
Using Pre-Lecture Resources in your Teaching: A Short Guide

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Overview

Pre-lecture resources are a way of scaffolding students' learning of the new material in a module by providing in advance of each lecture some information to ease the cognitive load associated with new material presented in a lecture. This guide aims to offer good tips and hints for the development of pre-lecture resources for academic staff. It is the result of both recent educational research and exchanges on good practice between academic staff in the School of Chemical and Pharmaceutical Sciences, DIT. It provides some information on the use of pre-lecture resources in any technical discipline, on how integrate into teaching and give some examples from literature. [Presented at the 12th Annual Showcase of Learning and Teaching Innovations, DIT, Jan 2011]

What are Pre-Lecture Resources?

Pre-lecture resources are any activity a student might do in preparation for your lecture. This could take the form of reading a textbook extract or Word document, listening to a podcast, performing an online activity or completing a quiz. However a key aspect is that the pre-lecture activity is integrated into the module design and into the lecture itself, so that it is attributed a sense of value by student and lecturer.

The concept of pre-lecture activity is underlined by cognitive load theory, which describes how learners acquire and retain new information. The load, or mental effort has three components, and capacity to process the load is limited by working memory and enhanced by level or prior knowledge. The three components are intrinsic load – the processing of unfamiliar new material and terminology; extrinsic load – the sifting out of pertinent information from information provided; and germane load – the acquisition and integration of new knowledge and storage into long term memory. Pre-lecture resources aim to reduce intrinsic load by introducing some terminology or concepts prior to a lecture, so that students can become familiar with these and allow for working memory in the lecture to concentrate on integrating these terms/concepts into long term memory (germane load).

Integrating Pre-Lecture Resources into your teaching

The nature and extent of pre-lecture resources that you may use in your own teaching will depend on discipline and the nature of your students. The purpose is to reduce the load

associated with the lecture itself, so the resource might introduce some key terms or ideas, ask students to review something before the lecture (which will subsequently be discussed in the lecture) and/or structure a review of some key terms from a previous lecture that will be useful for the forthcoming lecture.

A flow-chart for the development and integration of pre-lecture resources is shown in **Figure 1**. For each lecture, the learning outcomes and new terminology or concepts are listed, and from these core principles underlying that lecture are drawn up. The resource is structured around these, keeping in mind good practice in the design of e-learning materials (see <http://michaelseery.com/home/?p=463> and/or further reading, below). The pre-lecture resource, in the model espoused here, is not a mini-lecture or lecture summary – it is intended to prepare students for their learning in the lecture. Therefore care should be taken not to demand too much of the pre-lecture resources, or they themselves will have their own cognitive load problems. In my own practice, I restricted the resources to less than five minutes interaction time, plus whatever was required to complete a small quiz at the end of the resource. Imposing a time restriction meant that only the most important items to prepare for the lecture were incorporated.

An additional element of the design to consider is interactivity and feedback. Using a podcast or online document means that the information is presented to the student without any opportunity for them to test their understanding. Therefore, a resource with an associated quiz – either a quiz on the virtual learning environment (*webcourses*) or embedded into the resource itself – means that students can test their understanding of what you want them to know before the lecture. In my own case, I had a quiz with four questions for each resource. It is worth considering the questions carefully. Firstly, the questions should be at a level suitable for the pre-lecture knowledge – what do you want them to know before the lecture rather

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than what expect them to know after the lecture, and therefore are likely to be quite easy. Secondly, careful development of questions around common mistakes or misconceptions, along with targeted answer-specific feedback provide a great opportunity for students to identify and address difficulties prior to the lecture on an ongoing

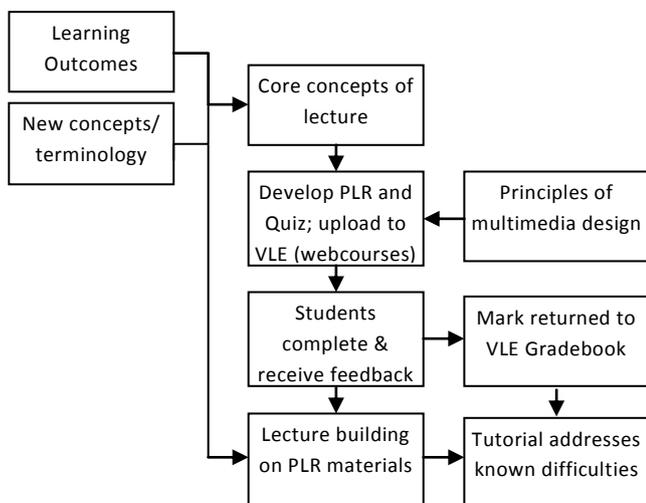


Figure 1: Flowchart for designing and implementing pre-lecture resources (PLR)

