

# Integration of modern and traditional teaching strategies in plant physiology

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## Abstract

A deep approach to learning leads to quality learning outcomes. While teaching and learning should be inseparable, the teacher conducts the learning process. Therefore, the teacher should use appropriate teaching strategies to encourage students to use deep level approaches to learning. This paper first outlines the current approaches to teaching plant physiology in my university. Some measures to encourage more student-centred teaching to enable students to actively participate in the learning process are discussed. The difficulties of introducing change are also discussed, and a gradual transition is recommended.

## Introduction

It is important for a university teacher to understand that the learning approach of students will strongly influence the quality of their learning outcomes (Chin and Brown 2000). In quantitative studies, the teacher's approaches to teaching correlated with student's approaches to learning (Kember and Gow 1994).

Teaching and learning are inseparable, because learning is a criterion and product of effective teaching. Teaching is part of a whole that comprises the teacher, the learner, the content of the discipline, the teaching/learning process, and the evaluation of both the teacher and the learner. To encourage a deep approach to learning which leads to good learning outcomes, teachers should use an appropriate teaching style.

What is the most effective way to teach? Although there are many ways to teach effectively, all require that the teacher understand three things:

1. the material being taught;
2. the best instructional strategies to teach the material; and
3. how students learn.

The concept of teaching has three main divisions:

1. encouraging students to see content in context;
2. enabling students to incorporate new content into existing conceptual frameworks; and
3. providing the boundaries of each discipline, and the links to related disciplines.

Recognition that students must be active learners to learn effectively requires a teacher-centred approach being replaced by a student-centred approach. Student-centred approaches place much greater emphasis on how people learn. The approaches are aimed at the interaction between the existing knowledge or beliefs of the learner, and the new experiences students are receiving. Learners go through a series of stages associated with intellectual growth, achieve their own understanding through interaction with the learning environment in many different ways, develop their 'schema' by constructing related concepts, and modify their schema through these processes.

## Description of the course

Plant physiology studies principles of how plants grow and develop. It is a basic subject for students who major in the biological sciences and in agriculture science. The curriculum contents are shown in Figure 1.

### *Course style*

The course is taken by second year students. It is divided into two parts: 50 hours for lectures and 30 hours for practical sessions, totaling 80 hours. In addition, there are twenty days of research work during the summer vacation.

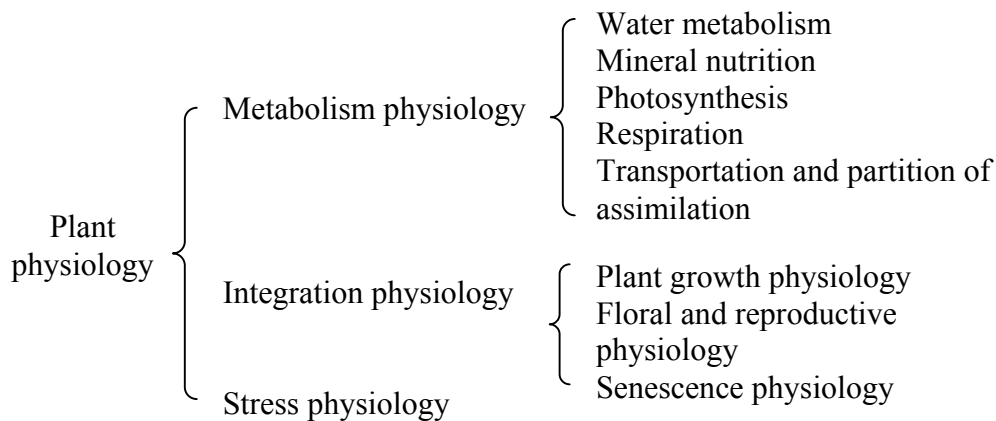


Figure 1. Curriculum of plant physiology

## Current teaching approaches

### Traditional lectures

The current approach to teaching in our university uses traditional lectures. Each lecture takes approximately 2 hours. The lecture content is well organised and presented. Most of the teachers have used some modern teaching techniques such as multimedia instructional materials, *PowerPoint* slides and computer simulations, etc. to make the lecture more interesting. Usually students can get more information during the lecture. Traditional teaching methods are employed, teachers mainly focus on how to deliver knowledge and the lecture is centred on the content of the course. Students are treated as a sponge, ready to absorb knowledge.

