P103

Reflections on an integrated team approach to the creation of new e-learning resources for first year engineering students.

Holly Fox, David Whitley, Julian Tenney, Carol Eastwick
(carol.eastwick@nottingham.ac.uk)

University of Nottingham, UK

Abstract: *The creation of material to support student learning through an e-learning platform requires an understanding of students' preferences in delivery and learning styles. By establishing an integrated team of academics, student and teaching technologist these issues were examined relating to the teaching of heat transfer within two different disciplines of engineering.*

This paper reflects on the advantages and challenges of an integrated team approach for this project. Briefly benefits have included effective transfer of knowledge and good working practices, as well as novel approaches to the creation of material. Whilst challenges have included the steep learning curve and the need to assess technologies at the same time as material creation, with an underestimation of the training requirements at the beginning of the project.

The e-learning objects created within this project are being used throughout the 2009-10 academic year and feedback is being collected from students to assess the effectiveness of the material. Initial feedback is positive but the data is too sparse at present to produce a robust analysis. Collection of feedback is continuing to allow further analysis and development.

Introduction

Within the Faculty of Engineering at the University of Nottingham a ten week project took place over the summer of 2009 to create a new set of e-learning resources for use in foundation and first year teaching. The project was internally funded from the University of Nottingham E-Learning Teaching and Learning Strategy fund and allowed the formation of an integrated team of academics, teaching technologists and current students to investigate different aspects of e-learning from all disciplines in engineering.

The project was arranged into a series of themes and this paper relates to one of those themes. The theme discussed in this paper is the creation of e-learning media to support and supplement teaching of heat transfer to first year students.

The main aim of this paper is to provide a reflection on how effective an integrated team was in designing and creating e-learning units. The lessons learned are examined to highlight issues for future projects of this type. This paper does not seek to describe e-learning or teaching technology development, rather it describes how an integrated team approached e-learning and how the process was managed to ensure inclusion of student driven creation of material. Recent publications on e-learning development (Russell and Bullen, 2009) provide a good starting point for readers who wish to further investigate e-learning development.

This paper includes an initial evaluation of the units created. However, as the project is in a continuation phase at present, with evaluation, review and adaptation of the resources based on feedback still to be completed, this paper is very much a reflection on the initial phase of the project rather than a description of the final outcomes of the project.

The project team was made up of a current third year mechanical engineering student - Holly Fox, a learning technologist from the University of Nottingham central team - Julian Tenney, and academics from two different disciplines of engineering, Chemical Engineering - David Whitley, and Mechanical Engineering - Carol Eastwick.

Project Aims & Objectives

The aim of the overall e-learning project was to create a new set of resources where student feedback had highlighted a need. For each theme an aim and set of objectives were then identified.

For the theme described in this paper, creation of media to support heat transfer teaching, the aim was to develop self-driven e-learning media that would allow students to recap concepts presented in lectures. This aim was set prior to the launch of the project.

The objectives for the project were defined jointly by the team within the first week of the project, as were the methodology and time plan. This joint definition by the team was a positive feature of the project, allowing input from all members in a co-operative manner, breaking down any student/teacher behavioural patterns or pre-conceptions of role at the beginning of the project.

The project objectives set by the team were to

- Provide resources that would be useful across both Chemical and Mechanical Engineering courses
- Provide resources to allow students to revise basic concepts they may have met in secondary education or to provide self-learning for those students who had not covered basic heat transfer previously
- Provide resources to supplement lectures and allow students to recap material at their own pace multiple times
- Provide visualisations of heat transfer behaviour to better meet students learning preferences
- Provide video animations of worked examples presented in lectures that allowed both an expansion of the worked examples but also multiple viewings of explanations

Within the ten week initial phase of the project it was not possible to evaluate student usage and feedback of the media due to the short duration of the project. However usage and feedback has been monitored subsequently throughout the academic year in a continuation of the project and this is expanded on later in the paper in the section entitled initial evaluation.

The next sections of the paper expand on the context of the project with the methodology and lessons learned presented in subsequent sections.

Context

Traditionally engineering students have had a perception that they struggle with the material taught in Thermodynamics and Fluid Mechanics modules, with the difficulties of teaching this discipline the subject of a number of papers (e.g. Meltzer, 2008).

Feedback from previous first year level students at the University of Nottingham has indicated that they would like support material that related directly to the material delivered in lectures in a format that matched their own notes, with the same use of words, symbols and units. Module feedback also indicated that students had a preference for web delivered e-learning material that could be accessed at any time of day or night.

