Using contemporary education strategies to improve teaching and learning in a Botany course at Beijing Forestry University

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Abstract

This paper introduces some contemporary education strategies and recent trends in teaching and learning. The report then reviews the general condition of a botany course in Beijing Forestry University. Based on the weakness of conventional teaching methods and the advantages of contemporary education strategies, five possible approaches are used to modify the botany course: concept mapping; PBL (problem-based learning); case study; web-based learning and changing assessment. Also discussed are possible problems with implementation.

Introduction

With the rapid development of science and technology, we now face a world where information and knowledge are instantly available. This provides challenges to educators who have to ask: do the traditional teaching strategies (Behaviourist Theory) match our teaching objectives? How can teaching and learning be improved?

Many pedagogical theories that aim to improve teaching and learning have appeared since 1970, including constructivism (Piaget 1972; von Glaserfeld 1989), the developmental view of learning, situated learning (Lave and Wenger 1991), and the practice of learning (Wilson 1996). The pedagogical theories all indicate that learners play an active role in learning.

Constructivists see the learner coming to any learning situation with an existing set of beliefs, values and understandings (correct, partially correct, or incorrect). The teaching and learning experience they have with you only makes sense in terms of what they already know. What they learn with you is always assimilated in the context of these prior conceptual constructs. Effective teaching starts with trying to understand the initial conceptual understanding of the learner. The only person that can change these existing understandings in the mind of the learner is the learner (Mike 2004).

The major theoretical development in recent education research is the move towards a constructivist perspective and view of how people learn science. The major practical development is a move towards student-centered approaches and student active science as an appropriate teaching technology, which is compatible with the constructivist view of learning. In the West, the recent trends in practice of teaching and learning are from a behaviourist view to a more constructivist and developmental view, a move from a strongly 'Teacher-Centered Approach' to a much more 'Student-Centered Approach'. Recognition that students must be more active participants in the learning process wherever possible, stems from the aim of promoting deeper processing of knowledge (Mike 2004). Higher education in science should develop intellectual and imaginative powers, understanding and judgment, problem solving and communication skills, the ability to see relationships, to have a broad perspective on the chosen discipline, to have an inquiring, analytic and creative approach, exercise independent judgment and have critical self awareness.

I will consider the Botany course at Beijing Forestry University (BJFU) that I have taught for about ten years, with respect to these theories. This paper will investigate the application of contemporary education strategies to teaching botany.

The Botany course at BJFU

Teaching goals of botany

Botany is a basic subject for all students who major in Biological Science and related disciplines. The teaching objectives are: to understand the basic theories and attain generic skills, understand the structure, function, growth, development and classification of plants, and be properly equipped to participate in more advanced units of study involving forestry.

Background of reform in the botany course at BJFU

With the knowledge explosion, new content and some new courses have been included in the discipline of Forestry. Nowadays, most of the universities in China that teach botany, combine botany, plant physiology, plant systems and evolution into one course called Plant Biology. Forestry universities must stress plant structure and classification. So in BJFU, we continue to teach botany. Since courses have been added and the number of students has increased, but students still have only a limited number of hours for study, the traditional courses at BJFU were reformed in 1997. At the time, Botany was reduced from 80 to 50 hours, requiring many changes to the course. Firstly, we created computer aided instructional (CAI) courseware for botany, and used it in lectures. Secondly, in laboratory work, we made full use of multimedia facilities, decreased verifying experiments, and added some creative experiments. Thirdly, the textbook and lab guide were revised. Through these methods, we have improved the quality our teaching somewhat. Our efforts were recognized when the courseware was awarded first prize in BJFU during the CAI courseware competition.

Current structure of the botany course

Botany is designed for first year students. At present, this course consists of 50 teaching hours per year and is divided into two semesters: correlative contents of plant morphology and anatomy are taught in semester 1, while plant classification is taught in semester 2. The course includes three sections: lectures, laboratory work and includes a field trip (semester 2 only). In semester 1, students attend lectures (12 hours) and practical work (18 hours). In semester 2, the course includes lectures (8 hours), laboratory work (12 hours) and a field trip (7 days).

