Bioscience Learning & Teaching Case Study

Example/Case Title	Development of a Virtual Analytical Laboratory (VAL) multimedia resource to support student transition to laboratory science at university.
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Activity	The development and pilot testing of an on-line laboratory skills resource containing multimedia content to support student transition to laboratory science to (and through) university.
Student Group	First year undergraduates studying Biomedical Science and Medical Science (BSc Honours) at De Montfort University have used the resource this year, totalling n=110 students. Biomedical Science is an IBMS accredited programme that has a strong emphasis on laboratory skills and techniques, whilst Medical Science combines laboratory and clinical techniques to prepare students for broader-based medical-related careers.
Aim	Our aim for the VAL was that it would enable undergraduate students to build a foundation of basic laboratory skills and knowledge before they enter the bioscience laboratory.
Context / Background	Large numbers of students are entering bioscience programmes at De Montfort University with no prior laboratory experience. Students range from those working in laboratories as part of the co-terminus and intergrated vocational pathways, to those with absolutely no experience of laboratory work from school or college. A 2007 survey of biomedical science students (circulated in November after 6 weeks of teaching) indicated that 25% of 1st years had never been in a laboratory prior to university (64 respondents out of a cohort of 71), and in a repeat survey in 2008, 35% claimed to have no prior experience (82 respondents out of a cohort of 88). Using a Likert scale to understand student attitudes towards their own laboratory skills, (where 5 = strongly agree and 1 = strongly disagree), a third the 2007 first year students claimed that they were not confident in their laboratory skills six weeks into the term; second year students also questionned commented that their laboratory skills were often rusty after returning from the summer holidays. Our first thought was to search for suitable resources on the internet. YouTube is a useful source of video material, and whilst lab skill resources do exist, e.g. how to do serial dilutions or use a spectrophotometer, they are often poorly produced or too basic. Hence, 5 members of staff within the School of Allied Health Sciences decided to develop a set of basic laboratory skills resources and introduce them into Biomedical Science and Medical Science programmes in October 2008.
Example description	The Virtual Analytical Laboratory The Virtual Analytical Laboratory (VAL) resource is innovative in that it is one of the

	first comprehensive resources of its kind for bioscience undergraduates that is freely available on the internet. VAL is essentially a website housing a number of multimedia lab skills resources including 6 videos, 22 animations with voice over and 11 screen-capture resources to date, (with more in the pipeline and collaborators welcome). Resources include introductions to microscopy, spectrophotometry, pipetting, serial dilutions and standard curves. The aim was not to produce polished, rehearsed video sequences but to capture information just as the lecturer would explain it in the laboratory. The format of the design was based on the University of Nottingham School of Nursing "SONET" group who have published a large number of resusable learning objects incorporating text, sound, animation and video. (Available at: http://www.nottingham.ac.uk/nursing/sonet/index.php). Development approach and feedback The content for each resource was developed by a member of staff and reviewed by the multimedia developer (VR) who is also a bioscientist. For animations, the text provided the basis for a voice-over which was then the starting point for the animation timings. Resources such as those demonstrating equipment or techniques were more appropriate in video format. Resources that demonstrated computer programmes such as Excel were produced using screen-capture software. This case study reports the results of an initial evaluation of the pilot resource. Embedding VAL into bioscience programmes The module BIOM1004 Structure and Function of Cells and Tissues was chosen to pilot the resource, (since it is one of the modules that I lead). In term 1, two computer-aided learning (CAL) sessions (each lasting 3 hours) were timetabled for students in weeks 1 and 3, and laboratory-based practicals were delayed until week 5. In the CAL sessions, students worked through the resources, in addition to being encouraged to use them in their own time. An academic stayed in attendance to answer questions for part of the time and was available on email for the remainder. Technical specifications Animations were developed using Adobe Flash CS3 Professional. Video was captured in non-high definition and converted to Flash video format (".flv" file). Adobe Captivate 2 screen capture software was used to produce tutorials to demonstrate software for example the use of Microsoft Excel to construct graphs and perform calculations. The beauty of Captivate 2 is that a basic tutorial can be produced as a demonstration, and then re-produced with an increasing level of interactivity. More details of the techncial specifications and the problems encountered when developing the resource can be found on the VAL website under "Designing VAL", and there is now an accompanying developers blog.
Results / Feedback	A questionnaire was circulated to all BIOM1004 students (n=82 respondents out of a cohort of 88) asking about their prior laboratory experience, perceptions of the VAL resource and included a short laboratory knowledge test. Questions were based on a 5-point Likert Scale (1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree), or were open-ended questions.

Usability and perceived educational value

The student evaluation of VAL was positive in terms of usability of the resource (ease of navigation, web design, ease of use); 84% of students (agreed or strongly agreed) they were satisfied with VAL overall, with a mean Likert score of 4.1. For other perceived positives and negatives, the results were as follows as indicated in the table:

Table of Likert Scale Responses (1 = strongly disagree, 3 = neutral, 5 = strongly agree).

