Teaching Botany in English in China

Lijun Wei
Department of Life Science and Engineering
School of Science
Harbin Institute of Technology
Heilongjiang 150001
People's Republic of China

Mary Peat
Faculty of Science
The University of Sydney
NSW 2006
Australia

Abstract

This paper looks at the ways in which the science discipline of botany has been previously taught within the Chinese university system, and ways in which a new teaching methodology could be introduced that would help to develop students' lifelong learning skills. An argument for change is proposed based on the educational research that identifies the strategies used by students in surface learning and deep learning and when they use them. The new model proposed supports the development of a greater self-reliance with students taking responsibility for their learning.

Introduction

As a visiting scholar, Lijun Wei participated in the program *'Teaching Sciences in English: a professional development course for Chinese university science teachers'*. The program introduced ideas about teaching and learning that encourages the development of lifelong learning skills and ways in which these ideas can be incorporated into the teaching of botany. This led to a reflection on current teaching practice and to ask the question 'Why do some students fail?' Every semester there are students who fail the examination. Is it because they do not study enough or is it because 'teaching intent' and 'learning outcomes' are rarely the same thing (Print 1991). Students only learn when they want to learn and what counts for successful learning are motivation, interest and relevance. This is supported in the research literature (e.g. King 1997; Jarvela and Niemivirta 1999; Entwistle 1989).

Approaches to learning

There are three approaches to learning: surface approach, deep approach and achieving approach (Ramsden 1992; Chin and Brown 2000; Zeagers 2001; Entwistle 1989). Students who take a surface approach only memorise information they perceive is needed for assessment. This leads to focusing on discrete elements without any integration of content and building of a knowledge base. Students who take a deep approach can understand what they have learned, and can relate new ideas to previous knowledge, relate concepts to everyday experiences and relate evidence to conclusions. Students who take an achieving approach are concentrating on obtaining the highest possible marks. They can organise their time and effort to the greatest effect, using previous examination papers to predict questions and be alert to clues about marking schemes. These students are often called strategic learners.

Many students take a surface approach to learning, and research of this indicates that taking such an approach is often related to the perceptions of the students about the aims of the course and the types of assessment used. If the teaching is good and the goals and standards are clear, then the students are likely to adopt a deep approach to learning, but if students think the assessment and workload are inappropriate, then they will adopt a surface approach. Analysis of performance and learning styles links excellent students with a deep and achieving approach to learning and poorly performing students with a surface approach to learning (Ramsden 1992; Chin and Brown 2000; Trigwell, Prosser and Lyons 1999). It would appear that one of the most important factors affecting approaches to learning is the quality of teaching. A good teacher should be responsive to the students' needs, have clear teaching goals, well-organised teaching materials that are relevant and approach each teaching task with a good grasp of the content and an enthusiasm to share this with the students. In addition assessments should be appropriate to encourage deeper approaches to learning.

Context of the discipline

Botany and zoology are compulsory basic subjects for all students who will major in the Biological Sciences. Unfortunately, students love animals more than plants, because they are more familiar with animals and find the study of botany difficult as it has many new concepts, structures and names to be remembered. Much of the basic information or core knowledge must be assimilated by the students before they can move on to study the more applied biological courses that are inherently more interesting. At this first year level many students find botany boring, and this can lead to them taking a surface approach to learning. Plants have a significant relationship with humans and this aspect (using real-life issues) needs to be explored by teachers to enthuse and encourage students to take a deeper approach to learning botany.

Characteristics of the first year botany students

Our first year students are mostly school leavers, aged between 18 and 20, and come from single-child families. Most of them are not living at home, having come from other cities, and they live on campus with their classmates in residential facilities. As they have just moved from the school system to the university system, all of them face a number of transition issues, such as the ability to live independently, forming new relationships with peers and a sudden change in their learning environment. Some of these issues may cause them problems during first semester and it is apparent to me that some of the students are still not accustomed to university life during the second semester of their first year.

Our students enter our University with varied background knowledge of botany. In junior middle school they would have studied botany for one year, zoology for one year and human physiology for one year, whilst in senior middle school they would have studied general biology for one year. As biology is not included in the entrance examination in some provinces, the resulting educational and academic background of enrolling students varies depending on the school they attended.

Current teaching and assessment approaches

The current approach to teaching is teacher-centred. Students attend classes to listen and take notes; they are not required to be interactive during these sessions. This is a passive experience for them and a good memory can help them to get a high mark. Most of them are probably taking a surface approach to learning. A move from teacher-centred teaching to student-centred learning will help change the student learning outcomes.

Teaching approaches

The course has 54 hours of teaching time, currently divided into two parts: lectures for 33 hours and practical work for 21 hours. In addition, there is a ten day field trip to Hat Mountain during the summer holidays.

