Making online learning more student-centred in the Department of Earth Sciences at the University of Nanjing

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Introduction

A major challenge for tertiary education in China today is the requirement to provide an education for progressively increasing numbers of students, with relatively static resources. Enrolments are at an all-time high and growing rapidly. In contrast, teaching staff and physical resources (such as practical rooms and lecture theatres) have not grown at a comparable rate. Educational institutions are commonly located in urban areas and tend to be concentrated in densely populated areas which reduces the access to tertiary education for people living in the more remote parts of the country.

In order to deal with these two challenges, tertiary institutions in the People's Republic of China began to utilise the advantages of online learning around five years ago. One of the useful characteristics of online learning is the ease of access – educational resources can be uploaded to the Web and then utilised by anyone with a modem and a telephone. These resources can be shared among all people. Learners can access these educational resources at any time and from any place. Online learning is a new tool that can increase our reach, so that we can communicate with a much larger audience and maximise the educational opportunities of people living in the more remote regions. This technology also has the potential to improve the quality of learning and reduce the cost of education.

Online learning at Nanjing University

The first course material to be presented online at Nanjing University was delivered in 1999. Currently, more than two hundred courses are delivered online, complete with username access and password protection. These courses are drawn from many different disciplines and are generally delivered in one of three formats.

1. As support material for traditional lectures–this is provided for on-campus students and consists of online courseware as well as web-accessible lecture notes.
2. Totally online, optional courses for on-campus students. This material consists of lecture notes and courseware provided for students majoring in a different discipline, but taking a particular course in order to satisfy the requirements of their degree program.
3. Totally online-learning for off-campus students. These are online courses provided for students not able to travel to Nanjing University on a daily basis. This style of learning is commonly called '*the third generation of distance education*' in China.

***Introduction to Earth Science* – the online version**

One of the first courses at Nanjing University to be delivered online was the Department of Earth Sciences' first year subject, *Introduction to Earth Sciences*. This course is a core course for undergraduate students in geoscience and also an optional course for non-continuing students without geoscience background. It is generally presented to first or second year students and the main aim of the course is to provide a thorough, but general introduction to the earth and its environments.

For students who major in geology this online material is provided to support traditional lectures. Non-major students do not take lectures; instead they only have access to the online material which presents a thorough, rigorous treatment of introductory geological content and concepts. Students generally respond poorly to the course (either in the traditional way or in the online version). Despite individual curiosity and well-developed interest in the geological environment, it seems that the volume of content and the requirements of our assessment system lead to 'student overload'. Students report that they find remembering too many facts and definitions, classification schemes, lists of mineral properties, rock names and ore deposit characteristics very tedious. As a consequence many students lose their interest in the subject and report that they have no desire to continue studying it.

Two hundred non-continuing students are enrolled per semester and they take the course totally online. Most of these students take the course to fulfill rules that require NJU students to select at least 10 credit points of optional courses for their Bachelor degree. Students report that they read the content online occasionally and then learn everything by rote just before the final examination. They do not have the opportunity to take the practical classes or fieldwork provided for the majors and so miss out on the most important and interesting part of this course.

There are also some other problems that we have encountered in our attempts to use online learning. Anecdotal evidence indicates that students have problems adjusting to the style of online learning. The absence of face-to-face interactions between students and teachers and amongst students, has led students to report that they do not feel that they are involved in a learning process. It leaves them feeling remote, detached, and isolated from each other. This discourages students from participating in the learning process. Students also complain that much of the online courseware is material that has simply been transferred from existing textbooks to a web site, with the online version being little changed or not changed at all. Similarly much of the other online material is text-based. Students report that it makes no difference to them if they read online or read from textbooks. The absence of face-to-face communication with teachers, vivid facial expressions and body language, leads some students to indicate that the worst thing about our online course is that because it is delivered online, it doesn't seem like a real course at all – which is unfortunately reported elsewhere and is a relatively common attitude expressed by students exposed to poor quality web-resources (cf. Bullen 1998).