Current approaches in teaching and learning

Every year, in BJFU about 750 students take Botany. Five teachers and one laboratory staff member are responsible for this course. Usually, each of us teaches five classes totaling 150 students, for the entire teaching year. Lectures are often given to all five classes in one lecture theatre, while practical sessions involve only one class in the botanical laboratory. Before the lecture, we prepare the course together so that teachers maintain the same rate of progress.

In lectures, because of the limited time and considerable content, I teach all the time using multimedia. Students seldom ask questions or discuss issues. Students listen carefully and take notes.

In the laboratory, I briefly introduce the main content or procedures of the experiment, then students work individually according to the main procedures written on the blackboard. If they have questions, they can ask me immediately. After the lab class, students submit reports that are marked.

Students visit the western Mountain forest farm that is one hour away from BJFU by bus, and the Beijing Botanical Garden. I provide the name and characteristics of plants to students along the way. Students take notes and work in small groups collecting specimens. After they return to campus, they continue identifying these specimens and learn how to mount dry specimens. At the end of the field trip, each student attends an oral quiz on identification of plants and hands in a report on the activities.

Assessment

The assessment of the Botany course consists of two parts: final closed-book examination and laboratory reports. The final examination includes multiple choice questions, true/false, drawing or labeling pictures, short answer questions, and long answer (essay-style) questions. The short answer questions use ‘fill in the blanks’ formats and definitions of botanical concepts. The mark distribution is 30% for laboratory work, 70% for the final examination. For the field trip, we give students another mark for the field trip based on the oral quiz and report.

Reconsideration of current teaching and learning

Weaknesses of current teaching and learning in Botany

We are spoon feeding our students in both lectures and practicals, and depend on the formal lecture for teaching and learning. Students become overly dependent on information selected and provided for them by their lecturers, and assessment methods place too high a premium on memory and recall. The approach is teacher-centered. Though we have reformed some aspects of Botany, we have considered how to teach from the teachers view, and not fully considered student learning. The key point is that we have not changed from a teacher-centered to a student-centered approach to teaching and learning.

Studies show that teachers who describe their teaching as an information transmission/teacher-focused approach are more likely to be teaching students who report adopting a surface approach to learning (Keith 1998). Students who take a surface approach memorize information they perceive is needed for assessment. This leads to focusing on discrete elements without adequate integration of content and building of a knowledge base. A wealth of evidence concludes that surface approaches to learning are related to lower quality learning outcomes (Marton and Saljo 1976; Van Rossum and Schenk 1984; Ramsden 1992; Prosser and Millar 1989). Students can pass the exam with a high mark, but after a while they forget most of the information they have learned. In addition, teachers pay more attention to the transmission of knowledge and fail to develop generic skills in students.

Reflection on current teaching and learning
Faced with these conditions, we have to reflect on our current teaching strategies and think about strategies we might use to achieve our teaching intent. Use of contemporary education strategies may improve our teaching and students' learning. The amount of available knowledge is increasing rapidly. Students face a world in which much of the work they will do has not yet even been imagined. Teachers and students must realize that the pace of technological change and the growing access to new technologies means that students will need to constantly reinvent themselves to succeed. The ability to access and generate new knowledge in a purposeful fashion and to move from simple content knowledge to critical analysis, requires teachers to change their approach. Courses should deliver not simply specific skills and specific knowledge but also attitudes, aptitudes and problem solving skills, which will sustain learning throughout the life of the student.

According to contemporary education strategies, teachers are responsible for learning activities, learning experiences, teaching/learning strategies, and teaching methods. The main contemporary teaching strategies include analysis of case studies, small group inquiry/investigations, PBL approaches, role play activities, simulations, interactive teaching/learning sessions, discussion-questioning, viewing-listening, programmed instruction, independent learning tasks, community activities, mixtures of mini lectures and traditional lectures. We also must recognize that no one strategy is appropriate to all learning contexts, no single method is superior to another in all situations, particularly in terms of student performance. Consequently, strategies must be matched to knowledge-, process- and personal development-based objectives (Mike 2004).

