Raising the dead: Reptiles recovered from the brink of disaster.

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Abstract

The "Comparative Physiology and Biodiversity Project" is a series of web delivered CBL modules designed to replace wet laboratories dealing with biodiversity and anatomy of reptiles and echinoderms (sea urchins, seastars etc). The project was conceived as an alternative to traditional animal dissections and because of the advantages offered by virtual environments for comparing physiological systems. The reduction in the use of animals for dissection is important, especially with respect to sensitive native fauna experiencing a decline in local population. Also important is exposing the students to material that is difficult to source, eg. Tuatara, (an endangered but evolutionarily important NZ native species). The modules were conceptualised in 1994, funded by the Committee for the Advancement of University Teaching (CAUT) in 1995, alpha tested and evaluated in 1997. When it came time to fix content and programming errors in 1998 it was discovered that the source code for the Reptiles module, 50% of the entire project, had been lost. The School of Biological Sciences (SOBS) Teaching Development Unit (TDU), an internally funded multi media group, considered the modules of significant educational and bioethical value worthy of completion without additional funding. Pre-alpha source code was recovered and "Reptiles" was resurrected. While the project has successfully replaced significant amounts of live teaching, much work remains to bring the modules to completion. This paper discusses the history of the project and illustrates lessons learnt along the way, especially in the linkage between educators and developers.

Introduction

The major aim of comparative zoology is to communicate an understanding of the conceptual framework that underlies the evolution and diversity within the animal kingdom. Ideally, students should be able to understand the underlying mechanisms that have given rise to major animal types. Pursuit of this objective gives rise to a synthetic view as opposed to a series of "remembered facts". Most often, teaching comparative zoology at university level centres on lectures which describe theories that link in turn to laboratory classes (practice), where animals are dissected and their characteristics observed. Comparison of the structures among animals forms the basis of hypotheses about the origin and function of animal structure. The laboratory classes relate directly to the concepts discussed in lectures.

Comparative zoology has been taught this way for at least 150 years. However, because comparative zoology has become a "fact-intensive" subject, concepts are often lost in the description and review of these facts. Students generally are left to place

observations made in the laboratory into the theoretical framework on their own as there is often a considerable time lag between dissections and related lectures. This also makes the direct comparison of key features very difficult for the students to achieve. A second problem facing courses in comparative zoology is access to a complete set of relevant material. For example, the structure of the reproductive and urinary systems of Tuataras (an evolutionarily interesting yet endangered reptile from New Zealand) is central to an understanding of evolution of mammals from reptiles, but never are Tuataras available for student dissections.

The "Comparative Physiology and Biodiversity Project" set out to improve the way comparative zoology could be taught at the university level. It attempted to do this by pursuing the following practical outcomes: (1) virtual dissections of members of two important animal groups using interactive CD ROM technology. These will provide (2) an interactive textbook that linked lectures directly to practical material and (3) a software platform that would allow a direct comparison of virtual dissections at appropriate points during self-discovery by the students. It was also hoped that a template for the future development of additional material would be provided.

Initial alpha testing of the different modules and the user evaluations concluded that the project was progressing in the right direction. However after a yearlong hiatus in the development process, disaster struck the reptile module. The source code could not be found; it, as well as a number of other works in progress had been accidentally erased from the development machines during the 12-month break in production. Minor content corrections instantly became a major exercise, as the entire module required rebuilding from a pre-alpha version. Moreover the funding for the project had dried up.

History

Initial work began on the Biodiversity project in 1994. It was broadened to include both Echinodermata and Reptilia to gain maximum impact within pre-existing course structures in comparative zoology. Funding for the project was sought from the Committee for the Advancement of University Teaching (CAUT), and was successful in 1995 (CAUT Thompson, Hoegh-Guldberg). The step from concept to reality was then possible. The project was handed over to the University of Sydney multi media production unit.

While advice regarding delivery method had been sought from technical experts when applying for the grant, it became clear that the rapid pace of technological change demanded that the scope and specifications of the project be re-assessed. This was our first lesson. The project became "distracted" by technology. The academics within the project kept resetting priorities and platforms as they were exposed to seemingly better ways of achieving the project goals. In 1996 a decision was made to adopt technologies for CD-ROM delivery on the PC platform.

