Science General Education Courses: the Student's Perspective

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ABSTRACT

We surveyed students on their expectations and experiences when taking general education courses offered from the School of Science. Our survey shows that their major expectations were: knowing more about the relevance of science to daily life, gaining knowledge of real-life issues, and achieving better observation skills. Such expectations were satisfied in general. Year 2 students consistently had the lowest expectation while Year 0 students were most enthusiastic. The top factors affecting their course selection were: their interest in the course materials, appropriate workload, and good grades. Interactive teaching methodologies such as demonstrations, field visits and experiments were considered more useful than discussions and projects. Additional unexpected findings indicated the need to establish more explicit objectives of general education in the School, and to bridge the gap between the expectations of the students and instructors.

Keywords

Science general education, student expectations, course selection, interactive teaching methodologies

I. INTRODUCTION

For a long time, various departments in the School of Science have been offering a spectrum of general education courses. In two recent semesters, there were a total of 7 courses serving around 1,000 students. Looking forward, the approaching "3+3+4" educational reform in Hong Kong requires all local universities to provide a broader curriculum for undergraduate programs. Responding to this demand, the development of additional general education courses has been given a high priority by the School of Science.

We recently conducted surveys among students taking the Science general education courses to help gear up the School's efforts to meet student needs. The objective was to collect student opinions on their expectations and experiences, which will be taken into account in the improvement and overall planning of courses in future. In this paper, we report the findings of the survey, and discuss their implications for the future development of Science general education.

II. METHODOLOGY

Three courses were selected for this study in the Spring semester of 2007 with two tailor-made questionnaires used for data collection. They were BISC 001 (Appreciation of Biological Sciences), PHYS 002 (Introduction to Astrophysics and Astronomy), and GNED 011S (Environmental Conservation and Public Health in Hong Kong). The survey covered students from Years 0 to 4 in our three-year curriculum[1].

A "pre-study" questionnaire (Appendix A) was distributed at the beginning of the courses, focusing on students' expectations from general education. Near the end of the semester, a "post-study" questionnaire (Appendix B) was distributed to investigate whether the courses had met those expectations. 278 "pre-study" questionnaires and 217 "post-study" questionnaires were collected.

III. RESULTS OF THE PRE-STUDY QUESTIONNAIRE

1. Students' Expectations

As shown in Fig. 1, the top three expectations of the courses are:

a. The course should relate science to daily life.
b. The course should enable them to gain knowledge and become more aware of real-life issues.
c. The course should enhance their observation skills.

We note that these aspects of students' expectations are higher than the remaining choices, which are:

d. The course should help them develop lifelong learning skills.
e. The subject matter of the course should connect with other areas of study.
f. The course should enhance their critical and independent thinking.

The expectations show that the students take a "practical" attitude towards the courses.

2. Interactive Learning Methods

We also surveyed students' preferences towards various interactive learning methods. In descending order of preference, they were: demonstrations, field visits, experiments, discussions, and projects.

[1] Year 0 refers to the preparatory year, mainly composed of students from Mainland. Year 4 students refer to those taking courses at or after the 7th semester.

The preference for demonstrations and field visits coincided with students' expectations on relating science to daily life and more awareness of real-life issues. On the other hand, the lower preferences for discussions and projects could be a consequence of HKUST students' heavy workload.