In this teacher-centred approach, students attend the lecture, listen and take notes. After the lecture they review their notes and recall the information. Students cannot completely understand the basic concepts, particularly given the lack of active participation. The students may be seen as passive recipients. The goal of learning is to pass the examination. It was reported these traditional methods are less effective in helping our students develop an understanding of the science concepts we are teaching (Pearsall 1992). The traditional way often leads to a surface level approach to learning.

### Laboratory classes

The laboratory class is used to cultivate the practical skills of students, both at the individual and group levels. Practical skills are very important for students of plant physiology. In the last three years we have made some innovations in laboratory class.

The plant physiology laboratory is opened daily to students. Students are supplied with a number of problems. Students choose from a list of the topics, including physiological and biochemical changes during leaf senescence, or physiological and biochemical changes of plants grown in low temperatures or drought. In order to foster their group activities, most of the practical tasks and the design of experiments are completed by groups of 3-5 students depending on the total number of students.

Students work in groups and complete a series of experiments related to one topic. The outcome of the group activity is a formal presentation.

Instead of writing a standard laboratory report, students write a short research paper, to improve their writing skills relevant to the discipline, and to promote a deeper analysis of the experiments and their results

## Introduction of student-centred learning to plant physiology

I have learnt many new teaching strategies that will influence my ideas in the future. The responsibility of the teacher is not only to deliver skills and provide a conceptual map of the subject, but also to motivate students to be more active, adaptable, confident, creative, cooperative and inductive in their thinking. That is, we should prepare students for lifelong learning, one of the most important aims in higher education. Those teaching methods that only focus on transferring knowledge, and consider the student as a passive learner, should be replaced. Teachers should be centred on the student's understanding of how they learn, the difficulties they experience, and what motivates the students to participate actively in their learning. The teacher must also help students make the transition from passive listeners to active participants, changing from surface to deep learning approaches. We should help them to develop their abilities and skills for lifelong learning.

There are several ways to help students make the transition from passive listeners to active participants in their own learning (Orzechowski 1995), and from taking a surface approach to a deep approach to learning. These methods depend on the students' situation and on the curriculum.

## How can we improve teaching strategies in our discipline?

Each curriculum has different demands in abilities and skills, and requires different teaching strategies. Each course also has particular knowledge and a methodology base. Therefore appropriate strategies should be chosen according to the specific requirements of the course and its

content. At the same time common abilities and skills of the students should be integrated within the entire curriculum.

Selection of strategies will depend on the content. In my teaching, my goals are to assist students to:

1. understand basic principles and concepts;
2. develop a conceptual framework;
3. think and solve problems in a scientific way;
4. explore questions and engage in active learning; and
5. communicate and work in group activities.

Learning is enhanced when we create an environment that provides students with opportunities to learn in different ways. Whatever the similarities and differences among our students, we can help all of them by employing a range of active approaches (discussing, listening, writing, reading, and reflecting) and using various teaching strategies (lectures, multimedia presentations, demonstrations, discovery laboratories, collaborative group and independent projects). Moreover, by using a variety of teaching techniques, we can help students make sense of the world in different ways, increasing the likelihood that they will develop a conceptual understanding.

A good deal of our knowledge of science must come from lectures, texts, and original sources. As teachers, we should make better use of traditional formats to help students gain knowledge, to understand how scientists develop knowledge, and the methods used by them. In the following sections some new strategies incorporating teaching and learning will be discussed.

**Mini-lecture**

People can concentrate for about 15-20 minutes, after which time research indicates that their concentration levels reduce significantly. One way to keep students engaged is to pause periodically. The pause may be used to assess student understanding, or to initiate short discussions with students. I propose to break each two hour lecture into a

series of mini-lectures, and separate them with questions and discussions. For example, at the end of the lecture on photosynthesis and respiration, students might be asked to clarify the differences between photorespiration and respiration. They will have 5 minutes or so to think independently, followed by discussion in small groups, who then present their ideas to the whole class. The teacher organizes the process and summarises the contributions.

To lead an effective discussion, the teacher must be a good facilitator, monitoring and supporting group dynamics. The teacher must also meet learning goals, covering key points. Guidance is necessary to keep the discussion from becoming disorganized or irrelevant. The lecture materials and questions need to be carefully designed, and students briefed on their part in the process.

**Concept map**

Each discipline has its basic concepts; some of them are difficult to understand. Teachers should help students to understand these concepts and overcome their misconceptions. The key is ensuring that students are constructing or reconstructing a correct framework for their new knowledge. One effective way of establishing a framework is to create ‘concept maps’. A sample concept map of ion absorption is shown in Figure 2. A concept map of photosynthesis is shown in Figure 3.