During development, images were sought from a variety of sources, including academics from other institutions interested in the project. In return for use of their photographs it was agreed to make a copy of the finished project available to them.

After a year of development, the first version of the project was ready for testing within the teaching laboratory. Students used the alpha release versions of the modules in second semester 1997. Formative and summative evaluations were made of the software modules. Comparative performance evaluations were made between two groups of students, one group used the CBL modules and another used the traditional wet lab materials. There was a slightly better performance by the students using the CBL

modules (Appendix 1). Based on the evaluation it was decided to continue with the development of the modules as planned.

Minor navigational problems were encountered during the weeklong trial period. Attempts were made to correct these on the spot so the modules would function correctly, but doing this introduced a new set of "bugs". The more substantial bug fixes, content corrections and responses to user feedback were noted and left until the return of the academic content providers from sabbatical.

> Glaister and Jenkins (Phillips 1997) propose that fixing bugs on the spot is not advisable as this can introduce a new set of bugs. It is better to make detailed notes of the errors and return to the design process at a later time.

While CAUT funding brought the project to the alpha test stage, funding did not cover the remaining development period. Because of the enormity of the project and the visual nature of the subject matter the CAUT funding had been spent producing the digital resources and alpha versions of the modules.

> *"In the real world a project is considered finished when the development money runs out. Hopefully project management and design have been farsighted enough to ensure the project is complete and can be used."*
> (Phillips, R. & Jenkins, N. 1996, p 36)

The above unfortunately was not the case for the Biodiversity project as there were a number of bug fixes and content corrections to be made so that the various modules could continue to be used in learning. It became the responsibility of the newly formed School of Biological Sciences Teaching Development Unit (SOBSTDU), an internally funded multimedia production group, to complete the project.

The modules on the Echinodermata were completed to beta standard with minimal difficulty. They only required navigational changes, interface modifications and optimisation of images for Internet delivery (JPEG compression). When it came time to make corrections to the beta version of the Reptiles module the source code could not be found anywhere. The final alpha version used for evaluation purposes had been totally and absolutely lost.

Recovery from the brink of disaster

Many hundreds of hours and thousands of dollars had been spent producing the digital resources for the reptile module and all that remained was an old pre-alpha Shockwave version that could not be decompiled.

The first step in the recovery process was to scour the hard discs, JAZ discs, MO discs, ZIP discs and CD-ROMs of everyone involved in the project in an attempt to locate the most recent version. The DAT tapes used for routine incremental backups had been recycled and overwritten during the year the project had been idle.

Fortunately the hundreds of photographic images had been archived and were quickly located. A version of the reptile module was eventually located but it was approximately 6-7 months pre-alpha release. There was a lot of work to be done and only 10 weeks to complete it before it was required for teaching.

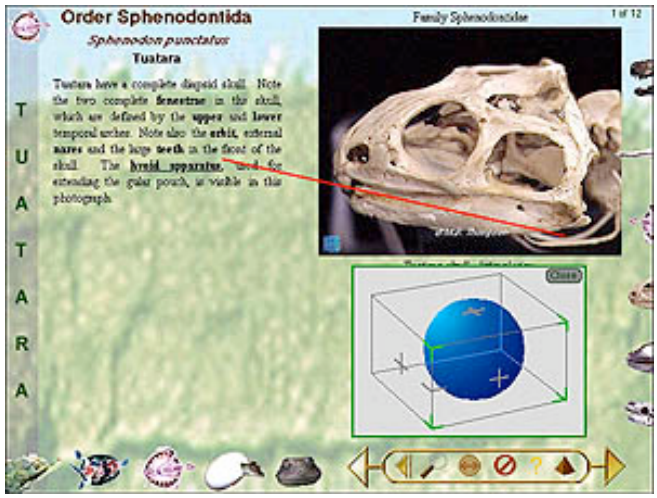
Re-Development of Reptile Beta Product 1999

Because the reptile module needed to be almost entirely rebuilt from scratch other development tools and delivery mechanisms were considered before the reconstruction commenced.