To solve those problems, we need to rethink our approach to online learning and employ more effective and better learning strategies. We cannot teach anybody anything if they do not wish to learn it (King 2004), so the most important thing is to engage students' curiosities in the subject and nurture their interests in it. This requires: adoption of a more student-centred approach and a redesign of our online course; provision of more interactive online content; opportunity for staff-to-student and student-to-student interaction and greater student involvement in the learning process. In the following sections of this paper I will outline and discuss the strategies that could be used to develop more sophisticated and interactive online courseware, including virtual laboratory work, alternate ways of enabling better communication (student-to-student and staff-to-student); and the development of a more challenging assessment system.

More interactive online courseware

Most online courseware currently in use is too sophisticated, too fact-rich and uses complex language and terminology that is not easily comprehended by the target audience (Science Teaching Reconsidered http://books.nap.edu/html/str/). Successful online courseware often places the most familiar, least abstract and intrinsically interesting modules at the beginning of the course, allowing students to 'settle comfortably' into the course and providing them with maximized opportunities for early success (Powell 2003). In general, online courseware is constructed in such a way that students can navigate curiously through the material. This means that they tend to 'jump' from one area to another and are not constrained to a linear path. This non-linear navigation can give each student more control over their own learning. Ideally, each student could choose a path that best suits them, and be able to link to related concepts to discover connections, or review necessary materials (Powell 2003).

With the help of high-resolution multimedia, we can illustrate what we think has happened in the earth's past, events that are happening now and events that will probably occur in the earth's future. We can even visualize some of the most exciting moments and geological processes that have ever occurred on the earth using animations. Some online case studies can also help students to build analytical and synthesis skills.

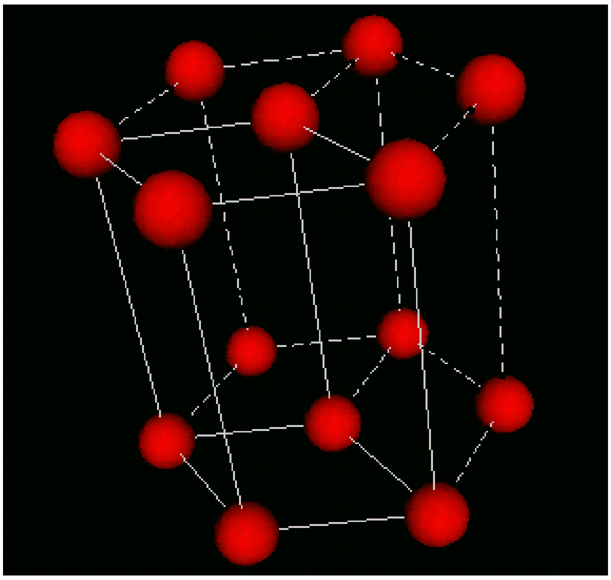

Figure 1. 3D model of an Hexagonal Primitive Lattice

The Bravais crystal lattices can be used as an example of how animation can assist student visualisation. We used to illustrate the organization of crystal structures to our students with still images accompanied by text. Students have difficulty comprehending this concept because they need to think abstractly and in 3-dimensions; that is rotate the structure in their imagination. But if we could provide students with the equivalent animated images, they can make sense of the concept much more easily. We produced rotating animations of the 14 Bravais lattices in VRML (Virtual Reality Modeling Language). VRML is a world standard language to describe interactive three-dimensional objects across the Internet and allows for dynamic exploration under interactive control over Internet. The animations of the 3D Bravais lattice can be viewed from any position, in any perspective and from any distance. The scale of the lattice could be interactively changed to suit different viewers' requirements. Figure 1 shows a hexagonal primitive lattice in VRML.

Integration of animations of this type into well-designed online courseware is an example of the way in which greater interactivity can be achieved. Similar efforts could make the online courseware more attractive so that students are better served by our online learning packages.

Interactive online laboratories and practical work

Laboratory work is a fundamental requirement for an effective tertiary geology education and underpins a professional career. It consists of surveying, observing, describing, and mapping the geometrical or geological relationships of rock units and landforms at the site of their occurrence (Qiu 2002). Geology majors have the opportunity to do practical work and go to real field sites, but the non-continuing students do not currently have these opportunities due to the lack of resources. They have no lab work with real samples and no field experience. If their online learning experience included intelligent virtual tutorials, practicals and field trips, it would improve their experience and provide a more effective education. In addition, students would have the opportunity to take these virtual classes whenever it suited them as many times as they liked. It could be a new tool to support the traditional lab work and provides the opportunity for students to practise and refine their skills.