Given that the same concepts are delivered to Mechanical and Chemical Engineering students it was decided to collaborate across disciplines in the generation of new material. The two disciplines are taught separately by a different team. This is partly to restrict class size to protect the student experience, as the combined cohort of students exceeds 350, and partly due to specialism requirements, where Mechanical Engineering students cover fundamental aspects in the first year leading to follow-on modules in subsequent years, and Chemical Engineering students cover a range of specialist (process based) applications to ensure pre-requisites for subsequent modules.

Methodology

The team was created to bring together expertise in teaching and teaching technology and marry it with a student who had recently taken relevant modules at the University of Nottingham. The student having prior knowledge of the both the subject and the teaching approach used, since she had studied the topic within the mechanical engineering stream in 2008.

Using this approach allowed a fresh examination of both how teaching was presented, that is the media used, but also provided a forum to discuss approaches that might better capture the imagination and interest of the student population. The syllabus was not under consideration within the project, the project focused instead on the creation of material for a specific topic.

It should be made clear at this point that the student member of the team was responsible for designing and creating the material, with the teaching technologist and academics providing support.

The framework for the project was a cascade of tasks, starting with an investigation of existing resources on the web, both to see what was available and to establish good practice. Following this review a short list of teaching topics to be addressed within the project was created. Once the topics were identified the learning outcomes were established and appropriate teaching methodology and media investigated.

The following sub-sections draw out the outcomes from each of the tasks, with a review of the lessons learned regarding the approach in the following section.

Review of Available Resources and Best Practice

Whilst some members of the team were experienced at the creation of e-learning it was important that the whole team developed an understanding of what technology was available, what e-learning existed in the area already and what best practice could be adopted throughout the project.

The first issue, that of what technology was available, was covered by the inclusion of a teaching technologist in the team. This brought a considerable wealth of experience in the development of software e-learning tools and in the development of material for a diverse range of subjects (e.g. Tenney (2003), Tenney (2007), Ball & Tenney (2008)).

The second issue, establishing what e-learning existed in the area already, was partially established prior to the projects conception, since this material had been reviewed for inclusion in the existing teaching material provided to students. The previous review had highlighted non-chargable available material, including for example “how stuff works” (2010) as well as the material posted to open courseware (2010). A further review, driven primarily by an investigation of material hosted on the internet, highlighted other freely available material. Further material that was available commercially was also highlighted, notably Wiley thermonet (2010), and CompuEduHPT (2010). On completion of the review it was decided that there was a need to create units within the project, since no existing material provided all of the requirements.

The review also looked at best practice in the area, and here the resources provided by the Higher Education Academy (HEA, 2010) and JISC (JISC: Implementing e-learning, 2006) were accessed and employed, as well as advice from individual papers (e.g. Cheung et al, 2009).

E-learning Unit Creation

Following on from the review the team identified which specific topics were most appropriate, given both existing resources and previous student’s feedback.

The first two topic units that were identified were targeted at supporting students without an advanced physics background in their transition to university courses, these were:

- Introduction to Heat Transfer
- Basic conduction

The final three units were designed to support students through their first year university courses, these were;

- Intermediate conduction – to extend the basic concepts using simple worked examples linked to lecture material
- Advanced conduction – to further extend and include concepts and worked examples for more advanced applications

- Linear interpolation – to support students in understanding how to interpolate using tables of data, a common activity in engineering, for example steam tables

The next stage of the project was to investigate what tools should be used in the creation of material. The requirement was for material that could be self-driven and easily integrate into the existing VLE platform used at the University, namely WebCT.

For each of the units it was decided to use the Xerte toolkit (Xerte, 2010) to provide a structure to present the material, whilst Microsoft office Powerpoint animated using Camtasia (Camtasia, 2009) was employed to create the video content. The decision to use Xerte was based on its ease of use combined with its flexibility in embedding multiple forms of media, as well as extensive local knowledge and support. Xerte is freeware software developed within the University of Nottingham Learning Team that has been used globally for the creation of e-learning media. The decision to use Camtasia to animate Powerpoint was based on availability and ease of use. The project also investigated capture of examples via smartboards and the creation of videos of physical events.

Xerte was used to create a common template for all of the units. The template has the following structure:-

- an introductory title page,
- a page describing the target audience & learning outcomes,
- a page providing a summary of the concept being covered in the unit to introduce the topic,
- a number of pages with embedded media, e.g. videos, hot pick diagrams, and interactive quizzes to explain the concept in a number of different ways to reinforce learning.

A typical text based page from the new units created in Xerte is shown in figure 1, with a still shot from one of the example videos shown in figure 2 and an example of an interactive page in figure 3.