Initially the product was created in Authorware for delivery on CD-ROM. Internet technology had advanced in the four year period since the project was first funded so that it was debated whether other web based authoring tools could be utilised in the reconstruction process. There was however the 10 week time constraint to consider so any decision needed to be made quickly and reconstruction had to be completed within that time frame.

The Reptile module was required to be cross platform (PC & Macintosh) and to run on both major browsers, Internet Explorer and Netscape. Development tools that were considered were -HTML, DHTML, JavaScript, Active Server Pages and Shockwave for Authorware. All of the above authoring tools except for Shockwave are browser specific and there is no easy way to guarantee that screens will be displayed on the user's computer as designed. Another major consideration in the reconstruction process was the complex navigation used. The navigation system is non-linear and non-hierarchical. It is designed as a free information landscape, where the user can choose any path to explore.

Figure 1. Reptile Module Interface



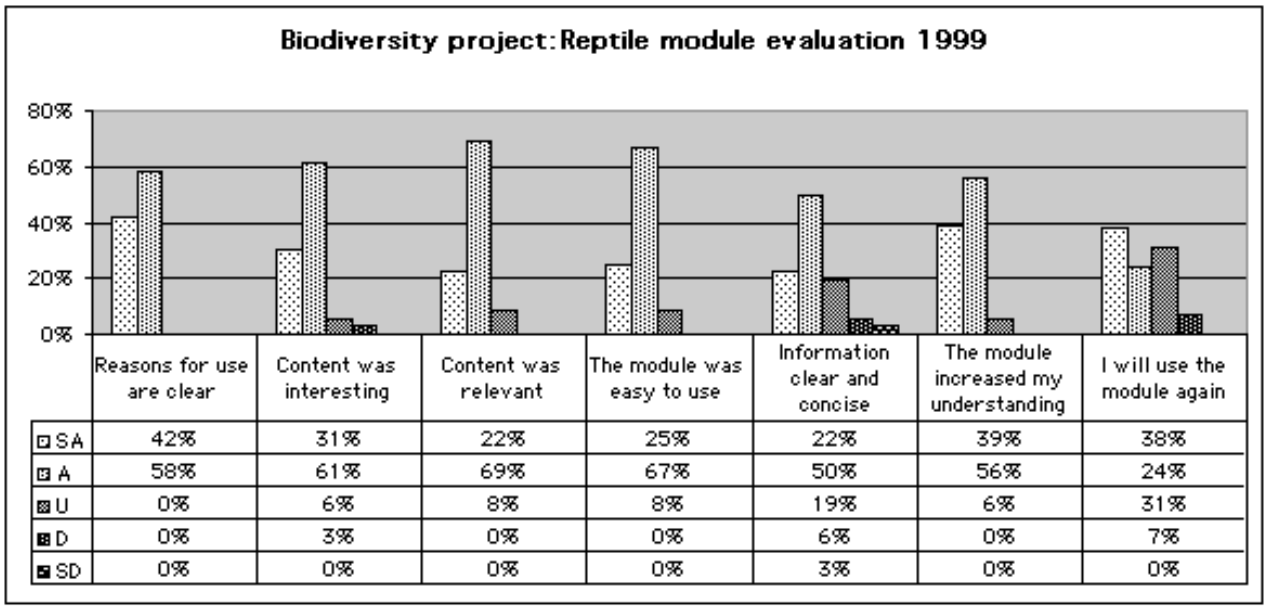
The interactivity level is also high, not only for navigating through pages but also for the information displayed on each screen. Three different functions needed to be available in the text. Mouse over on bold hot text would point to part of the image described in the text. Single clicking on any word would call up the meaning of that word from the glossary and display it in a small floating window. Double clicking on underlined hot text would navigate to another relevant page. All of this would be difficult to replicate using the web based authoring tools.

Factors swaying the developers in the direction of continuing with Shockwave™ for Authorware were the ability to import the navigation set up from the echinoderm modules and that the majority of the images were stored in a pre-alpha version Authorware library.