Virtual tutorial

Online learning is a type of self-directed learning, and while we can provide students with interactive online courseware, it's probably not enough to make the online learning effective. Students need to interact with a tutor to discuss concepts and ask questions. In a virtual tutorial, sets of frequently asked questions can be provided in addition to interactive multimedia and demonstration for the online learners to deal with commonly encountered conceptual problems. Some geological processes could be visualized with animations and some geological phenomena could be filmed and narrated. We try to help students to understand and interpret some geological processes through virtual tutorials, and articulate and re-evaluate their knowledge by audio-visual means. The virtual tutorial can support traditional lectures or be watched by online learners.

Virtual practical

In traditional practicals, students are required to examine mineral samples and record their observations, to get familiar with the mineral properties and compare the properties of a range of different minerals. Currently we can provide geology major students the opportunity to take traditional practicals and there are insufficient resources available to provide these for non-continuing students. So in order to provide an equivalent experience for online students, we have taken digital photos of mineral samples and placed the mineral properties in a database. As figure 2 shows, each icon represents a mineral. Every time the online learner clicks on an icon, a web page will be generated dynamically (as shown in Figure 3). All the main physical properties for mineral identification will be shown on the left side of this page and an image of this mineral with its Chinese and English name, as well as its structure formula will be shown on the other side. Online learners can also examine the mineral and get familiar with their properties online.

Some of these samples could even be filmed or modelled in 3D and be programmed in Java applets, so that online learners could view it interactively from any position and in any perspective, live. These online materials allow online learners to experience something similar to what we do in the traditional practical classroom.

