Science Course for Gifted Local Secondary Students with Supplementary Problem-Based Learning Component

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ABSTRACT

"BISC 004 Exploration of Life" is a university-based credit-bearing general education course jointly offered since 2003 by The Hong Kong University of Science and Technology (HKUST) and the Education Bureau (formerly Education and Manpower Bureau) as part of the Support Measures for the Exceptionally Gifted Students scheme. It features a series of multidisciplinary general education programs for senior secondary students exhibiting outstanding potential or exceptional ability in science.

Participants are gifted local secondary students recommended by school principals and selected each year by the School of Science, HKUST and Gifted Education Section, Education Bureau.

The course includes lectures on a number of modern life science topics, ranging from biology and biotechnology to environmental science and social sciences given by teaching staff from the Department of Biology, Atmospheric, Marine and Coastal Environmental Program, and Division of Humanities, HKUST, and occasionally by invited speakers from other local universities. After each lecture, a tutorial session with related investigative questions is arranged so students can look further into the subject areas. Students are divided into small groups and encouraged to have discussions within the group.

This course has provided gifted secondary students with an alternative to learning outside their conventional classroom with real-life applications and has received positive feedback from them over the years.

This paper summarizes lessons learnt and student feedback over the past five years and hopes to serve as a potential model for the development of other similar courses for gifted senior secondary students and/or general education courses for university undergraduates in the future four-year curriculum.

Keywords

Supplementary problem-based learning component, general education course in science, gifted education

INTRODUCTION

In early 2001, the Education Bureau (formerly Education and Manpower Bureau) launched the "Support Measures for the Exceptionally Gifted Students Scheme" to help nurture and develop the potential and talent of gifted students. From 2001 to 2006, over 5,000 secondary students whose performance had been outstanding and who showed potential in leadership, mathematics or sciences joined the Scheme through the annual territory-wide school nomination exercises. They then participated in various enhancement programs including thematic seminars, workshops, training courses, study camps, research projects, visits and competitions with students from mainland China and other territories. Some of these were university-based credit-bearing courses co-organized with tertiary institutions.

"BISC 004 Exploration of Life" (formerly "GNED 100B" when it was initially offered in the Spring Semesters of 2003 and 2004) was jointly offered by the School of Science, HKUST and Gifted Education Section, Education Bureau first in 2003 and since then in the Spring Semester of every academic year. For the past five years, around 400 gifted secondary students have taken part, fulfilling the course requirements and being awarded two university course credits at HKUST.

The course was designed with the following learning objectives:

- To develop the scientific research skills, thinking and organizational abilities, inductive, dialectical and problem-solving skills of students exhibiting outstanding potential and performance in science;
- To enhance students' interest in science and cultivate a positive attitude towards the study of science and value judgment; and
- To deepen their understanding of themselves and the human culture through the exploration of life by adopting a multi-disciplinary approach.

SELECTION OF PARTICIPATING STUDENTS

Secondary Six students exhibiting outstanding potential and performance in science were nominated by school principals according to the guidelines set by the Gifted Education Section, Education Bureau. After preliminary short-listing, student nominees were invited to attend a screening test conducted by the Department of Biology, HKUST and the Gifted Education Section, Education Bureau, in which each student's level of knowledge in basic science was assessed. Each year, a maximum of 100 students were selected to participate in the course, based on the results of the screening test, the individual student's competence in English, and his/her school and public examination results.

COURSE DESIGN

The course offers an exploration of life from the perspective of physics, biology, humanity and economics. It consists of eleven to twelve 90-minute lectures, each supplemented with a 90-minute tutorial and group discussion session. All the learning activities were conducted on Saturday mornings at the HKUST campus.

In order to fulfill the course requirements for obtaining the two university course credits, each student was required to attend at least 90% of the lectures and tutorial sessions, as well as to

submit one essay assignment for each lecture.

CONVENTIONAL LECTURE

Lectures were given by teaching staff from the Department of Biology, Atmospheric, Marine and Coastal Environmental Program, and Division of Humanities, HKUST, and occasionally by invited speakers from other local universities. Subjects included Origin of life, Evolution, Molecular Biology, Genetics, Biotechnology, Neurobiology, Marine & Environmental Biology, Ecology, Traditional Chinese Medicine and Philosophy of Life. Two or three related investigative questions were set by the lecturer each time to form a basis for the subsequent group discussion. These were usually open questions for the students to think through, so as to further explore the lecture topics.

TUTORIAL/GROUP DISCUSSION SESSION

After each lecture, students were divided into several groups for the subsequent tutorial and small group discussion sessions. These were led by teaching assistants who were themselves postgraduate students in related fields.

Each tutorial session was divided into three major parts, firstly a question-and-answer time for the lecture, followed by division into groups of three or four for small group discussion on the questions set by the lecturer. These open questions helped the students to further investigate the lecture topic, and think through the issues raised through interactive discussion, with the teaching assistant and/or lecturer acting as the facilitator(s). During the last part of the tutorial session, a representative from each group was invited to present a summary of their group's findings in front of the class, with immediate feedback from the other students, teaching assistant and/or lecturer.

ESSAY ASSIGNMENT

After each lecture and tutorial session, the students were given a week to compile their discussion summary into a short essay as the course assignment. This helped them organize their discussion findings at home and provided another platform for the teaching assistant to give his/her feedback and monitor individual student's progress.

COURSE EVALUATION

Course evaluation by students was conducted at mid-term and the end of the course. For the past five years, more than 70% agreed that the arrangement of the course was appropriate. Over 80% considered it helpful in enhancing their problem-solving, analytical and organizational skills. About 90% of the participants recognized the importance of the tutorial sessions in providing them with a deeper understanding of the subjects.

In 2007, the students' school teachers were also invited to participate in the course evaluation. Most gave positive feedback and recognized that the course had a positive impact on their students and broadened their horizons.

CONCLUSION

Our experience has demonstrated tutorial sessions with problem-based learning component act as a good supplement to conventional lectures, enabling the students to think deeper about the subject areas covered. The interactive group discussion also enhanced the students' problem-solving and analytical skills.

With appropriate stimulation for learning interest and sufficient background information on the subjects, the gifted senior secondary students demonstrated good abilities in independent learning in a university setting. Our course also serves as a potential model for the development of science general education for university undergraduate students in the future four-year university curriculum.

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