Modifications in the botany course through Contemporary Education Strategies

According to this analysis, if students are to become independent, lifelong and active learners, our teaching strategies need to include tasks which are interesting, motivating and involve our students in both team and individual learning tasks (King 1997). In order to improving teaching and learning in botany , I am going to modify the course by using concept mapping, problem-based learning, case study, web based learning and by changing the assessment system.

Using concept mapping to improve teaching and learning
Concept mapping was developed by Prof. Joseph D. Novak at Cornell University in the 1960s. The work was based on the theories of David Ausubel, who stressed the importance of prior knowledge in being able to learn about new concepts. A concept map is a diagram in which various forms or lists of information are classified and their linkages are shown (Novak 1991; Lawson 1994). Generally speaking, the concept map reflects the inner relationships between concepts. By forming systematic knowledge 'webs' in the brain, students can apply knowledge and concepts more flexibly and knowingly. Concept maps have been described as working like 'spark plugs' or catalysts for discussion because students have a structure to start with (Kankkunen 2001).

Concept mapping can generate ideas (as in brain storming), be used to design a complex structure (for example, long texts, hypermedia and large web sites), to communicate complex ideas, to aid learning by explicitly integrating new and old knowledge and assess understanding or diagnose misunderstanding. For example, in the first lecture, we can use concept mapping to introduce the content of the Botany course. I might ask students to brainstorm and tell me the content they think they need to study, and then I will give them a detailed concept map about the course. In this way, students will have the general framework of the Botany course, from which they gradually construct their own concept map. The use of concept maps might be more specific. For example, seed plant sexual reproduction is complicated and difficult for students to understand. I plan to use concept mapping, including relevant pictures, to introduce the whole process (Figure 1). From this concept map, students can see the sexual reproduction process of Gymnosperms and Angiosperms. They can compare the two subphyla.

So concept mapping seems a very useful tool for solving many of the problems of teaching modern Botany.

Using problem-based learning to improve teaching and learning
Problem-based learning (PBL) is a curriculum design and teaching/learning strategy that simultaneously develops higher order thinking and disciplinary knowledge bases and skills by placing students in the active role of problem solvers confronted with a situation that reflects the real world. PBL can be a very effective method to develop critical thinking, self-directed and lifelong learning, problem solving, and teamwork skills (Woods 1994).

We come in contact with plants every day. Thus, many real problems can be used in a Botany course. PBL is difficult to use throughout the whole course because of the limited time available. I would like to use some small problem solving projects in the course. For example: Li Ming is a planter who has a nursery garden in a suburb of Beijing. In his nursery garden, there are a lot of different seedlings and trees including some big *Eucommia ulmoides*. The bark of *E. ulmoides* can be used to make traditional Chinese medicines, and we can also get glue from the tree. One morning, Li Ming found that the bark of some *E. ulmoides* trees was wholly cut away and in some trees just pieces were removed. After a while, he began to worry about the *E. ulmoides* trees. 'Will these trees die?' he said to himself. Because he was not quite sure whether the *E. ulmoides* trees would die, he came to BJFU asking for help.

The questions for students to ponder are:
1. Do you think a tree whose bark was cut away will die? What can you do to help these trees to survive?
2. Why does the hollow Chinese scholar tree grow so well?