Figure 2. An online list of mineral samples

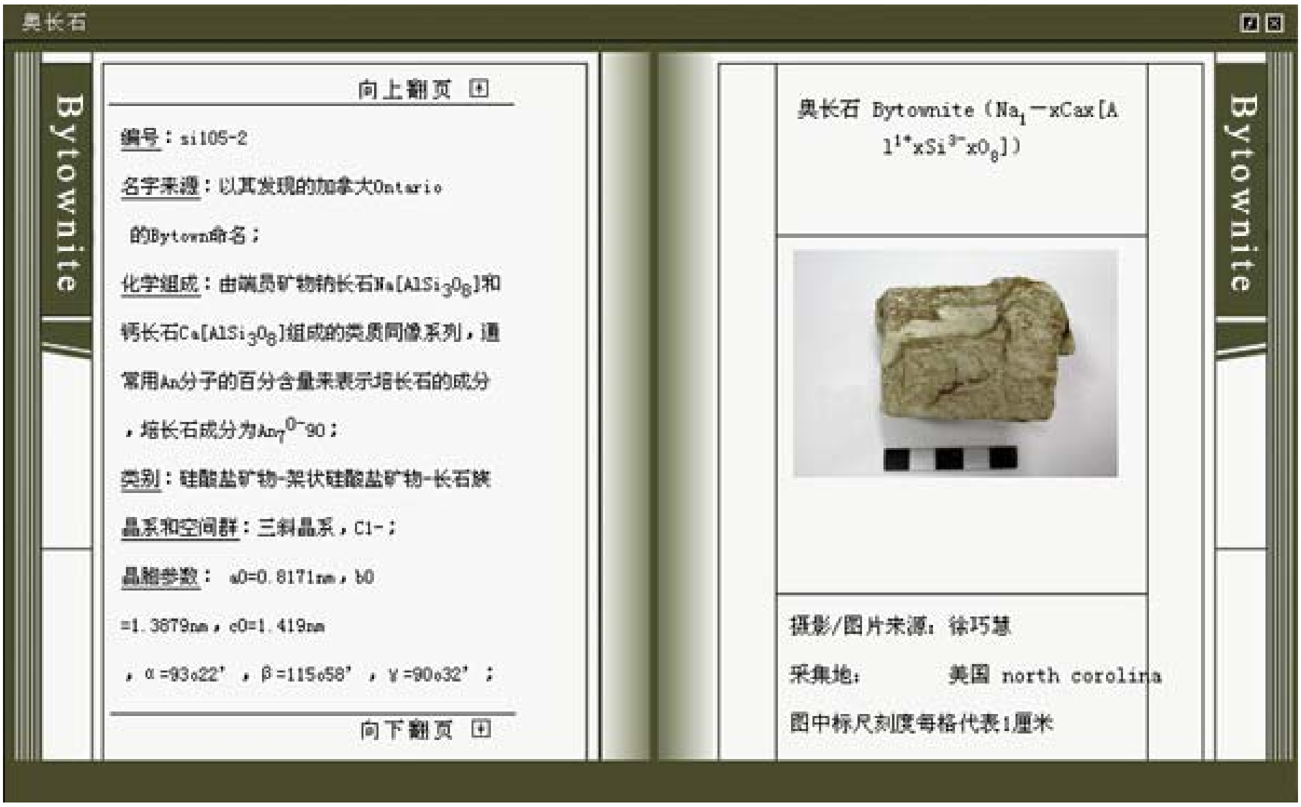

Figure 3. The example of Bytownite for the online examination

Virtual field trip

Field trips or excursions are an important component of training students in the geosciences. In a traditional field trip, we observe and survey the geological relationship of rock units and some other geological features. In a virtual field trip, we attempt to provide a virtual model of the real site to be observed and surveyed. A virtual geology field trip is typically composed of a set of instructions, landscape images and accompanying texts, videos, illustrations and a glossary. All these elements should be connected in a logical way by links and intellectually by task specific activities (Qiu 2002). Figure 4 shows an example.

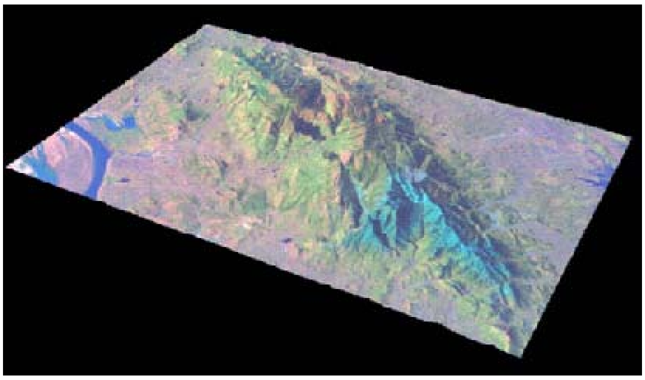

Figure 4. DEM of the Lushan region

This is a Digital Elevation Model (DEM) of the Lushan region. Lushan is a world heritage listed site in southern China. The DEM superimposed with remote sensing images can be surveyed and observed from any distance and any perspective. With high-resolution remote sensing images, online learners can observe the distribution and relationships between rock types and other geological features from this virtual model.

Provision for alternate methods of communication: both student-to-student and staff-to-student

One of the deficiencies of online learning described by students is the lack of human interaction inherent in this style of learning. This problem can be partly rectified by encouraging students to ask questions and seek answers as if they were not constrained by the online setting. This would enable them to be more active learners and gain maximum benefit from the online learning. So both the provision of opportunities for student-to-student communication interactions and student-to-staff communication is considered to be essential for successful online learning.

Both staff-to-student and student-to-student interactions in the online learning environment could be achieved through frequent email interactions. Students could pose questions for each other and to their teacher and share answers and discussions online. This helps students to focus and solidify their own understanding of the concepts into meaningful questions (McConnell 2004).

Chat rooms, bulletin boards, discussion forums and online conference can be used to simulate a classroom discussion environment online. Experience shows that in order to make online interactions more effective, student discussion should be monitored by a teacher. So the online chat requires some advance planning by teachers. For example, they might prepare a list of questions related to the content in order to focus the online discussion and keep the chat on the right track.

Development of an appropriate assessment system

Assessment of the traditional lecture courses at NJU tends to emphasise end-of-semester examinations to simply assess and rank students. It is not challenging or effective. In an online learning environment, we need to develop an appropriate and sustainable assessment system. Formative assessment can provide such a system and could be introduced to improve the online learning opportunities provided by NJU. Because there are no face-to-face responses between students and teachers in online learning, we need to inform students about their progress and give them timely feedback on what they do and do not understand (King 2004). This needs to be provided continually and not only at the end of the semester. Formative assessment indicates to the students their weakness and strengths (Hubble and Dalziel 2000).

