Chapter 14

Innovative Approaches in Teaching and Learning for Sciences

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ABSTRACT

It is a challenging task to produce science graduates who are successful academically as well as competent in various life-long skills that are needed for a successful career. To innovate the learning process and promote skill development, students should be encouraged to practise self-directed learning via online learning materials and e-learning tools, in addition to attending the conventional face-to-face lectures. In this chapter, the importance of a shift in the teaching and learning paradigm from teacher-centered to learner-centered learning is highlighted. The methods and approaches behind a successful implementation of blended learning for undergraduate science programs are discussed. Various e-learning tools and appropriate e-learning activities that can promote the development of self-directed and collaborative learning are also described in detail.

INTRODUCTION

To have a successful career, graduates should not only be academically adept by mastering discipline-specific knowledge, but they should also be competent in various inter- and intrapersonal skills such as the ability to communicate proficiently, work effectively in a team and manage time efficiently. Unfortunately, current approaches used in undergraduate science teaching in many institutions are still not geared towards skill enhancement. In many institutions, students are still primarily taught and assessed
mainly based on their ability to retain and reproduce knowledge. Knowledge is often delivered via the teacher-centered teaching method, where students learn passively through lectures. While this is the most conventional teaching method, many studies have shown that it certainly may not be the best. Through this method, the process of learning science is often associated with memorising and regurgitating facts, rather than an interesting opportunity to make new discoveries. Additionally, students are not given the opportunity to develop extra skills that are needed for employment and life-long learning. Thus, the objective of this chapter is to describe and discuss new innovations in teaching and learning for science undergraduate programs. These efforts are aimed at developing an all-rounded science graduate, who is not only knowledgeable but also have the ability to adapt well in the working environment and exhibit life-long learning skills.

TEACHER-CENTERED AND LEARNER-CENTERED TEACHINGS

Teacher-Centered Teaching

The teacher-centered teaching model is the traditional teaching method that focuses on the delivery of material or knowledge by educators (Blackiea, Caseb, & Jawitzc, 2010). While the teachers take full responsibility in conducting and coordinating each lesson, learners in turn play a passive role in learning (Blumberg, 2008). Teachers have full control over the lesson content, types of assessment and how a class should be run. Class activities, if any, usually require the students to work alone (McManus, 2000) and noises in the classroom are usually frowned upon. Consequently, the classroom remains in an orderly manner throughout each lesson.

Despite its limitations, there are several reasons why teacher-centered teaching is still widely practised. One reason is that the seating arrangements in lecture halls usually favour this traditional teaching method. Lecturers are positioned in front of students who are seated in rows, restricting their ability to have meaningful interactions with the students. Teacher-centered teaching is also favoured because it allows the course learning outcomes to be achieved in an orderly manner. Inclusion of student participation or activities in the learning process may hinder the timely completion of a particular course. Some lecturers may not feel comfortable when students are allowed to discuss course materials beyond their lesson plans. This is because the unpredictable nature of students’ queries may challenge their authority as the “expert” of a particular field when they are unable to address those queries. Science lecturers in higher education institutions are often comprised of researchers who may have an impressive resume of successful grant applications and publications, but have not had formal, accredited training in teaching (Tanner & Allen, 2006). They most likely have also been taught via this conventional method, thus continue the vicious cycle when they themselves become educators. In addition, active learning requires substantially more preparation time than lecturing, thus may not be favourable amongst faculty members who may prefer to prioritise their research. Unlike the recognition given for successful grant application and publication, there is usually no incentive given for the time invested in classroom innovations aimed at promoting active learning (Waldrop, 2015).
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