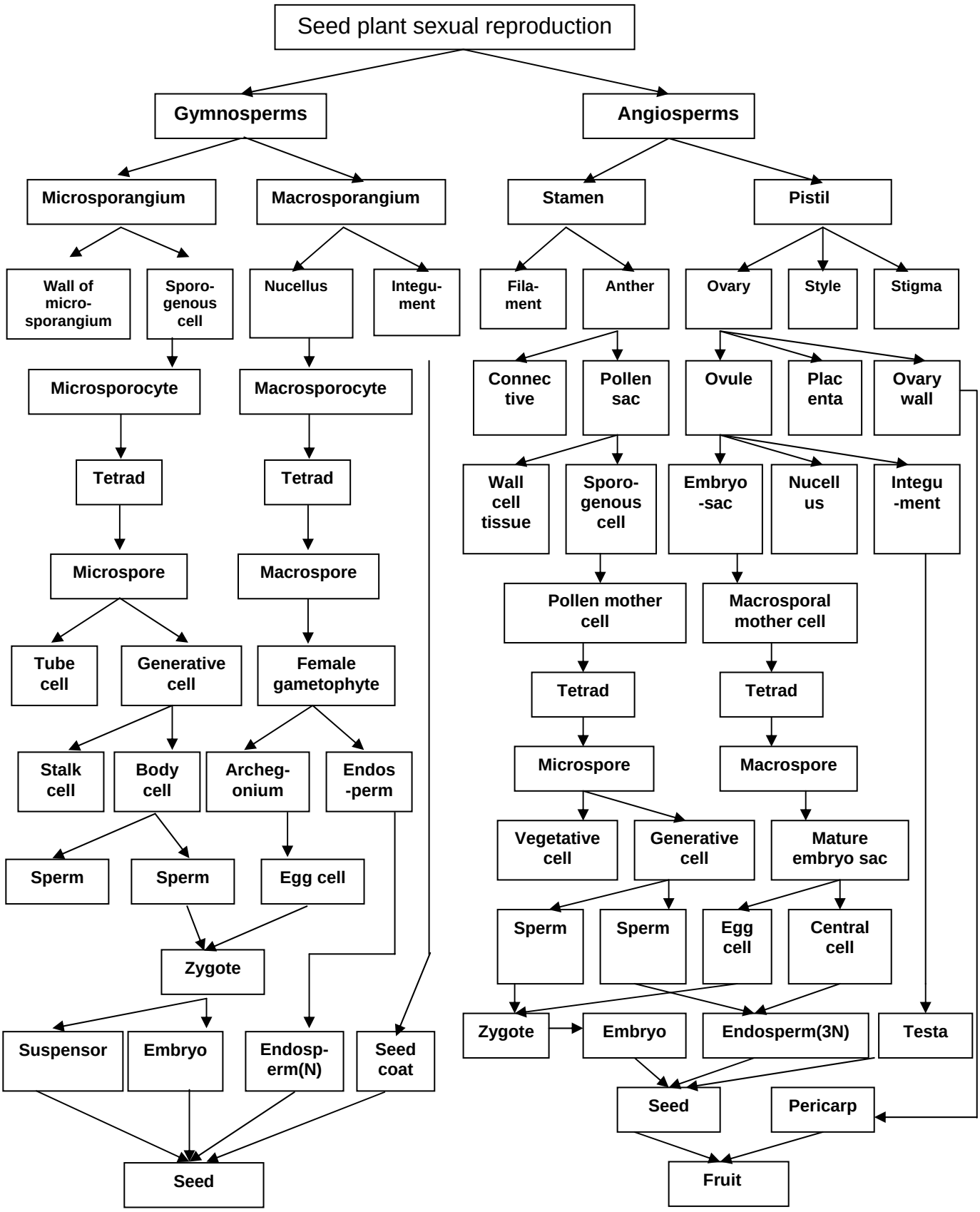

Figure 1. Concept pathway of sexual reproduction in seed plants

Students will be given three weeks to solve these questions. First, students will be divided into groups, of four. Second, students will gather relevant information from textbooks, the library, Internet, journals, and other sources. Third, they will spend time thinking and discussing the questions in their small groups. Then each group will report on the questions. Finally, every student will hand in a written report. Through PBL, students will come to better understand the structure, function, and physiology of plants, especially the primary and secondary structure of the root and stem, and the function of plant tissues. They will obtain self-directed and lifelong learning skills, analytical and critical thinking skills, teamwork, communication and problem solving skills, and also achieve the integration of interdisciplinary knowledge. Use of PBL will increase students' interest and motivation in the course, making them more active learners and improving their problem solving and 'life-long' learning skills. PBL is a useful strategy for training generic skills.

Using case study to improve teaching and learning

A case study is a story with a message and a question, and it educates through the story. In this strategy, students learn particular concepts, issues or topics in a relevant course through a complete and real story that has academic and professional significance as well as social implications. In a case study, the teacher guides students through the maze of a case discussion by questioning, redirecting questions, clarifying, probing and highlighting points or issues.

