brack *et al.*, 2003). The design of the environment was informed by constructivist educational philosophy with an emphasis on embedding content in an authentic context and engaging learners in authentic activities (Honebein *et al.*, 1993). We have now developed a project on 'Ebola virus' to extend the 'Disease' module which focuses on the basic principles of immunology underpinning host pathogen interactions. Themes of cause, transmission, mechanism, diagnosis and prevention are explored using an example from each of seven major disease causing organism. The Ebola project is consistent with the constructivist approach taken in the earlier projects of the learning environment but aims to resolve problems of inherent authenticity in the design of activities.

Proponents of situated cognition argue that meaningful learning will only take place if it is embedded in the social and physical context within which it will be used (Brown, Collins & Duguid, 1989). Therefore, learners need to be provided with an authentic context "that reflects the way knowledge will be used in real life" (Herrington & Oliver, 1995 p. 255), and that they undertake authentic activities. However, it has also been acknowledged that learners can experience difficulty in immersing in authentic environments (Herrington *et al.*, 2003).

In the design of the Ebola project we have attempted to move beyond the comfort zone of authentic contexts by experimenting with imaginative contexts in which to embed content and set activities. We postulated that the use of fantasy would aid in the suspension of disbelief required for engagement. Within the imaginative context the project addresses the constitutive elements of a situated learning process described by Herrington & Oliver (1995) namely: the learner, the implementation and the interactive multimedia program.

We have used visual representation to set contexts, develop research skills and enhance memory retention. Visual representations are used in combination with text at the levels of both content delivery and learner's constructivist response. We have built in opportunities for the four levels of visual constructivism described by Alesandrini (2002): verbal instruction verbal constructivism, verbal instruction visual constructivism, visual instruction verbal constructivism, and visual instruction visual constructivism. We have incorporated dual modality by presenting information in both text (verbal) and visual forms but avoided redundancy by presenting information in one form supporting but not duplicating the alternate form. In this way we have minimised the extraneous cognitive load (that resulting from the way in which tasks are organised and presented) on learners and maximised working memory (Feinberg & Murphy, 2000).

The project is presented as a global case study using the following scenario *"You are an alien scientist who has been summoned to earth to gather information about a number of infectious agents that are ravaging the planet. Gather as much information as you can while you are here."* The learner's task is to construct a case study based on this scenario, or one of their own, as a starting point and shape it using information gathered from within the project, "The Virtual Laboratory" site beyond the project and from the Internet. Learners are guided in the framework of their study through the setting of themes common to all infectious diseases.

The project on Ebola was constructed within "The Virtual Laboratory" as a series of web pages and embedded multimedia modules (Flash, Macromedia Inc).

Development and implementation

The contexts represented visually in the major multimedia module of this project were at four levels. Learners are initially introduced to the disease in a global context (Fig 1), where distribution and outbreak statistics are layered interactively through rollovers. Environmental factors are explored at a local level where information on themes such as cause, transmission and mechanisms are presented in rollovers (Fig 1) and conveyed in animation. The aetiology and pathology of the disease are similarly revealed in a scene representing the community level. Facts and concepts of diagnosis, control and prevention are developed in a local hospital environment. At each level learners are challenged to locate, retrieve, evaluate and associate information. They analyse the information retrieved aurally (audio file describing disease progression) textually and visually and collate it in a comprehensive case study of the disease. Redundancy was avoided by presenting information and concepts in one mode either aurally, visually or in text.

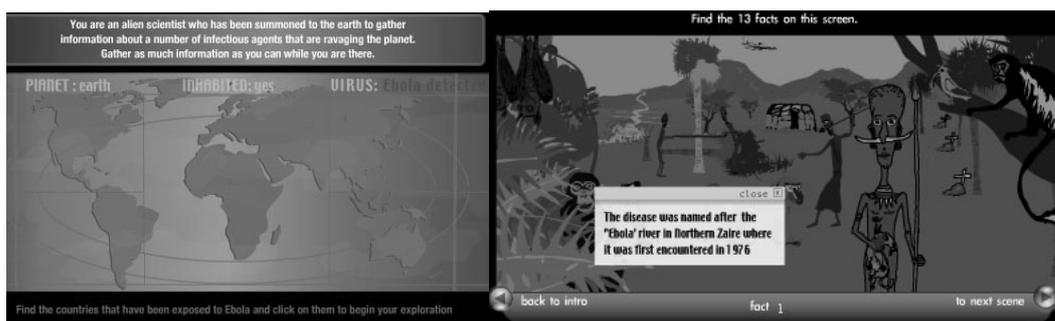


Figure 1: Screens setting the global and the local contexts of Ebola

These four scenes allowed us to contextualise factors common to all infectious diseases. These factors fall into common themes developed for all of the projects on the seven diseases presented in "The Virtual Laboratory". Guidance through analysis of disease enhanced the transparency of scientific analysis and communication.

To participate in the information age, learners need to be equipped with a range of skills, including the ability to collect, analyse, and organise ideas and information (Oliver & Towers, 2000).

To encourage these skills information, organised as separate facts, was interspersed in multiple layers throughout the site. Learners had to search the visual environments and resource section of the site for facts. Visual cues for misunderstandings were incorporated to assist learners in becoming discriminating. For example, learners find in the facts and animations vectors which are common in other diseases but are not vectors for Ebola.

Chunking and categorising of information are modeled as relevant facts are presented in pop up windows (Fig 1). The project requires that learners search further in the site and the Internet to gather data relevant to their particular case study in order to develop the themes of the disease. Guidance in framing the case study further encourages learners to be specific and discriminatory in their search strategies.

Evaluation

Two evaluations were conducted, six months apart, with four students, of the Ebola project and the SNPs project from the Gene Technology module (Brack *et al.*, 2003). The first evaluation was by questionnaire and focus group and covered issues of usability, engagement, interactivity, content difficulty and amount. The second evaluation was by individual interview where students were asked to describe the projects and what they remembered about them.

In the initial evaluation three of four students stated that the 'Ebola' project was more fun and less demanding than the text based project in the Gene Technology module of "The Virtual Laboratory". In the Ebola and Gene Technology projects the intrinsic cognitive loads were similar, as measured by the amount and complexity of the content. The form of supporting material was similar but the projects differed in the way the content was chunked and the media used to deliver the tasks. The Ebola project was more ill-structured. Student perception that the Ebola project was easier is consistent with the reduction of cognitive load resulting from the greater use of visual representation (dual modality). Although one student would have preferred the information presented in a more realistic style, three of the students said that the fantasy style of the project made the topic more interesting and easier to understand. The students did not have difficulty retrieving the information required for their case-study. They understood and managed the multiple levels of retrieval required, within the project, "The Virtual Laboratory" site and the Internet. Further, the searching of information within the project helped them to understand how to search, retrieve and evaluate in a wider context beyond the project and to present retrieved information.

Students found that being able to visualise themes helped them to memorise information. Three of the four students had considerably greater recall of information, both in amount and accuracy, from the Ebola project than from the Gene Technology project six months after completing the modules. The fourth student could recall similar amounts of information but the nature of the information recalled was different.

Conclusion

The Ebola project supported the goal of "The Virtual Laboratory" as a constructivist learning environment. It extended the use of authentic learning into an imaginative framework using visual representation and dual modalities to set contexts and explore themes. In this study, we found that the use of an imaginative context facilitated engagement of learners addressing limitations of authentic activities. The multiple modality with audio, text and visual representation and interpretation was a valuable mechanism for modeling strategies for searching and learning, and facilitation of integration and retention of information.

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