Student-centred pedagogy in *Computer Technology Application* course design

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Abstract

Lifelong learning skills, creativity, and communication skills are become the most important abilities for the young generation living in an era of a knowledge explosion. It is the responsibility of the tertiary education to accomplish this target for society. As an application of constructivist learning theory, this paper discusses how the student-centred pedagogy can be adopted in a *Computer Technology Application* course design at a university in China.

Keywords: student-centred pedagogy, constructivist learning theory, course design

Introduction

The current knowledge explosion is changing the world dramatically in the 21st century. It is impossible for students to acquire all the necessary knowledge which may be needed in their future careers in just the three or four years of their university studies. Therefore, it becomes very important for students to obtain lifelong learning skills. Tertiary education system should inevitably be responsible for the training of new generations and their development of lifelong learning skills.

Students will no doubt encounter unforeseen situations after graduation. They need also to develop the ability of creative thinking and are thus able to creatively apply what they have learned at universities to solve the real-life problems. How to trigger the students' interests in the development of their creative thinking skills becomes one of the essential issues of tertiary education.

Many jobs need to be done through cooperation because of the fine division of work in a modern society. This is more prominent in the information technology areas. Communication and interpersonal skills become very important individual qualities for the younger generation to survive in the future world. Higher education should also be responsible for training students to develop their teamwork skills and cooperating spirits.

Traditionally, lectures have been used mainly for transmission of knowledge with students taking a fairly passive role, which easily leads to shallow approaches to learning. There is little on how to transfer knowledge or skills to new situations. This happens more frequently at universities in China. At East China Normal University many lecturers use lectures to deliver knowledge and the final examination is the only main assessment at the end of the course, making students focus more on the examination for getting credits.

Over the past decade there has been growing disquiet amongst educators in science about student understanding levels and student abilities of transferring knowledge to new environments (Clement 1982, Champagne, Gunstone and Klopfer 1985, Roth 1990). In many Western universities including The University of Sydney, there has been a lot of research work and reform undertaken in order to improve the outcomes of higher education. The six-month study at The University of Sydney has made me think more seriously about science education and the restructuring of courses in my university.

The course situation at present

Computer Technology Application is a first-year unit of study caught in second semester, following *Computer Technology Fundamental*. It is a service course open to all students at our university. In the *Computer Technology Fundamental*

course, students have studied computer operating systems, running programs and using office applications and the Internet. They have also learned static web page design technology, and certain basic theories of multimedia such as acquiring and dealing with different kinds of digital media.

In second semester, dynamic web site development skills are taught in the *Computer Technology Application*. It includes interface design technology, HTML technology, *JavaScript* technology and database management technology. Traditionally, these contents are taught by lectures mixed with certain laboratory exercises. Students are required to finish their laboratory work by themselves following a laboratory textbook. Lectures are given in a classroom with only one computer connected with an overhead projector, and students listen to the lecturers passively. Lectures and their corresponding laboratory exercises are arranged one or two weeks apart. While students enter the computer laboratory to do the laboratory work, they may forget what they have been taught in the classroom several days before.

Usually there are more than 150 students in a class and there may be more than 20 classes taught by different teachers at the same time. It is a compulsory course, so the same syllabus and textbook are used and the same practical work and exercises are given during the teaching period. Each student is required to attend two lectures and two practical sessions each week. Traditionally midterm and final examinations are the main components of assessment. Two credits are given if the students pass the examinations.

Students of our university are selected by passing the public *University Entrance Examination* held in June each year. Some of them come from large cities and developed areas such as Beijing, Shanghai, Zhejiang and Jiangsu Provinces, while some others come from far west mountain areas. As the economic development is different in these areas, the basic IT knowledge that student bring with them when they enter university differs greatly. Some of them can use computers and network skilfully before taking any IT courses, and some have no knowledge of IT and may just be able to finish the practical work according to the guide in the textbook. However, all these students have experienced teacher-centred pedagogy before they enter university and they like to follow what they are told during the learning period. In such a big class and using traditional teaching methods, it is very hard to motivate every student and lead them to deeper learning of new information technology. New teaching methodology is thus needed to improve the efficiency of students' deep learning.

Curriculum reform must be done to achieve the purpose of contemporary higher education, with the fostering of lifelong learning skills, creativity and teamwork being crucial during the course. The research on student learning by psychologists and educationists has resulted in the view that people construct their own knowledge while they are willing to learn. The studying experience at The University of Sydney has provided me with examples of how the constructivist theory can be adopted in the teaching of IT courses.