Many real life events related to forestry are fit to be used in a Botany course. For instance: A farmer in Miyun county near Beijing collected a lot of seeds from cypress trees. In the second year he sowed these seed directly into the soil in spring, but found that none germinated. The questions are why did the seeds fail to germinate, and how can we ensure seed germination in future? To begin, I tell the story or give detailed material about the case to the students. Then students will discuss the questions and brainstorm their ideas. They might discuss possible reasons and then I will draw a concept map. During this process, I will ask students questions such as, what is the seed type? What is the seed structure? What is the definition of dormancy of seeds? How is dormancy of seed broken? How do you treat seeds to increase the seed germination rate? On my return to China, I plan to use more case studies to improve my teaching.

Using a web site to improve teaching and learning

Due to the rapid development of information technology, the Internet is now extensively used for online teaching and learning. Using the Web as a medium for integrating computer based learning into an organized course has proved to be an interesting and beneficial exercise (Redfern 1999). One of the main ideas is to create a student-centred environment in which we can encourage the students to work independently of us but within a community of learners (Peat 2000; Franklin and Peat 1998). I was impressed by the Virtual Learning Environment (VLE) used in first year biology at the University of Sydney. The use of WebCT also encourages student-centred activities, and thus helps to promote learning.

When I return to China I would like to construct our own Virtual Learning Environment to improve teaching and learning. It will be difficult for me to do this alone, and there is no existing website in the Botany course. I will ask colleagues to join the program and then request support from the administration. Then I plan to complete it step-by-step. First, I will use a local web site in BJFU to provide lecture notes and establish a BBS or a chat room to discuss issues with students. Second, I will gradually establish a VLE. The VLE will include the course content, general course information, laboratory information, independent learning modules and communication, and include simulations and demonstrations, real world data sets, case studies, image banks, virtual field trips, interactive tutorials, self-assessment tasks, information sites, e-mail, chat groups, discussion forums, and other resources. In addition a VLE will offer links to external resources such as the university library web site, student services web sites, and the botanic garden's web site. The VLE is an online resource that permits synchronous, collaborative interaction among teachers and students, and also provides asynchronous learning resources for individual use by student at any time.

Using web-based teaching and learning will help to improve teaching, and it is a convenient and interesting way for students to learn new knowledge, seek information, gain feedback on assignments and communicate with teachers and other students.

Modification of assessment

A very significant part of any program of learning in science is the style and strategies of assessment. Because assessment influences student learning, if we modify the teaching and learning strategies, we also need to modify the assessment. We must place a greater emphasis on developing lifelong self-assessment skills in students, in line with the notion of sustainable assessment. As to the Botany course, I plan to decrease the proportion given to the final examination, increase the self and peer assessment, and add to the proportion given for oral quizzes and presentations. I will use combined assessment to evaluate students. The marks for each task are final examination (50%), laboratory report (15%), small quiz or oral quiz (15%), presentation (10%), self-assessment (5%) and peer-assessment (5%).

Possible problems with implementation

It will be a big challenge for me to use contemporary education strategies to modify the Botany course in BJFU. The problems that are likely to be encountered include language barriers, time, attitudes of colleagues and students, and financial support. In my opinion, available time will be the main problem. On the one hand, due to little familiarity with these new teaching strategies, it will take me a lot of time and energy to prepare the course. Each of us uses the same textbook, the same syllabus and all of us keep the same teaching speed through the course content, so modification may be difficult for the leader and other teachers to accept. On the other hand, students are more accustomed to lecture teaching (spoon-fed teaching) during their studies in middle school. They are not used to

taking much responsibility for their own learning and will possibly complain about the extra efforts needed, and be reluctant to accept these learning approaches.

Summary

The main opinions presented in this paper involve the modification of the Botany course at BJFU to make it more interesting, informative, relevant and motivating, by using more student-centered strategies built on the basis of our traditional approaches. Use of concept mapping, PBL, case studies, modifying assessment, and allowing access to web-based learning resources will increase the student focus of the course enabling skills for life-long learning to be promoted among the students. Finally, we must recognize that any teaching strategy or method may not be appropriate for all students and teaching situations. Strategies are often matched to objectives, so we must adopt different strategies according to teaching contexts by turn.

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