In these two figures, we see concept maps as a diagram in which various components of the concepts are classified and their linkages shown. With this technique, students may learn to visualise a group of concepts and their interrelationship and linkages with each other.

Concept maps can train students to build up relations among concepts by themselves, and help students to clarify differences of related concepts and motivate them to think more deeply.

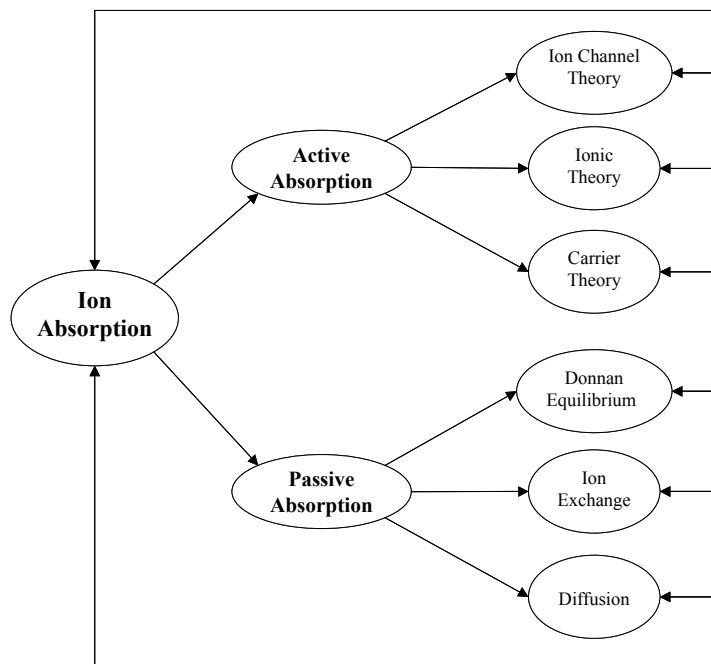


Figure 2. Concept map of ion absorption in plants

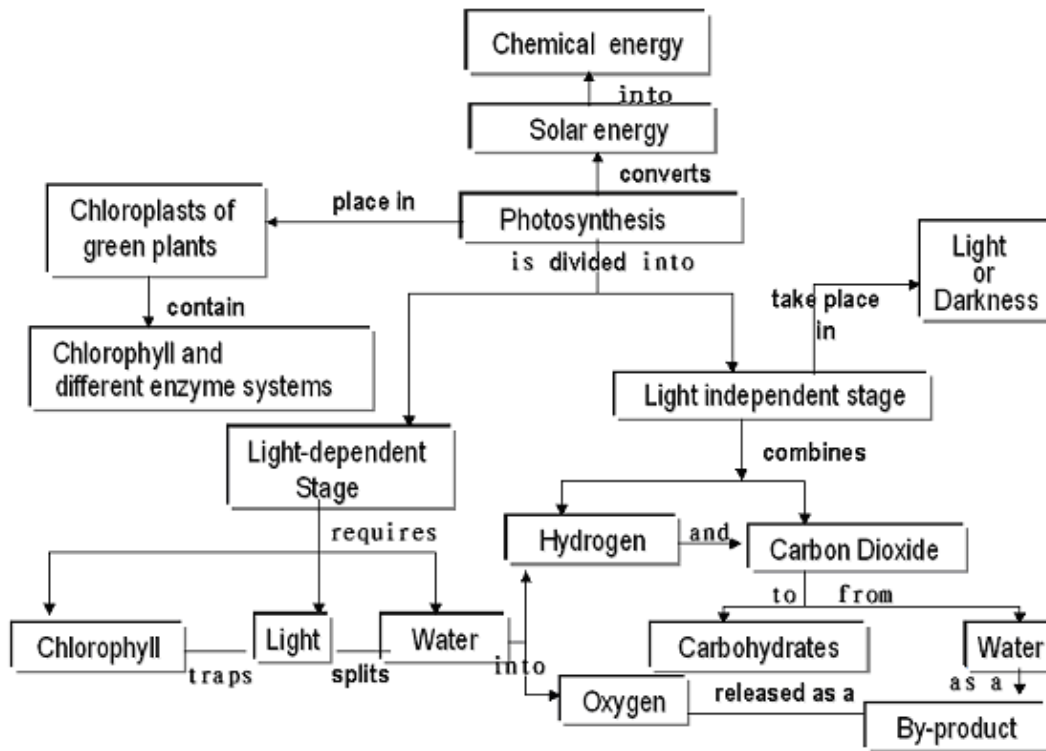


Figure 3. Concept map of photosynthesis

**Applying problem-based learning in lectures**

The course I teach is an experimental science, so I can find many interesting real world problems from our daily life to motivate students. However, when teachers propose a problem, they must have the objectives clearly in their mind. They must develop the analytical skills of the students, and must ensure students are able to, and actually do, participate.