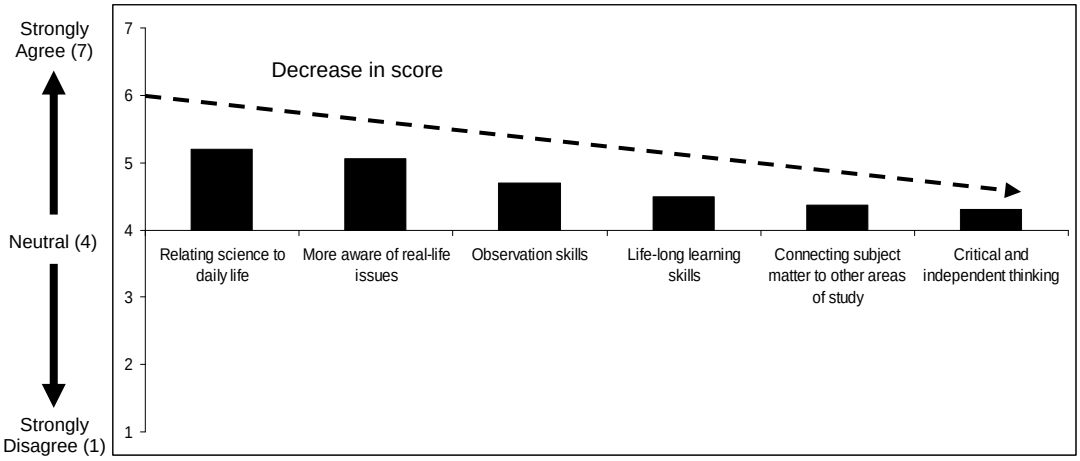


Fig. 1: Students' expectations on Science general education courses in the "pre-study" questionnaire.

3. Key Criteria in Course Selection

In decreasing order of preference, students selected a general education course to fulfill the general education requirement according to the following criteria:

a. The course materials are interesting.
b. The course has a relatively light workload.
c. The course gives students good grades.

We note that these criteria were more important than the remaining ones, in descending order:

d. The course is relevant to real-life situations.
e. The course can let students acquire knowledge outside the scope of the major study.
f. The course is just one of the courses that can fulfill the curriculum requirement.
g. The course can let students acquire knowledge relevant to the major study.

It is comforting for front-line instructors and curriculum designers to find that an interest in course materials remained the topmost criteria in the students' minds, although one can never rule out the tendency for them to seek a reduced workload and good grades.

4. Year Effect

Besides these overall observations, we have analyzed whether students' responses depend on their years of study. As shown in Fig. 2, we find that Year 0 students had more enthusiasm, better learning attitudes, and higher expectations from their study. They consistently gave higher scores (5.0-5.6 in a 7-point scale) to the questions related to their expectations.

It was particularly interesting to note that Year 2 students consistently gave the lowest scores (4.0-4.9 in a 7-point scale) for expectations relative to others.

Good responses by Year 0 students could be due to their composition as mainly top students from Mainland high schools. It would be interesting to monitor, in future surveys, whether their expectations were assimilated with their peers' in subsequent years.

A natural question is whether students' enthusiasm affected their academic performances in the courses. We collected statistics on the average grades of several Science general education courses for several years. Results for the course BISC 001, typical of these courses, are shown in Table 1. Except for the exceptionally high average grade of Year 0 students, the average grade improved with the students' year of study. While Year 1 students were more enthusiastic than those in Year 2, their average grade remained lower. This implies that besides their enthusiasm, other factors such as study skills could be more important in affecting their academic performance.

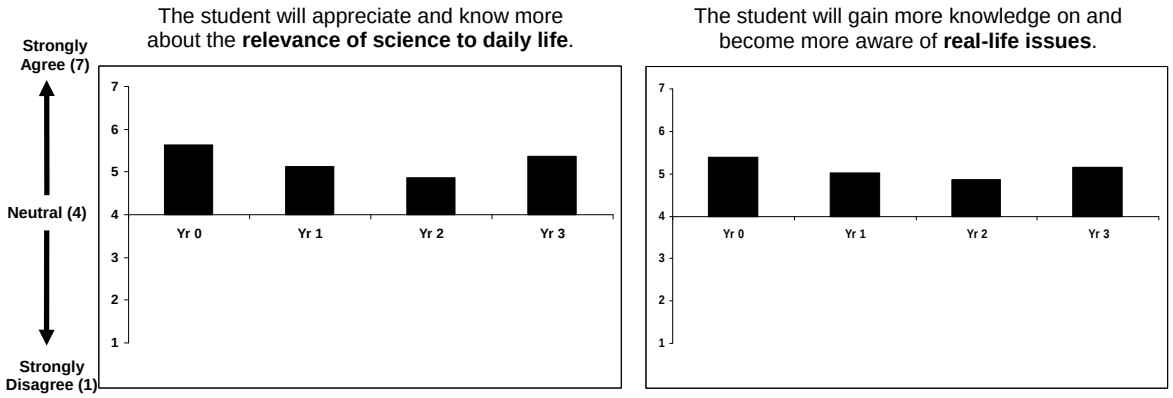
Year	Average grade	Sample size
Year 0	9.15	76
Year 1	5.82	97
Year 2	6.39	76
Year 3	7.17	169
Year 4	--	0

Table 1: Average of grade points (in a scale from 0 to 12) of students taking BISC 001 during the academic years 2004-05, 2005-06, 2006-07.