Figure 1: Example of a text based page from the Xerte unit on basic conduction

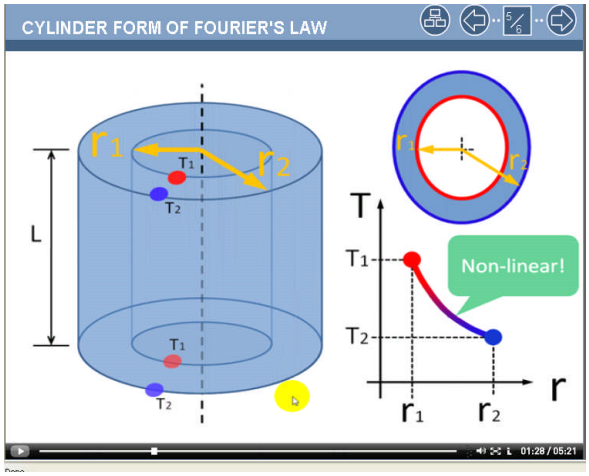

Figure 2: Still screen shot from a video page from the Xerte unit on advanced conduction

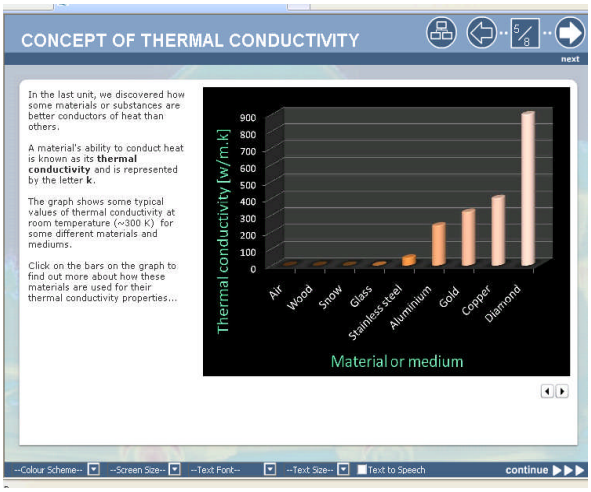

Figure 3: Example of an interactive page from the Xerte unit on intermediate conduction

The completed units were launched for use at the end of the project and have been used throughout the 2009-10 academic year by two separate cohorts of first year students.

A feedback and review process is currently being carried out, with students using the resources being polled via online surveys, use of module review feedback and interaction within lectures via question and answer sessions. The initial verbal feedback from those students who have used it has been very positive. Data analysis is on-going with feedback still being collected. Initial evaluation is provided towards the end of this paper.

Reflection – Lessons Learned

One of the unique aspects of the project was the team composition, which raised challenges but significant benefits to all members. This section seeks to draw out the experiences and to highlight things that worked well and reflect on those aspects of the project that did not go quite to plan.

The biggest project management challenge facing the integrated team was establishing a common agreement on deliverables given that each member essentially used a different language to describe goals/tasks and had different expectations on what a successful outcome would be. This was overcome by ensuring regular and frequent meetings to air project concerns and that clear agreed statements of project deliverables were created.

The other significant challenge was the steep learning curve for some members of the team in creating e-learning material. This was overcome by providing training and close supervision. However, at the beginning of the project the time allocated for this was underestimated. For any future projects it would be advisable to define in advance training requirements fully, taking into account both the need to provide training on pedagogical aspects, as well as the pragmatic aspects of learning new software tools.

Working within an integrated team brought a range of skills and expertise to the project, allowing transfer of good working practices and pragmatic skills in a very effective manner. This was a very beneficial aspect of the project which the team would like to repeat in future projects.

The benefit of using a student member to generate content included the asking of fundamental “why” questions that allowed the re-examination of motivations and learning outcomes, together with novel ideas for presentation of material. Other benefits included a different view on technology usage, and a students’ perception of the likely behaviour of the student community to new material. Having a student member in the team was a very positive experience and again is something the team members would like to repeat in future projects.

A major hurdle at the beginning of the project was in establishing what software and hardware to use, as the team was trying a variety of new approaches, which led to delays in the creation of the material. It may have been better in retrospect to have investigated this in a separate project prior to the start of this project.

Overall the benefits far outweighed the challenges, with close involvement of all team members and frequent meetings overcoming the issues facing the team.

Initial Evaluation

The e-learning units created within the project are currently being reviewed by student users via a WebCT based anonymous quiz, combined with face-to-face volunteered feedback within lectures and support classes. An on-going on-line survey is also collecting more detailed anonymous responses and the student evaluation of module form is being processed to highlight comments relating to these e-learning units.

The surveys are eliciting student responses on a range of questions such as whether they have used the e-learning material and if so how they would rate it on a five point scale for a variety of features. Questions are also posed as to how they are using the material, i.e. to supplement or replace lectures or support classes.