Applying problem-based learning (PBL) in lectures can give students more opportunities. In the style of lecture used previously, students were passive recipients. Now we make them learn by themselves by challenging them with a problem to solve. Students can practice their knowledge, think actively, independently and discuss interactively. They can combine scientific knowledge with the real world to solve real world problems.

An example of a real problem is contained in the following question: ‘Why did the farmer’s soybean not form seed?’

*Last year, a peasant in Beijing went to Guangzhou and returned with soybean seeds. Guangzhou is in the south of China. In general the photoperiod in Guangzhou is shorter than that in Beijing. In spring, he planted seeds of two kinds of soybean, from Beijing and Guangzhou. Both seeds germinated and grew very well. But when the Beijing soybean was ready to harvest, the Guangzhou soybean was still growing without a single flower.*

*During autumn, the temperature decreased. So Guangzhou soybean was frozen to death, certainly the farmer did not harvest any seed. He was very sad, and wondered why his*

*soybean didn’t fruit. Can you help him to analyses why? How many factors can influence plants to fruit?*

With this problem, students are expected to understand the concepts of photoperiod, critical day length and short day plants. Soybean is an example of a short day plant. Several kinds of soybeans originate from different areas. Different soybeans have different critical day length. When soybean grows and matures, and the photoperiod is less than the critical day length, soybean will flower and form seed.

**Laboratory class**

For the last three years laboratory classes have been reformed. Feedback from students strongly supports the changes. The course is designed to engage students in the scientific research process. It is emphasized that taking part in the research process and understanding the results is more important than obtaining ‘correct’ results.

**Possible problems with implementation**

Problems might be encountered in implementing the proposed modifications. Teachers and students are accustomed to the traditional way of teaching. The first problem in using new strategies is to encourage and manage a change in the role of the teacher. Teachers need to understand that their responsibility, nowadays, is not only to provide content and a conceptual map of the subject, but also motivate students to be more self-directed, creative, adaptable, cooperative, and inductive in their thinking.

Chinese students are shy in expressing themselves. They fear asking questions in class. They have little opportunity to work in teams or to give presentations. When these new

teaching strategies are used there is a question as to whether our students will adapt easily to a new teaching context, and also a question as to how much they will cooperate with their teachers.

The main problem will be the pace of this transition, changes should be done step by step. It may be difficult to change all aspects of our teaching style completely and immediately. The best approach may be to integrate modern teaching methods with traditional teaching methods initially, and gradually change the emphasis of our approach over time.

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## References

- Anderson, C. D. B. (1997) Enabling and shaping understanding through tutorials. In F. Marton, D. J. Hounsell and N. J. Entwistle (Eds) *The experience of learning* (2nd ed.) Edinburgh: Scottish Academic Press.
- Biggs, J. (1999) Setting the Stage for Effective Teaching. In *Teaching for quality learning at University: What the student does*, Buckingham: SRHE and Open University press, 54-67.
- Chin, C. and Brown, D. E. (2000) Learning in science: A comparison of deep and surface approaches. *Journal of Research in Science Teaching*, **37**(2), 109-138.
- Entwistle, N. (1998) Improving teaching through research on student learning. In J. Forest (Ed.) *University Teaching International Perspectives*. New York: Garland Publish Inc.
- Gibbs, G. (1992) *Improving the quality of student learning, Technical and Education Services*. Oxford Centre for Staff Development.
- Gow, L. and Kember, D. (1993) Conceptions of teaching and their relationship to student learning. *British Journal of Educational Psychology*, **63**, 20-33.
- Kember, D. and Gow, L. (1994) Orientations to teaching and their effect on the quality of student learning. *Journal of Higher Education*, **65**, 58-73.
- Orzechowski, R. F. (1995) Factors to consider before introducing active learning into a large, lecture-based course. *Journal of College Science Teaching*, **24**(5), 347-349.
- Pearsall, M. K. (Ed.) (1992) *Scope, Sequence, and Coordination*. Vol. II, Relevant Research. Washington, D.C.: National Science Teachers' Association.
- Trigwell, K., Prosser, M. and Lyons, F. (1999) Relations between teachers' approaches to teaching and students' approaches to learning. *Higher Education*, **37**, 57-70.