5. Suggested Topics

Some of the topics suggested by students for future general education courses are: Food Science, Bioengineering, Environmental Protection, Weather and Climate, Tourism, Psychology, Physical and Mental Health.

The School of Science has shown a very good grasp of students' interests. Concerning environmental protection, the course "Energy and Related Environmental Issues" (PHYS 006) was offered in the Fall semester of 2007. Related to Food Science, the course "Gastronomy" (SSCI 003) will be launched in the Spring semester of 2008.



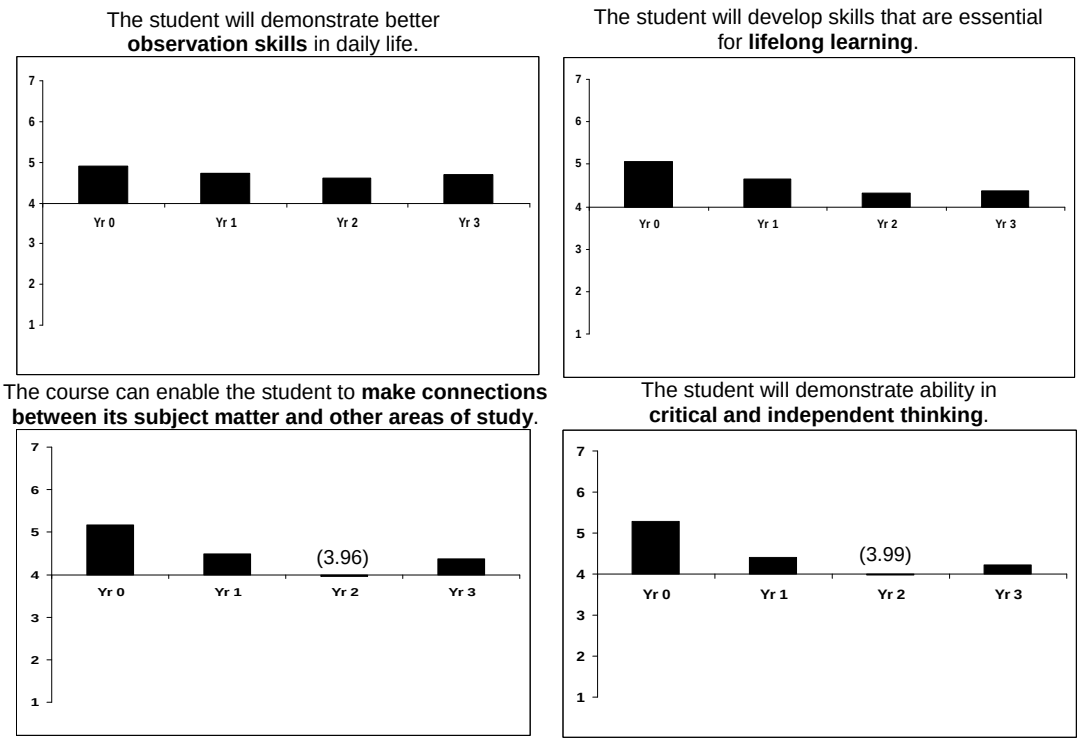


Fig. 2: The dependence of students' expectations of Science general education courses on their years of study.

IV. RESULTS OF THE POST-STUDY QUESTIONNAIRE

The "post-study" questionnaires show that in general students agreed that the Science general education courses surveyed in this study met their expectation. The comparison between pre-study and post-study is shown in Fig. 3. In particular, the students indicated that they had learned the relevance of science to daily life from these courses, and had become more aware of real-life issues. These two topmost items correspond to the two topmost expectations in the pre-study questionnaire.

Consistently, the students considered the use of interactive learning methodologies effective in enhancing their learning. Same as their perception in the pre-study, interactive learning methods in descending order of preference were demonstrations, field visits, experiments, discussions, and projects. These approaches will be recommended when courses are developed in the future.

