

Integrating Academic and Mentoring Support **FOR THE DEVELOPMENT OF FIRST-YEAR ChE STUDENTS IN HONG KONG**

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In recognition of the difficulties beginning university students face in handling the transition from secondary school to university,^[1] many resources have been developed to help them deal with the academic, social, and emotional adjustment issues.^[2] Engineering students, in particular, are often at risk because of a technically demanding curriculum. The situation is even more severe in Hong Kong, where the normative length of an engineering degree is three years. This means engineering students face a heavy workload right from the start, just when they are trying to adapt to university life. It is thus important to help students develop effective learning skills and habits early.

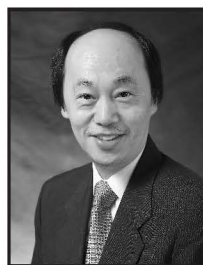
To address this issue, the School of Engineering at The Hong Kong University of Science and Technology has made provisions for its departments to offer introductory courses that are specifically targeted at the academic and professional development of beginning students. In response, the Department of Chemical and Biomolecular Engineering—the only such department in Hong Kong—has offered a newly designed course, CENG001, since Fall 2005 to meet the following key objectives:

1. to help students deal proactively with the transition from secondary school to university,
2. to familiarize students with the intended learning outcomes of university and engineering education,
3. to develop professional skills such as the ability to communicate, to work on multidisciplinary teams, and to engage in lifelong learning within a conceptual framework, and
4. to build a learning community among new and senior students in the department.

To date, the newly designed CENG001 has been offered four times. About 250 first-year chemical engineering students

have taken the course, including every student who is currently in the department.

In the teaching of CENG001, we have made an attempt to make reference to other chemical engineering courses that students are taking in the same semester in order to place the learning of professional skills in context. Furthermore, we have integrated the course with the department's mentoring program in order to provide peer support to the first-year students. This integration has the added benefit of fostering a learning community, thus enhancing students' out-of-class learning and their sense of belonging to the department. Taking such a holistic approach to promote the personal and professional development of first-year students is innovative and (as discussed below) effective.



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TABLE 1
Learning Outcomes of CENG001

At the end of this course you (students) should be able to:	
1.	Explain to a layman (someone without expertise on this subject) the skills and competencies a university graduate in general, and an engineering graduate in particular, should possess.
2.	Use your knowledge of Myers-Briggs Type Indicator (MBTI) to develop skills and competencies in areas such as time management, communication, and teamwork.
3.	Identify your strengths and weaknesses in relation to the skills and competencies that are important in a modern workplace.
4.	Make concrete plans for personal and professional improvement, especially in areas in which you are currently weak.
5.	Develop the habits to become a reflective, self-regulated learner.

COURSE DESCRIPTION

Learning outcomes and course contents of CENG001 are shown in Tables 1 and 2, respectively. Briefly, the course focuses on the academic and social adjustment issues commonly faced by first-year university students. Topics include the purposes of university and engineering education, learning, time management, teamwork, communication and interpersonal skills, and goal setting.

The sequence of topics is based on meeting the students' needs. For example, time management is discussed at about one month into the semester, just when students are feeling the pressure to manage their time well in order to deal with the first round of examinations. Teamwork and presentation skills are introduced at a time when students have to make presentations based on group projects in the other chemical engineering courses they are taking in the same semester. This coordination puts the learning of these skills in context, and students have found it useful to be able to apply what they learn in one course to another.

An important intended learning outcome of the course (which is also expected of engineering graduates accredited by signatories of the Washington Accord) is for students to become self-regulated lifelong learners. To this end the Myers-Briggs Type Indicator (MBTI), a widely used and researched instrument on personality types,^[3] is adopted for students to gain a better self-understanding. In particular, students learn about the strengths and blind spots of each MBTI type in situations such as participating in teamwork, resolving conflicts, and communicating with people. MBTI thus provides a useful tool for them to monitor their behaviors and to identify areas for improvement, which is important for self-regulation.

As the key in self-development rests on a better understanding of oneself, students in CENG001 are asked to participate in many reflective activities in class, either individually or in small groups. To the extent possible, these activities involve the applications of MBTI and make reference to other chemical engineering courses (*e.g.*, CENG152, Introduction to Environmental Engineering) students are taking in the same semester, in order to place students' learning in context. Below are three examples of these activities:

TABLE 2
Course Contents of CENG001

Session #	Topic
1	Introduction/Setting expectations (what are we going to do?)
2	University education
3	Engineering education
4	Myers-Briggs Type Indicator (MBTI)
5	Time management
6	Effective learning
7	Introduction to teamwork
8	Communication skills
9	Presentation skills
10	Conflict resolution skills
11	Making the most out of your university education: setting personal and professional goals
12	Reflection/Evaluation (how well have we done?)

1. Based on a realization of your strengths and weaknesses as a learner in terms of your learning style, identify an area of learning that you would like to improve the most and formulate an action plan. Think on your own first, write your plan down, then discuss with your neighbor for a few minutes. Be prepared to share your discussion with the whole class.