basis – a bonus for first years unsure of how they are doing in a new system. Marks may be included formally in the module if required. In developing my own resources, about half the time went to developing these quizzes and feedback, with resources taking around one hour each to develop. Some examples of the resources I developed are available at the website michaelseery.com/chem1306.

The resource is then made available to students in the days after their previous lecture and before the subsequent one. As they complete it, they will receive feedback and a grade, if these are incorporated into the design (the value of harnessing technology is that this is all automated once set up). The lecture itself can then build on the pre-lecture resource, for example building on the key terms introduced or asking students to discuss what they were asked to review. This is important, as it gives the resources a sense of purpose and demonstrates to the students their importance to the lecture. In my own practice, along with other examples from the literature given below, it is found that the nature of the lecture changes as students are able to discuss ideas or preview work with each other or with the lecturer, shifting the nature of teaching to a more student-centred approach. From these discussions, along with feedback from the quiz, tutorials on this lecture content can address difficulties and misconceptions in a more targeted manner.

Some examples from the literature

Some examples and key findings from a few studies available in the education literature on this concept are presented below (from <http://michaelseery.com/home/?p=568>).

1. **Online Discussion Assignments Improve Students' Class Preparation**, *Teaching of Psychology*, 2010, 37(2), 204-209: Lecturer used pre-lecture discussion activities to encourage students to read text before attending class. It had no direct influence on examination results but students reported that they felt they understood the material better and that they felt more prepared for exams.
2. **Using multimedia modules to better prepare students for introductory physics lecture**, *Physical Review Special Topics – Physics Education Research*, 2010, 6(1), 010108: Authors introduce multimedia learning modules (MLMs) which are pre-lecture web-based resources which are awarded credit to incentivize usage. Authors mention one of the reasons as being to reduce the cognitive load in lectures. The total time required for each pre-lecture was about 15 mins, and they covered most of what was coming up in the lecture itself. The authors argue, with evidence from exam scores, etc, that the pre-lecture resources increased students' understanding of a topic before coming to the lecture, measured by post-pre-lecture-but-before-lecture questions, and will present in a subsequent paper how the lecture experience changed because of the introduction of these resources. (T. Stelzer, D. T. Brookes, G. Gladding, and J. P. Mestre, *Comparing the efficacy of multimedia modules with traditional textbooks for learning introductory physics content*. Am. J. Phys.). The authors provide a link to examples of their pre-lecture resources (research.physics.illinois.edu/per)
3. **Benefits of pre-lecture quizzes**, *Teaching of Psychology*, 2006, 33(2), 109 – 112: Tests the use of pre-lecture quizzes and found that students felt that lectures were more organised, felt better prepared for exams, and performed better on essay questions when compared to students who had not completed pre-lecture quizzes.
4. **Student-Centered Learning: A Comparison of Two Different Methods of Instruction**, *Journal of Chemical Education*, 2004, 81(7), 985 – 988: Lecturer introduced pre-lecture quizzes to facilitate just in time teaching – teaching based on student misunderstandings/difficulties identified just prior to the lecture. The students took the approach seriously as they were given some credit for it. The approach was considered successful by staff and students in the programme.
5. **From the Textbook to the Lecture: Improving Pre-lecture Preparation in Organic Chemistry**, *Journal of Chemical Education*, 2002, 79(4), 520 – 523: This paper describes attempts to encourage students to prepare for lectures. The authors argue that engagement with the textbook results in more active learning by students. Pre-lecture activities (“HWebs”) were to be completed by students prior to each lecture, and were based on the content of that lecture. The lecture itself remained relatively unchanged. The analysis found that student performance on HWebs correlated with their end of semester grade. While students generally liked the material, they felt that the system penalized them for being incorrect on material they had not yet been taught. Students did

generally agree that use of the HWebs helped them understand the material in lecture and the lecturers found that the nature of the lecture did gradually evolve to more explanation and discussion.