Some summative online quizzes, which contain mainly multiple-choice questions about the course and related lab work, will also be given to students throughout the semester to ensure that they work their way through the required material progressively rather than in one or two large batches. These quizzes will be worth up to 25%. A final summative assessment will also be given at the end of the semester. It will be worth 50% of the course mark. The immediate feedback of both the continual and formative assessments given to students will include not only the answers to the questions, but also the explanation of them.

Despite the fact that online learners are separated in space and in time, they must be encouraged to act as a group by developing learning activities which promote interaction and collaboration between partners (Ragoonaden 2000). In addition, all students will be required to work in a group of three to four and produce a group report. This assignment will require the construction of a report for online exhibition to their peers. The topic could be anything that is discussed in the courseware or an earth science topic that the students are curious about, but should be discussed with teachers by all means (email, in person, chat-room, whatever). It will be worth 25% of the course mark. Because it is an online course and students haven't many chances to meet in real world, it encourages them to communicate through Internet as much as possible. They need to retrieve information from all possible sources and exchange ideas and information. They are not supposed to reinvent the wheel and do everything individually. So they should cooperate to complete their assignments. After their reports are uploaded onto the web, everyone would share their outcomes so that the online course will become a thought-provoking tool for everybody.

Conclusion and discussions

In this paper, we addressed the problems of online learning in China, especially at Nanjing University, and proposed a new set of possible solutions to achieve more interactive and effective online learning opportunities. We have outlined and discussed several strategies that will make students more involved in the online learning process. These are generally concerned with generating student interest in the course and providing them with more control over their own learning. Online learning is a relatively new phenomenon both for teachers and students. Both groups need time to adjust to the online teaching/learning process.

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References

Barajas, M. and Owen, M. (2000) Implementing Virtual Learning Environments: Looking for Holistic Approach. *Educational Technology and Society*, **3**(3).

Bork, A. (2000) Learning with the World Wide Web. *The Internet and Higher Education.* **2**(2/3), 81-85. [Online] Available: http://www.ics.uci.edu/~bork/learningWWW.htm.

Committee on Undergraduate Science Education (1997) *Science Teaching Reconsidered: a Handbook*, [Online] Available: http://books.nap.edu/html/str/.

DeChambeau, A.L. (2003) Using Information Literacy Standards to Improve Geoscience Courses. *Journal of Geoscience Education*, **51**(5), 490-495.

Hubble, C.T. and Dalziel, J.R. (2000) Helping Them Pass The use of formative assessment, trial exams and *WebMCQ* to assist students survive and excel in their first university exams. *Third International Geoscience Education Conference*, 49-50.

King, M. (2004) Course delivered to Teaching Sciences in English. A collaborative project between the China Scholarship Council and the University of Sydney.

McConnell, S. (2004) *Transferring your passion for teaching to the online environment: A five step instructional model.* http://www.usq.edu.au/electpub/e-jist/docs/old/vol4no1/2001docs/mconnell.html.

Peat, M. and Franklin, S. (2003) Has student learning been improved by the use of online and offline formative assessment opportunities? *Australian Journal of Educational Technology*, **19**(1), 87-99.

Powell, W. (2003) Essential Design Elements For Successful Online Courses. *Journal of Geoscience Education*, **51**(2).

Qiu, W. (2002) The Advantages and Disadvantages of Virtual Field Trips in Geoscience Education. *The China*

Papers: Tertiary Science and Mathematics Teaching for the 21st Century, **1**, 75-79.

Ragoonaden, K. (2000) Collaborative Learning via the Internet. *Educational Technology & Society*, **3**(3), 361-372.

Rankey, E.C. (2003) The Use of Critical Thinking Skills for Teaching Evolution in an Introductory Historical Geology Course. *Journal of Geoscience Education*, **51**(3), 304-308.

Thompson, S.D., Martin, L., Richards, L. and Branson, D. (2003) Assessing critical thinking and problem solving using a Web-based curriculum for students. *Internet and Higher Education*, **6**, 185-191.