Constructivism and its application in The University of Sydney

Constructivist learning theory

Formalisation of the constructivist learning theory is generally attributed to Jean Piaget, who articulated mechanisms by which knowledge is internalised and personalised by learners. The student does not just passively take in knowledge, but actively constructs it on the basis of his/her prior knowledge and experiences (Piaget 1972). The learning outcomes of any teaching depend not only on what the teachers do but also on the knowledge, the purposes, the motivations and the beliefs that the learners bring with them to the classroom. So rather than being the result of transmission, knowledge is constructed by the learner in the sense that he or she relates new elements of knowledge to already existing cognitive structures (Bruer 1993). That is to say learners have the final responsibility for their own learning. Quality learning is most likely to happen when it is student-centred, because that is where the responsibility lies.

From the pedagogical point of view, the learner's learning activities should be directed at activating his own prior conceptions and relating it to new knowledge. Accordingly, the learning environment should provide the learner with opportunities to test and try out his new conceptual understanding in various applied circumstances like problem solving or project work. The most important task of a teacher lies in the stimulation and coaching of a learner (Roelofs and Terwe 1999). In this way, the student develops an independent and active attitude of great importance for his or her functioning in a modern, dynamic society (Taylor 1992). When students are studying science, the construction of meaning is an ongoing and continuous process which must actively involve the learner.

Ideas based on the concepts of situated learning (Lave and Wenger 1991) and socially distributed cognition (Salomon 1993) aim at turning learning situations into challenging and interesting projects for students to try to solve authentic problems. Although it is the students themselves who construct and test their own conceptual understanding, the community of learners and interactions with different cultures of expertise have a notable bearing on the quality of learning (Brown and Campione 1996). Therefore the team activities are more likely to lead to the students finding more relevance in what they have learned and grasping knowledge more deeply.

Applications of constructivist learning theory at The University of Sydney

During the visit and study period at The University of Sydney, the applications of constructivist learning theory in courses impressed me greatly. In the *Teaching Science in English* course delivered by Associate Professor Mike King for example, the abstract learning theories and pedagogies were taught by group work where we undertook tasks combined with Mike's lectures. By experiencing this as a student, every theory and pedagogy became relevant to me. The experience of group work makes students not only

learn from each other, but also become motivated and more active than just listening to the lecture.

Within the discipline of computer science, I had the opportunity to listen to many courses in the School of Information Technologies. These courses also impressed me. For example, in the course of *Foundations of Information Technology and Software Development*, lectures are only a small part of the course. Practical work becomes very important. It occupies 60% of the course time. Although there are more than a hundred students listening to the lectures at the same time, only about 20 students are instructed by a tutor at the practical exercises. During the semester, students should finish some assignments in the form of group work according to the theories they have learned. Formative assessments are given in the form of small quizzes during the teaching period. Students also have the chance to give presentation about what they have done in their projects.

Student-centred learning strategies in course design

Strategy selection

The contemporary education theories learned in the Faculty of Education and Social Work and the experience in the School of Information Technologies at The University of Sydney stimulate me to think more about how to make the teaching more efficient in my own course.

In order to foster a deep approach in students' learning, apart from traditional lectures in classrooms and practical works in laboratories, many other strategies should be chosen to make students become the centre of learning. Problem-based learning (PBL), case study, problem solving and project work are all good strategies for student-centred learning. However, the problem is which one is the most suitable for my students in my course.

PBL is a curriculum design and a teaching and learning strategy introduced to help students to develop deep-level thinking and disciplinary knowledge based skills and competencies. In PBL, teaching and learning activities are centred around context-based real-life problems, and opportunities are created for self-directed small group learning by students. While working on the problem, students use a systematic working procedure to analyse the problem (Schmidt 1983).

The first session in PBL involves students discussing the case or problem as a group, clarifying terms and concepts not readily understood through collaborative learning and making use of knowledge of the group members. During this process, teacher and students collaborate to identify and locate necessary resources.

The next session in PBL involves students informing each other about their findings, and teaching the rest of the class what they have learned about their assigned issues. Any new questions raised in the learning process, or issues still not well understood become new learning issues, and the cycle is repeated until a satisfactory evaluation and clarification of the problem can be made. This second session aims at checking whether or not a deeper understanding of the problem has been reached. All these processes focus on student activities and the teacher attempts not to inform but to guide, support and encourage the students' initiatives.

PBL is a good strategy while students already have some ability to deal with problems. It is also a good strategy for small classes while teachers are able to take care of each group's progress while students are learning in the groups.

Most of students in the East China Normal University have come from different backgrounds and have different experiences, but have a common exposure to the same educational experience which has strongly shaped their general approach to learning.