To date the response has been very positive with some of the comments within the free text part of the anonymous survey including “I found it extremely useful and easy to follow”, “Very useful”, “It’s of very good quality and I'd like to thank you for taking the time and effort to make it so”, “Really enjoying the active use of WebCT”. International students have particularly commented that it is helpful to recap material at their own pace shortly after the lecture. No negative comments regarding the material have been recorded so far, although one student commented that they felt they did not have sufficient time available to use the resources.

At present the feedback data is too sparse to create a robust analysis and data collection is continuing. Following a more robust analysis a review of the material will be carried out and if appropriate further development and adaptation will be carried out.

Feedback is also being sought from academic users, with planned dissemination of the units via the open education initiative to collect further feedback from a wider audience.

Conclusion

The use of an integrated team including student and academic members with a teaching technologist proved to be a very effective way of producing e-learning material in a relatively short time scale. Five high quality units were produced and launched for student use within the 2009-2010 academic year. Initial evaluation from student users is very positive but insufficient data is currently available to create a robust analysis. The collection and analysis of feedback data is continuing and once available will lead to a review and adaptation of the material.

Lessons learned within the project, regarding the challenges and benefits of an integrated team, were reviewed within this paper. The key challenges included the steep learning curve for student members, with an underestimation of the training requirements at the beginning of the project. Another challenge included the decision to identify the appropriate technology within the project, as opposed to defining this prior to the project which would have led to faster progress. The major benefits identified were the transfer of knowledge within the team and the use of new approaches to the creation of material.

The team are now seeking to secure funding to extend the project over the next summer given that student feedback will be available to adapt the resources and identify new areas where students would benefit from this style of support.

References

Ball, S & Tenney, J., (2008), Xerte – A User-Friendly Tool for Creating Accessible Learning Objects. In: K. Miesenberger et al. (Eds.): Computers Helping People with Special Needs, Book Series: Lecture Notes in Computer Science. Springer Berlin / Heidelberg, 291-294

Camtasia, http://www.techsmith.com/camtasia.asp, [accessed 11th February 2010]

Cheung, K.S, Lam, J, Im, T, Szeto, R, (2009), Some principles for good practices of E-learning in continuing education institutions, *International Conference on Education Technology and Computer, ICETC 2009*, April 17 - April 20th 2009 Singapore

CompuEduHPT, http://www.energy.kth.se/compedu/Compedu_home_asp/main/default.asp, [accessed 11th February 2010]

HEA, e-learning resources, available from http://www.heacademy.ac.uk/ourwork/teachingandlearning/learningandtechnology [accessed 11th February 2010]

Heat transfer unit, http://www.hk-phy.org/energy/domestic/heat_phy/flash/heat_transfer_e.html [accessed 11th February 2010]

How stuff works, http://videos.howstuffworks.com/hsw/19106-exploring-heat-heat-transfer-video.htm, [accessed 11th February 2010]

JISC, Implementing e-learning, http://www.jiscinfonet.ac.uk/InfoKits/implementing-elearning/index_html, [accessed 11th February 2010]

Meltzer, D, (2008), Investigating and addressing learning difficulties in thermodynamics, *2008 ASEE Annual Conference and Exposition*, June 22- June 24, 2008 Pittsburg, PA, United states, American Society for Engineering Education

Open Courseware, http://www.ocwconsortium.org/ [accessed 11th February 2010]

Russell, M. And Bullen, P. (2009) Engineering Education: Journal of the Higher Education Academy Engineering Subject Centre, 4 (2), Special Issue: Learning Technologies in Engineering Education

Tenney, J, (2003) Flash, XML and re-usability: rapid interactive content development, *EuroTAAC*, March 2003, Blackpool UK

Tenney, J. (2007), Reusable Learning Objects: Enabling Contextual Adaptation, ALT-C 2007: *Beyond Control Learning Technology for the social network generation,* Nottingham, UK, 4-6 September 2007

Wiley Thermonet, http://www.wiley.com/college/moran/CL_0471465704_S/user/index.html, [accessed 11th February 2010]

Xerte, http://www.nottingham.ac.uk/xerte/, [accessed 11th February 2010]

Acknowledgements

Funding for this project was provided by the University of Nottingham E-Learning Teaching and Learning Strategy fund, which the authors would like to gratefully acknowledge.

Grateful acknowledgements are also made for the many useful discussions held with wider project team including Wyn Morgan, Iain Paterson-Stephens, John Filimon, Frank Brufton, Tegan Pringle, Kate Filimon, Mohamed Salahaldeen Alameen Elmaghrbi, Asad Fayyaz, John Horton.

Copyright statement