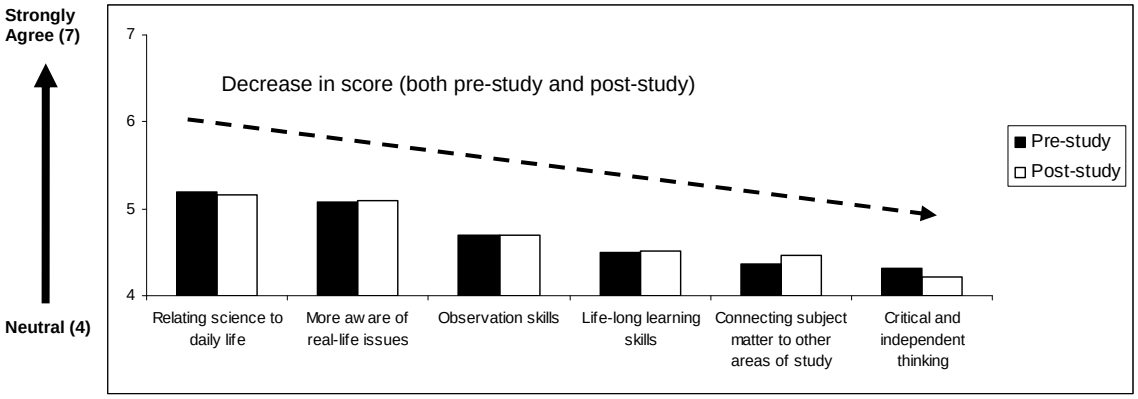


Fig. 3: Comparing the pre-study survey of the students' expectations, and the post-study survey of whether the students gain in the expectations after studying the Science general education courses.

V. DISCUSSIONS

In this paper, we have described the results of a recent survey of Science general education courses. The observations are summarized as follows:

1. In general, Science general education courses have met students' expectations.
2. Year 0 students had the highest expectation from Science general education. On the other hand, Year 2 students appeared to have the lowest. However, Year 2 students did not have the lowest average grade.
3. Through Science general education, students expected that they could be most benefited by gaining ability to relate science to daily life, becoming more aware of real-life issues, and acquiring better observation skills.
4. Students' preference and the effectiveness of interactive learning methods are in parallel, in the descending order of demonstrations, field visits, experiments, discussions and projects. Order corresponds to students' expectations on relevance to daily life and awareness of real-life issues.
5. Interest in course materials remained the top criterion in students' selection of courses, followed closely by their concerns for workload and grades.

Several issues arise from the study, and it would be interesting to follow them up in the future development of Science general education:

1. The pre-study and post-study findings are in parallel in many aspects. Does this indicate that our general education courses have been successful in fulfilling students' expectations, or does it imply that we have not been able to change students' learning attitudes through the courses?
2. Given students' low expectation on improving their critical and independent thinking skills through the Science general education courses, are our present format and the size of these courses effective in nurturing such skills?
3. Preliminary observation from the average grades over the past 3 years indicates that Engineering students appeared to perform poorer than other students in Science general education. On the other hand, the performance of the Business students seemed to be comparable to Science students. This discrepancy should be further studied.
4. Presently, Science general education courses are offered by various departments. In view of the impending 4-year curriculum, should the School of Science formulate a more unified statement of the learning outcomes of these courses, taking into account both the purposes of university education and the students' expectations?

It is anticipated that our findings can provide the University, in particular the School of Science, with a clearer direction in the overall planning of general education courses to cope with educational reform, meeting the students' needs and at the same time maintaining the academic vigor we aim to achieve.

ACKNOWLEDGMENT

We thank Profs. S. Y. Cheng and T. K. Ng for encouragement and meaningful discussions, and Alexander Yuen for technical support. This work is supported by a Continuous Learning & Improvement through Teaching Innovation grant (project code: 00400S).

APPENDIX A: THE PRE-STUDY QUESTIONNAIRE

This questionnaire aims at collecting students' opinions for the improvement and overall planning of general education courses under the School of Science.

Please answer all the questions.

Section I. This section is to collect some background information of the students.

1. Which undergraduate program are you taking? _____

2. Which year are you in?
   Year 0 ☐ Year 1 ☐ Year 2 ☐ Year 3 ☐

3. Are you an exchange student? If yes, please state your home university.
   Yes ☐ _____(University and location)
   No ☐

4. How much biology[2] knowledge had you acquired before taking this course?
   University ☐ A-level or equivalent ☐ F.5 or equivalent ☐
   F.3 or equivalent ☐ None ☐

Section II. This section is to explore the students' expectations from <u>a Science general education course</u>. (1 = Strongly Disagree, 7 = Strongly Agree)

5. The student will appreciate and know more about the relevance of science to daily life.
   Strongly Disagree 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ Strongly Agree