2. Think about the team experience you have in your CENG152 project so far, what has gone well and what could have been done better? In what ways could your knowledge of MBTI help your team to be more effective in the future?

3. Think of a conflict situation you had in your CENG152 team. Identify the main reason for that conflict, explain it in terms of your knowledge of MBTI, and propose a solution should you find yourself in a similar situation again.

These activities serve to promote active and collaborative learning in class, which is particularly important for beginning university students as such experience may be new to them. Furthermore, students are asked to submit monthly reflective statements, taking stock of their experiences in the past month and making plans for the coming one. The

TABLE 3
Reflective Statement

Name	
Month/Year	
Things that I have done well this month	
Things that I could have done better this month	
The most difficult challenge I faced this month	
The most valuable thing I learned this month	
My main goals for next month	
Activities needed to achieve my goals	
Resources needed to achieve my goals	
Evidence and measure of success	
A brief reflective statement of what I have learned from completing this form	

TABLE 4
Comparison of MBTI Type Distributions^(a)

ISTJ ^(b) 2%/12%/21% ^(c)	ISFJ 19%/16%/5%	INFJ 2%/18%/3%	INTJ 6%/7%/8%
ISTP 2%/2%/3%	ISFP 2%/7%/2%	INFP 6%/6%/2%	INTP 0%/0%/9%
ESTP 2%/0%/7%	ESFP 6%/3%/2%	ENFP 8%/3%/10%	ENTP 2%/2%/4%
ESTJ 10%/0%/11%	ESFJ 12%/7%/7%	ENFJ 14%/13%/2%	ENTJ 10%/4%/6%

(a) The three figures represent, respectively, CENG001 students in Fall 2007 / CENG001 students in Fall 2008 / U.S. students.^[6]

(b) I = introversion, E = extroversion, S = sensing, N = intuition, T = thinking, F = feeling, J = judging, P = perceiving

(c) Percentages are rounded to the nearest integer and thus do not necessarily sum to

form that helps them to develop the habit of learning from reflection is shown in Table 3.

The course instructor reads all statements and provides feedback to students both individually and collectively in class. Faculty tutors and senior student mentors also receive statements of their mentees. In general, students' reflective statements reveal the main challenges they face at different points in the semester (which contains 14 teaching weeks). In the first month, the key issues are making social adjustments and managing their time. In the second month, they are trying to establish the right balance between academic and social activities as they face the first round of examinations. It is not until the third month that many are able to find their own rhythm and become comfortable with university life. Throughout the semester, however, time management remains their biggest concern.

ASSESSMENT AND VERIFICATION OF MBTI TYPES

The approach used in assessing and verifying MBTI types in CENG001 is as follows:

1. Students are asked to complete an online assessment provided by Human Metrics.^[4] This particular instrument was chosen after a pilot study, in which participants rated its ease of use and clarity of results to be better than another online instrument.
2. Students are required to attend a debriefing session, during which they are asked to identify their "self-estimated" type.
3. Any differences between the online result and the self-estimated type are resolved by using a verification procedure described elsewhere.^[5] Verification, which is necessary for identifying the best-fit type, basically involves reading type descriptions in Introduction to Type and identifying the one with which the student agrees the most.

For the students we have worked with, about 55% found their online type and self-estimated type to be identical, and another 25-30% reported differences in only one dichotomy. Type verification thus turned out to be straightforward for most of the students. For those whose online type and self-estimated type were different, about half identified their best-fit type to be the online type; the other half, the self-estimated type. This shows that a self-estimated exercise is as good as this particular online instrument. The type distributions of CENG001 students in Fall 2007 and Fall 2008 are shown in Table 4, along with data for a group of sophomore chemical engineering students in the United States.^[6] These data are shown for reference purposes only because for the sample sizes in this study, there is a noticeable variation in the two batches of CENG001 students. The type distributions should thus be seen as snapshots of three specific groups and not a study comparing chemical engineering students in Hong Kong and the United States.

PEER MENTORING PROGRAM

The Department of Chemical and Biomolecular Engineering has established a peer mentoring program since 2005 to

Among those who made suggestions for improvement, over half expressed that the frequency of meetings could be increased. This suggested to us that the problem encountered by some mentoring groups was due to a lack of meetings. Overall, the evidence shows that the nature and content of the informal gatherings, together with the discussion on the reflective statements, was able to increase the students' awareness and their adaptive ability in making the transition to university life.

help incoming students adjust academically and socially to university life. Starting in Fall 2007, activities in the peer mentoring program have been coordinated with those in CENG001. Via this partnership, we expect to build a learning community among new and senior students and, in the process, extend the benefits of the program and CENG001 from the first-year students to student mentors.

For a class of around 60 students in the first year, we recruited 15 volunteers from the second and third year as peer mentors. These student mentors were selected by the faculty coordinator based on their maturity, good communication skills, and strong commitment to helping first-year students. Before the academic year began, student mentors were given a training session, in which they learned about peer mentoring, the roles and responsibilities of mentors, the overall structure of the department's peer mentoring program, and more importantly, the common adjustment issues faced by beginning students. The latter part was extracted from students' feedback for CENG001 in the past.