	Mean Likert score	% agreeing / strongly agreeing
POSITIVELY PHRASED QUESTION		
Helped me understand before going into the lab	3.8	76.3
Beneficial educational tool	4.1	84.2
Video clips are useful	4.1	86.8
Resources are good quality	4.0	81.3
Taught me basic skills before entering the lab	3.8	72.4
Quizzes and tests are useful	3.9	71.1
I watched resources and made my own notes	3.2	43.4
NEGATIVELY PHRASED QUESTION		
The calculations are confusing	3.1	35.5
I had technical problems	2.6	20.0
It confused me - once in the lab the skills were different	2.4	9.2
I would prefer learning IN the lab	3.5	50.0
Frustrating to use	2.1	5.3
Using resources online is not useful to me	2.3	10.5
The sound was annoying so I switched it off	2.0	5.3
I would have preferred a study guide	3.0	34.2

Students felt that the VAL was beneficial overall, and useful prior to entering the laboratory. The resources including video and quizzes were well received. Most students tended to watch and listen to the resources whilst others (43%) claimed that they made their own notes. It was important to know whether the skills, once in the laboratory, were taught differently, and only a minority agreed with this (9%). 50% would have prefered learning directly in the laboratory (possibly believing at the time that the VAL was a substitution for laboratory work altogether). Around a third of the students would have prefered a study guide to help them work through the resources.

Laboratory knowledge: perception and performance

Did the VAL help students acquire knowledge of laboratory skills? Students were given a short test based on the resources and also questioned on their perceived level of confidence in their skills. The test was issued in week 6, three weeks after they had completed the CAL sessions. Students were catagorised as those with prior laboratory experience and those with none. As with the 2007 cohort, many students in 2008 entered university with no prior experience (28 out of 82 students,

34%), as shown in the following table.

Table of Laboratory Test Scores and Perceived Confidence in Two Cohorts of Bioscience Students.

	Lab experience	No lab experience	Statistics
Total 2008 Cohort n=82			
No. students	54	28	
Laboratory test (12 marks)	4.94	4.76	p>0.05
Lab skills confidence (mean Likert score; 1 disagree - 5 agree)	3.75	3.65	p>0.05
Total 2007 Cohort n=64			
No. students	48	16	
Lab skills confidence (mean Likert score; 1 disagree - 5 agree)	3.88	3.13	p<0.05

It was interesting to see that although all the students just averaged a pass (40% overall) in the laboratory test, those students with no prior experience who had only used the VAL to obtain any laboratory knowledge performed EQUALLY as well as those with prior laboratory experience, with no signficiant difference in test scores ($p>0.05$). Both groups claimed to be equally confident in their laboratory skills ($p>0.05$). Comparing the 2008 group of studnets with no prior experience to those in 2007, there was a significant increase in their perceived confidence levels (2008, mean Likert score 3.65 *versus* 2007, 3.13, $p<0.05$).

Feedback from students

Overall the students found using VAL useful particularly before going into the laboratory for the first time.

> "I found it really useful because I know what I'm going to expect exactly in the lab sessions."
> "VAL is very useful for someone who has not been in the lab before".
> "VAL has been very useful in easing my nerves before lab sessions".

Some negative comments described technical difficulties that had been experienced, and reflected that that VAL was to basic or confusing.

> "I have already covered some aspects at A level".
> "Sometimes the videos wouldn't load".
> "I don't understand what it is used for".

Feedback from staff

The use of VAL has spread across the faculty including Forensic Science and Pharmacy programmes. Anecdotal evidence from laboratory staff is that it has had an impact in the laboratory, with students not asking so many basic questions and seeming confident in their approaches.

	Amendments and Adaptations 1. Improve the educational effectiveness of the resource by providing a study skills guide, and categorise resources them into those that contain basic skills and more advanced knowledge so students know which to use first. 2. Media files will be published in a range of formats including audio and video that can be downloaded to portable media players. 3. An aim for the final resource is to include diagnostic-pre test and a progress post-test. This will give more a accurate assessment on the academic impact of the resource and provide the students with a richer learning opportunity. It could be that resources are embedded within a VLE such as Moodle to do this. 4. Use Google Analytics to monitor the use of the site, and include on-line questionnaires to harvest feedback and comment from users (via Survey Moneky). A more comprehensive evaluation of the resource will take place including assessing the impact on student skills and knowledge. Conclusions A significant proportion of students enter bioscience programmes at De Montfort University without prior laboratory experience or knowledge. The Virtual Analytical Laboratory has been piloted in one module this year and has met its initial aim of providing a number of basic multimedia resources and quizzes to support students in their transition to science at university. Initial data indicates that is useful in providing knowledge prior to entering the laboratory; after using the VAL students WITHOUT laboratory experience were equally knowledgeable and confident in their laboratory skills as those WITH past work experience. The feedback from the pilot evaluation will be used to enhance the pedagogical effectiveness of the resource. From a staff perspective, time is generally acknowledged as a barrier to developing electronic resources. We have demonstrated that the production of good quality material is not impossible in a short space of time. An acceptable video may take 30 minutes to shoot; a screen capture resource demonstrating software may take a few hours and a more complex animation 1-2 days. The time saved from repeating instructions across multiple laboratory sessions to ensure that each student is able to work confidently and safely in the laboratory is incalculable.
Further comments or information	Web link to VAL! http://hlsweb.dmu.ac.uk/ahs/elearning/RITA/Index.html The resource is freely available to academic institutions to use under the Creative Commons 2.0 Licence. Funding to support the development of the VAL was received from De Montfort University Research Informed Teaching Award (RITA) and also VR's University Teacher Fellow Funding.
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