6. The course can enable the student to make connections between its subject matter and other areas of study.
   Strongly Disagree 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ Strongly Agree

7. The student will demonstrate ability in critical and independent thinking (for example, comprehension, application, analysis, synthesis, and evaluation).
   Strongly Disagree 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ Strongly Agree

8. The student will gain more knowledge on and become more aware of real-life issues.
   Strongly Disagree 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ Strongly Agree

9. The student will demonstrate better observation skills in daily life.
   Strongly Disagree 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ Strongly Agree

10. The student will develop skills that are essential for life-long learning.
    Strongly Disagree 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ Strongly Agree

[2] For students taking PHYS 002, they were asked how much physics knowledge they had acquired before taking the course.

11. Which type(s) of interactive learning methods can enhance the teaching and learning effectiveness of the course? (Please rank the options from 1 to 5; 1 = most important, 5 = least important)
    a. Demonstrations. ☐
    b. Experiments. ☐
    c. Field visits. ☐
    d. Discussions. ☐
    e. Projects. ☐

    If you have other suggestions, please specify:

    _____

    _____

Section III. This section is to collect feedback from the students about their views on general education as a whole (<u>not</u> restricted to Science general education).

12. What is/are your criteria for selecting a general education course to fulfill the general education course requirement? (Please rank the options from 1 to 7; 1 = most important, 7 = least important)
    a. Anything to fulfill the requirement. ☐
    b. Giving students good grades. ☐
    c. The course has relatively light workload. ☐
    d. The course materials are interesting. ☐
    e. The course is relevant to real-life situations. ☐
    f. To acquire knowledge outside the scope of my major. ☐
    g. To acquire knowledge relevant to my major. ☐

    If you have other suggestions, please specify:

    _____

    _____

13. Can you suggest other topics of general education courses in which you are interested?

    _____

    _____

    _____

    _____

14. From your experience in taking general education courses, what can be done to improve the teaching and learning effectiveness of these courses?

    _____

    _____

    _____

~End of questionnaire. Thank you! ~

APPENDIX B: THE POST-STUDY QUESTIONNAIRE

This questionnaire aims at collecting students' feedback whether the general education course under investigation has met their expectations. This semester-end survey is a follow-up procedure on the questionnaire conducted at the beginning of the semester. The results of both questionnaires will be used for the improvement and overall planning of general education courses under the School of Science.

Please answer all the questions.

Section I. This section is to collect some background information of the students.

1. Which undergraduate program are you taking? _____

2. Which year are you in?
   Year 0 ☐ Year 1 ☐ Year 2 ☐ Year 3 ☐

3. Are you an exchange student? If yes, please state your home university.
   Yes ☐ _____(University and location)
   No ☐

4. How much biology[3] knowledge had you acquired before taking this course?
   University ☐ A-level or equivalent ☐ F.5 or equivalent ☐
   F.3 or equivalent ☐ None ☐

Section II. This section is to explore whether the students agree that the general education course under investigation can meet the following expectations. (1 = Strongly Disagree, 7 = Strongly Agree)

5. The student has learnt to appreciate and know more about the relevance of science to daily life.
   Strongly Disagree 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ Strongly Agree

6. The course has enabled the student to make connections between its subject matter and other areas of study.
   Strongly Disagree 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ Strongly Agree

7. The student has strengthened their skills in critical and independent thinking (for example, comprehension, application, analysis, synthesis, and evaluation).
   Strongly Disagree 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ Strongly Agree

8. The student has gained more knowledge on and become more aware of real-life issues.
   Strongly Disagree 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ Strongly Agree

[3] For students taking PHYS 002, they were asked how much physics knowledge they had acquired before taking the course.

9. The student has demonstrated better observation skills in daily life.
   Strongly Disagree 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ Strongly Agree

10. The student has developed skills that are essential for lifelong learning.
    Strongly Disagree 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ Strongly Agree

11. These interactive learning methods may be used in the studied course. Which of them were useful in enhancing the teaching and learning effectiveness of the course? (Please rank the methods used in the course: 1 = most important, 2 = less important, and so on. Please put an "x" for those methods that have not been used.)
    a. Demonstrations. ☐
    b. Experiments. ☐
    c. Field visits. ☐
    d. Discussions. ☐
    e. Projects. ☐

    If you have other suggestions, please specify:
    _____
    _____

~ End of questionnaire. Thank you! ~