The course is taught mainly using 2-hour lecture sessions (with a short break in the middle) during which the students listen carefully and take notes. Although students are allowed to ask questions during the lecture, they seldom do, and questions are answered after the end of each lecture in a one-to-one mode rather than sharing the question and answer with the class. At the end of each lecture the students are given questions for homework and it is expected that they will use the textbook to help with the homework questions. Every week some of the homework is collected and students will receive feedback on this.

In the practical class, students work individually. They have written notes to follow; the main procedure for the practical class is put up on the blackboard and students are given a short lecture-style talk on what they are about to do. After the students have finished the practical work they hand in their reports which are later marked.

The field trip takes them to Hat Mountain that is three hours away from Harbin by train. Students work in small groups collecting specimens, which are identified along with the environments in which the specimens are found. At the end of the field trip each student hands in a report on the activities.

Assessment

Currently the students have two closed-book examinations, one in the middle of the semester and one at the end. These examinations include multiple choice questions, short answer questions, and long answer (essay-style) questions. The short answer questions use 'fill in the blanks' formats and definitions of biological concepts. In addition to the two examinations students gain marks for homework and practical work. The mark distribution is 10% for homework, 20% for practical work, 30% for mid-term examination and 40% for the final examination.

A new teaching model

Currently in tertiary science teaching there is an understanding that a move to student-centred learning (as opposed to teacher-centred teaching) may result in better long-term outcomes, in particular in graduates having the necessary generic skills to continue to learn throughout their professional careers. To encourage students to develop these skills may require some changes to the way we teach our science disciplines. To encourage students to take responsibility for their learning, develop team and communication skills and put in practice those skills required for lifelong learning, a new teaching model for the first year botany course is proposed. This must include a consideration of the aims of the course within the context of the student's professional aspirations. In addition it is important to specify to the students (as well as to the teaching staff) the expected student learning outcomes, and how they will be measured.

Aims of the introductory botany course

This course aims to build upon the ideas from the biology studied in middle school. In this way students will be able to construct their own knowledge schema. Students should:

- grasp the basic theories and skills of botany to establish

good knowledge backgrounds for higher level courses;
- develop the ability to solve real-life problems using the theories and skills learned in class;
- understand the concept that plants are forever evolving and have done so since the origin of life; and
- develop an inquiring and open approach to the study of botany.

Student learning outcomes

By the end of this course of study, students should be able to:
- apply the basic theory of growth and development to gardening and farming, including an understanding of plant structure and function;
- appreciate the basic characteristics of algae, liverworts, ferns and seed plants so as to be able to identify them and explain the difference between these groups; and
- understand the tight relationship between plants and their environment and that they influence one another.

New course format

In order to meet these aims and outcomes, the course will be re-arranged to include opportunities for student-centred exploration of issues and ideas. The course will be divided into four parts (instead of three): lectures (20 hrs), practical work (20 hrs), tutorial (14 hrs) and field trip (ten days).

Lectures

Learning outcomes will be clearly stated at the beginning of each lecture, along with the goals of the lecture, giving students an outline and related references, and telling them which part of the lecture will relate to assessment.

Presentation of lectures will incorporate the use of *PowerPoint*, VCD and videotapes.

Lecture time will be reduced in two ways. Firstly there will be fewer lectures and secondly the length of each lecture session will be reduced to one hour. In addition the lectures will incorporate student-centred activities to enhance active learning rather than passive listening. Each one-hour lecture will be divided into two sections with each section having a different emphasis. It is well documented that concentration time is limited to about 15-20 minutes, and after 20 minutes concentration rapidly diminishes. At the end of each short section, a question will be posed. For example, at the end of the lecture on mitosis and meiosis, I will ask them to find out the differences between these two patterns. They will be given 3-5 minutes to think about their ideas on their own, then asked to discuss their ideas in pairs or in small groups, and finally report back to the whole class. The class ideas will be put up on the blackboard.

Aspects of problem based learning will be incorporated into some of the lectures to enable students to develop problem solving skills. For example, *Why the farmer's wheat can't fruit?*

First, the students will be given a real world problem to read:

> *There are two kinds of wheat; one kind should be planted in spring, and bloom in summer then fruit in early autumn, which is called spring wheat. The other kind should be planted in autumn, as it can survive the winter in the field, then bloom in spring, and finally fruit in summer, this kind of wheat is called winter wheat. In China we plant spring wheat in the north of China, and plant winter wheat in the south of China. Last year, a peasant in Hunan Province (in the south of China) missed the planting time in autumn, so he planted in the next spring. The seeds germinated and grew very well, just as well as the spring wheat seeds, but when the spring wheat was ready to harvest, the farmer's wheat still kept growing without a single flower. So he got no harvest that year. He was very sad but he didn't know why his wheat didn't fruit. Can you help him to distinguish why? How many methods can be used to get plants to fruit?*

Students will be asked to work in groups of 5 or 6, to brainstorm the problem and construct a pre-concept map of their ideas. Based on their pre-concepts I will give them some reference material and after a week they will be asked to share their ideas with the class.