Due to the time constraint the decision was made to continue developing with Shockwave™ for Authorware. The rebuilding of Reptiles was completed to beta release in time and without serious difficulty and had more functionality than the alpha

version. Students again evaluated the software and results from this survey were again positive (Figure 2). 90% to 95% of the students agreed or strongly agreed that the content was interesting, relevant to the unit of study and increased their understanding. 72% of the students found the information to be clear and concise and 62% said they would use the module again.

Figure 2. Reptile Module Evaluation (1999)



	Reasons for use are clear	Content was interesting	Content was relevant	The module was easy to use	Information clear and concise	The module increased my understanding	I will use the module again
SA	42%	31%	22%	25%	22%	39%	38%
A	58%	61%	69%	67%	50%	56%	24%
U	0%	6%	8%	8%	19%	6%	31%
D	0%	3%	0%	0%	6%	0%	7%
SD	0%	0%	0%	0%	3%	0%	0%

Lessons learnt

One of the overwhelming lessons learnt from the loss of the reptile module is to "Backup, Backup, Backup", and to never reuse old backup tapes. For the cost of a few new DAT tapes, ten weeks work could have been avoided. Following on from this recommendation, do not put all your faith in one backup device. The authors have on several occasions been unsuccessful in restoring lost files from tape backups. The use of more than one form of backup is extremely advisable. It is recommended that for the small cost of a blank CDrom you can make a permanent copy of work in progress. Alternatively for a slightly higher cost some other form of removable media can be used, eg ZIP or JAZ discs, and these stored in a safe place off site (Jenkins 1997).

When working in a team on a large project such as Biodiversity it is extremely important to be organised. Records of the development process and details of the current status of the project must be kept up to date. This allows team members to easily locate the most recent versions of all resources when required. Following on from this it is also very important to keep all past versions of the source code and all resources used in the development cycle. It is especially important to protect master copies. Computer files can become corrupted for no reason and can no longer be opened. This is when previous versions become invaluable.

> *"In the microbiology project, delays in testing caused a real problem. The programming on one module was completed in October, but it was not tested for bugs until March. It was then found that the installed module was corrupt. In the meantime the programmer's hard disk had crashed, but he was not worried because there were any number of backups! Unfortunately each of the backups was also corrupt, because the regular cycling of tapes over the monthly cycle had over written the uncorrupted*

> *version. If a master copy had been made when the module was completed, this problem would not have occurred.*" (Jenkins 1997, p 157)

Another valuable lesson learnt in the reconstruction of the Biodiversity project is "Do It Properly the First Time". After the initial prototype stage is completed spend a little extra time creating final versions of graphics and navigation controls before adding content (Blum 1995). Many hours were spent converting large 1-2Mb images stored in the library file from bitmaps to smaller ~100Kb compressed JPEG's. The reduction in byte size was mainly due to the decision to continue with Shockwave™ for Authorware for delivery of the product. Low bandwidth files are especially important for Internet delivered learning materials. As a result of the reduction process the reptile module is approximately 50% of the original size and the echinodermata modules 30% of the original. This is a considerable saving in download time for students using an average speed modem. It would have been much more efficient if this procedure had been performed when the image library was created.

In regard to the navigation within CBL modules, the KISS principle (keep it simple stupid) should apply were possible. Complexity in navigation increases development time and associated cost considerably, with a subsequent increase in end user confusion. Navigation systems should be "stress" tested for many different user styles of navigation.

Associated with KISS is the PIFF (Plan the Interface First and Foremost) principle. Time is well spent in getting the interface right before continuing with the development. Careful planning, design and project management ensures that learning objectives of a project are achieved within budget and time frame. (Phillips 1996). It is important that the product has a professional appearance but this should not be at the expense of the educational objectives.

Conclusion

We feel that we have achieved a quality product that closely reflects the original vision, despite all the difficulties encountered. In the process the development teams have learnt many valuable lessons and will build on these experiences in future developments.

Appendix 1

1997 Data Comparative Evaluation	n	Average score /15	
		Wet Lab	CBL module
Echinodermata	87	10.18	10.35
Std Dev		1.69	2.22
Reptiles	87	7.19	8.35
Std Dev		1.75	1.36

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