6. **Preparing the mind of the learner**, *University Chemistry Education*, 1999, 3, 43: This paper uses examination statistics to demonstrate the effectiveness of pre-lectures, with a particular effect noted for students who did not have a strong background in chemistry. The pre-lecture is defined as an activity prior to block of lectures aimed at either stimulating the prior knowledge that may be present but inaccessible/forgotten and/or to establish the essential background knowledge so that learning takes place on a solid foundation. The students involved were in year 1 of 4 (Scottish) degree and included those who had to take chemistry in their first year as well as those who were pursuing a chemistry degree, and students with a low level of prior knowledge were enrolled on the module. The pre-lecture took the form of a short quiz at the start of the pre-lecture, which students marked themselves, followed by the class breaking into groups comprised of a mixture of self-designated “needing help” and “willing to help”. The remainder of the pre-lecture activity allowed for the group to work through activities. The evaluation took the form of comparing the exam results of students in this group (who had little or no chemistry) and the students in the group that did not have pre-lectures but had a good level of chemistry knowledge. The results demonstrated that there was a significant difference between these groups in the years that pre-lectures were not offered, but not in the years pre-lectures were offered. A range of confounding factors, including mathematics knowledge were examined and found not to affect the results. The results are surprising, given that the students without pre-lectures received approximately 10% more teaching time as this was the time given over to the pre-lectures for the group that had them.
7. **Preparing the mind of the learner – part 2**, *University Chemistry Education*, 2001, 5, 52: This second paper from the Centre for Science Education on this topic. Based on the evidence from the first study on the benefits of pre-lectures, this work looks at the development and implementation of “Chemorganisers”. These aimed to enable the preparation of students for their lecture course, ease the load on the working memory space and change students’ attitudes towards learning. The structure and purpose of Chemorganiser design is explained in detail, along with an example. Evaluation was carried out by comparing the exam marks between the two groups described in the previous paper. In the year Chemorganisers were instigated, this difference was insignificant.
8. **Developing Study Skills in the Context of the General Chemistry Course: The Pre-lecture Assignment**, *Journal of Chemical Education*, 1985, 62(6) 509-510: This short paper reports on the inclusion of using instructional activities during a lecture course to allow students develop study habits. Students are asked to read a

section of a text book prior to the lecture and are asked questions at the start of the lecture. Evaluation took the form of student survey, which found that they liked the pre-lecture assignments and that it encouraged in-class discussion.

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Further Reading

E-Learning Design

- Designing E-Learning Resources for Screencasting and podcasting: <http://michaelseery.com/home/?p=779>
- Clarke, R. C., & Mayer, R. E. (2008). *E-Learning and the science of instruction* (2nd ed.). San Francisco: Pfeiffer (Wiley).
- Mayer, R. E. (2005). Cognitive theory of multimedia learning. In R. E. Mayer (Ed.), *Cambridge handbook of multimedia learning*. Cambridge: Cambridge University Press.

Cognitive Load Theory

- Sweller, J. (2008). Human Cognitive Architecture. In J. M. Spector, M. D. Merrill, J. van Merriënboer & M. P. Driscoll (Eds.), *Handbook of research on educational communications and technology* (3rd ed.). New York: Routledge.
- Ayres, P., & Paas, F. (2009). Interdisciplinary Perspectives Inspiring a New Generation of Cognitive Load Research. *Educational Psychology Review*, 21(1), 1-9.

Critical analysis of cognitive load theory and instructional design

- De Jong, T. (2010). Cognitive load theory, educational research and instructional design: some food for thought. *Instructional Science*, 38, 105-134. (Available on author’s website).

Prior Knowledge

- Alexander, P. A., & Judy, J. E. (1988). The interaction of domain specific and strategic knowledge in academic performance. *Review of Educational Research*, 58(4), 377-404. (Paper copy in Aungier St Library)
- Dochy, F. J. R. C., De Ridjtt, C., & Dyck, W. (2002). Cognitive prerequisites and learning. How far have we progressed since Bloom? Implications for educational practice and teaching. *Active Learning in Higher Education*, 3(3), 265-284.