Tutorials

Tutorials will be introduced to enable students to take more responsibility for their learning by encouraging them in a small group situation to ask questions and share knowledge and understanding. The class will be divided into small groups (of ten students). The content of the course that would be best suited to this type of learning environment is botanical anatomy as it is the most difficult to conceptualise owing to the great variety within structures from species to species part. In addition most of the anatomy is at the microscopic level, which can pose difficulties in interpretation of what is being viewed down the microscope. A mix of visual aids will be used to help in the interpretation of anatomy.

Laboratory work

Practical ability is very important for biology students, both at the individual skills level and in groups. The botany laboratory will be open for two days a week for the students to use it when it best suits them. Most of the practical work will be done individually, but experimental design by small groups of students will be used to foster development of group skills. For example, students will be asked to design an experiment to find out the optimum condition for seed germination, and observe the process of seed germination. Each group will develop its own project guidelines and be able to practice in the laboratory with any of the available equipment. The outcomes of this type of group activity will be a formal presentation.

Field trips

As part of the new course the students will be expected to be involved in some field activity outside of class time in the local Botanic Garden. Students will be encouraged to carry out their projects in groups of 5 or 6, and will be required to make a group presentation of their work. Working in the field will help students to relate concepts learned in the classroom to the 'real-world' situation.

Students will continue to have a 10-day field trip to Hat Mountain where they work in small groups collecting specimens, which are identified along with the

environments in which the specimens are found. At the end of the field trip each student will hand in a report on the activities.

Assessment
The total mark should include practical work, presentation, field trip, mid-term examination and final examination. The type of examinations will include open-book examination, closed-book examination and oral examination. For example, for practice and field trip we can use oral examination, in the middle of semester use closed-book examination, at the end of semester use open-book examination. I aim to test understanding and critical thinking and believed that open-book examinations were a more appropriate way to do this than closed-book examinations (which could easily lead to memorization and regurgitation of material) (McDowell 1995).

The examination can include multiple-choice, short-answer questions and essays. Multiple-choice questions examine content (mostly), and only the best will test concepts. Short-answer questions can test understanding of concepts, but essays and long answers provide the best opportunity for students to explain. Students were likely to employ surface learning approaches in the multiple-choice question examination context and they perceive multiple-choice question examinations as assessing knowledge-bases (lower levels of) intellectual processing. In contrast, students were more likely to employ deep learning approaches when preparing their assignment essays, which they perceived as assessing higher levels of cognitive processing (Scouller 1998).

Possible implementation problems

Returning to China to teach botany in English, using teaching skills acquired during the professional development course will not be easy. The problems that are likely to be encountered will include.

Language barrier
Both teachers and students are not native English speakers and generally the English level of first year students is poor. This will need to be addressed by the University. Currently if the entire botany course is taught in English, most of the students will not be able to understand sufficiently to cope with the content and concepts of the discipline. This lack of language ability will encourage students to take a surface approach to learning.

Biology in the English language is full of words whose roots come from Latin or Greek. Sometimes these words are difficult for native Chinese speakers. For example:
- mesophyll (mesos=middle; phyll=plant leaf);
- gametophyte (gameto=spouse; phyte=plant);
- collenchyma (coll=glue; engchyma=infusion); and
- syngamy (syn=fusion; gamy=gametes).

In English speaking countries, Latin words are not always pronounced in pure Latin, but are anglicised. This is confusing for a native Chinese speaker who has learnt to pronounce pure Latin.

Student acceptance of the new teaching methodologies
University students are accustomed to the traditional way of teaching, including attending lectures, listening to the teacher carefully and taking notes, and reviewing the notes after class. University students have been successful in gaining entry to university because they are successful at following the rules of traditional teaching. This is the same for university teachers. If the teaching is changed will the students accept it? Currently Chinese students seldom do team work or give presentations in secondary school, so when they are first exposed to these ideas and expectations, how will they cope? Will they feel very uncomfortable? These issues will have to be addressed by all teachers before they begin to teach using any new teaching strategies.

Educational implications

Universities around the world are in transition from current teaching models to contemporary models that help address some of the issues facing universities today. Graduates are expected to be able to adapt and change within their profession and maybe to transfer their discipline and generic skills from one professional arena to another. Teachers are reviewing the student learning experiences they provide to facilitate students graduating with the necessary generic skills, discipline skills and employability skills. The advantages of a student-centred learning model include providing graduates with the ability to solve problems, and work together in teams.

Acknowledgements

Lijun Wei wishes to acknowledge the support of the China Scholarship Council, The University of Sydney and School of Biological Sciences for giving her the opportunity to join the program. In addition she would like to thank Associate Professor Mike King and Dr Peter McGee who helped me with the paper.

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