The education system in China is very much examination oriented. Public examinations function primarily to select students for progression from stage to stage, and thus become the focus for both teaching and learning at school level. This kind of emphasis on examinations has a strong negative effect on both teaching and learning (Morris 1985), with teachers teaching to perceived model answers to examinations, and students engaging in low level cognitive strategies such as memorising teaching notes and model answers by rote. This educational experience has resulted in the development of a surface learning approach (Biggs and Moore 1993) by many students when they begin their tertiary education. The motive to learn is to pass examinations, and the cognitive strategies used are mostly low level such as rote learning and reproducing. Therefore, before using a PBL strategy, other strategies should be chosen to accommodate for the students.

To cater for more than 120 first year students, over 20 groups each with six students will be formed. This will make it even harder for the teacher to use PBL in the course of *Computer Technology Application* in my university. Because these are first year students and course delivery is to large classes, PBL may be too difficult for both teacher and students. Therefore, the strategy of case study combined with group project work may be a more appropriate choice for my course.

Course design

In the information age nowadays, the Internet as the fourth media plays an important role in people's daily life. Surfing the Internet to get different kinds of information becomes part of people's ordinary life. E-commerce, distance learning, distant entertainment etc. are common applications now. However, most of the information from the Internet is in the form of web sites which are developed by people. Information technology proficiency is as important for the new generation as literacy was in the old days. One ought to have the ability to contribute to the virtual world while absorbing its nutrition.

As a new strategy for this course, a case study involving a of real web site will be introduced to the students at the beginning and then a project will be given for students to

Table 1. *Computer Technology Application* course arrangement

Weeks	Lecture time	Laboratory time
1	Introduce the case, give the project	Form groups
2-5	Using the case to introduce HTML technique	Practice of HTML, group work for project
6	Students give presentation about the plans of projects	Group work for project
7-10	Using the case to introduce JavaScript technique	Practice of JavaScript, group work for project
11	Students give presentation about their teamwork and group culture	Midterm examination
12-15	Using the case to introduce database technique	Practice of database, group work for project
16	Using the case to introduce the combination of the dynamic web site design	Group work for project
17	Half of students give presentation about their projects	Final examination simulation
18	Another half of Students give presentation about their projects	Final examination

finish at the end of the course. The case could be an e-commercial web site such as an e-market or a course enrolment system used by our school. The case web site will cover every technique of interface design, HTML, *JavaScript* and database which are listed in the syllabus.

The students are divided into groups with five to six students each. They can freely choose group members after the first lecture. These groups are actually learning units for the whole semester and should finish the project of a web site design and implementation at the end of the course. The web site should be chosen from the hotspots of campus or society needs. So the students will be encouraged to create the web site successfully.

There are 18 weeks in a semester and each week there is a 1.5 hour lecture and a 1.5 hour laboratory work. The course arrangement is shown in Table 1.

Assessment design

Despite of traditional examination as summative assessment, formative assessment is also an important part of the course. It can let the students know what they have learned and what they need to learn during the process of learning. The distribution of marks is in Table 2.

Table 2. Mark proportion of *Computer Technology Application* course

Component	Finish time	% of final mark
Project plan	Week 6	5
Final project	Week 17	15
Quizzes	During the lecture times	5
Midterm examination	Week 11	20
Final examination	Week 18	50

The formative assessment of this course is divided into two parts – self-assessment and peer-assessment. The criteria on the evaluation of the project are given to the students on the first day when they get the project requirements. When they submit their project at the end of the semester, they should give an assessment of the group members and their participation in the project as well as their assessment of the project. The former is a peer-assessment and the latter is a self-assessment. The teacher will give the final assessment of the project according to the result of project and the assessment of students.

During the lectures, quizzes will be given in the form of a few questions. After these quizzes, marking criteria of the questions will be given to the students, while they should check peers' answers in the classroom and hand out the result of the quiz.

Potential problems

There may be two potential problems – time management and conflict between the width and depth of content to be included in the course.

Using case study methodology and group work strategies in such a big class is a challenge for the teacher. Students working in groups can easily get out of control during the lecture time. Furthermore, when the students give presentations on their projects, time is even harder to control for these students who are not experienced in presentation. Thus some guidance on the presentation beforehand should be given to students.

The second problem is about content selection. The list of content areas in the syllabus is excessive. The width and depth of the content students need to learn is always in conflict. The most important content and those which easily lead to misconceptions should be chosen to introduce during the limited lecture time. Students also need time to construct what they have learned, so if there is too much content taught in a short time, the learning of that content will definitely be surface learning.

Conclusion

For the first year undergraduate students, teachers should help them not only in the grasping of knowledge, but also on the transformation from the teacher-centred learning habit formed in the high school to the student-centred learning habit which will affect their future study in

university. A combination of case study and project pedagogy can make students more motivated and more interested in what they should learn. The case study is the scaffold of the project for students. The group work experience can let students learn about the communication skills and foster the cooperative spirits. The new strategies will change the traditional surface learning habit of students into a deeper approach and foster creative thinking ability. All these are very useful for their future life.

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