Each mentoring group contained one student mentor, four first-year student mentees, and a faculty tutor. Student mentors are expected to initiate informal gatherings with their mentees at least once a month. They are encouraged to discuss adjustment issues with the first-year students using the reflective statements from CENG001 (Table 3) as a guideline. Their secondary role is to act as a bridge between mentees and their

faculty tutor. In addition, student mentors are responsible for proposing and organizing three departmental events during the first semester that can meet the objectives of the mentoring program. In Fall 2007 and Fall 2008, the events held were: i) an orientation session to provide practical tips about university life for the beginning students; ii) a departmental BBQ mixer—a social event for all first-year students, student mentors, and faculty tutors; and iii) a dinner event with chemical engineering alumni.

The department has put several mechanisms in place to monitor the program. In addition to the availability of faculty tutors and the mentoring program coordinator, student mentors can report to the program coordinator the progress and problems in a mid-semester review. Suggestions for improvement are followed up either in that semester or in subsequent years. As an example, the sharing of students' reflective statements with tutors and mentors was implemented upon learning that mentors found it difficult to start conversations with their mentees. The number of students assigned to each mentor has also been reduced based on the feedback from mentors. To assess the effectiveness of the mentoring program as a whole, both mentors and mentees are surveyed at the end of the semester with questionnaires and focus group meetings. The results, discussed below, are used to improve the program in the following year.

DISCUSSION

Assessment of Learning Outcomes

In the spirit of outcome-based education, the real success of CENG001 must depend on a direct demonstration of students having attained the intended learning outcomes. Since the development of skill and affective outcomes takes time, it is made clear to students (in the course syllabus) that having an awareness of the importance of a skill is not equivalent to the actual possession of that skill. Nonetheless, as pointed out by Kirkpatrick,^[7] reaction and learning lay the foundation for behavior and results; in that light the preliminary feedback from students has been encouraging. In the end-of-course evaluations, CENG001 consistently received course and instructor ratings in the range of 80-90 (out of 100), which compared favorably with the average scores (70-80) of the department and of the school. Perhaps more important are the enthusiastic students' (voluntary) comments, some of which are produced below.

"(This course) teaches us many things outside the textbook. Such things are probably the most important things in our lives. I personally feel that this course lets us know our inner self better."

"Students who have really paid attention throughout the course should be able to learn how to learn, which is one of the course objectives. I believe this is crucial."

"Since there is a sudden change from secondary school to

university, there are a lot of things that need to be adapted. From this course, I can learn a lot of useful skills to deal with the difficulties faced and have the chance to know more about myself."

Similar positive comments were made by students in our regular Faculty-Student Liaison Committee meetings. Another source of feedback was available when students were asked to share what they had learned in completing the reflective statements. Their responses are revealing, as illustrated in the following examples.

"Usually I do not sit down and think about how I am coping with life as an undergraduate. I think this exercise helps me do so."

"Always think about what we have done, if it can be improved, and set goals for the coming days."

"I have learned 'action' should be done once you have made a decision. Just 'thinking' of what you are going to do is not enough."

"Although this reflective statement is the last assignment of the course, I will continue the habit of learning from reflection."

In the reflective statements many students also made explicit mention of their learning in terms of MBTI, as shown by the following examples.

"The most important thing I have learned in this course is the concept and applications of MBTI. It is really useful for me to understand myself and even other people more."

"I now know what my MBTI type is and consequently my preferences in dealing with all sorts of things."

"My knowledge of MBTI has enabled me to work with others more effectively."

Integration With the Peer Mentoring Program

In the end-of-semester evaluation in Fall 2007, 46 mentees (close to 80%) responded to the survey. According to the student feedback, the mentoring program has been able to achieve its main objectives: 85% and 91% of the responding students indicated positively that the overall program has guided them to make academic and social adjustments, respectively. There also appeared to be a consensus among the respondents in identifying the benefits of the program. On the academic level, the program let them see a clearer picture of university education in the coming years, and learn the prospects of chemical engineering. On the social level, students enjoyed the friendship with their mentors and other mentees. Through the program, students were able to develop a sense of belonging to the department in only one semester. As one student pointed out, "I am not alone." And another has learned "how to plan for the future and set goals."

A large majority of the first-year students found the informal gatherings with mentors and departmental events helpful

(83% and 85%, respectively). As CENG001 reflective statements were discussed in some of the informal gatherings, we polled students whether this kind of mentor-mentee conversation helped them to discover and solve adjustment problems, and 83% gave a positive response. Among those who made suggestions for improvement, over half expressed that the frequency of meetings could be increased. This suggested to us that the problem encountered by some mentoring groups was due to a lack of meetings. Overall, the evidence shows that the nature and content of the informal gatherings, together with the discussion on the reflective statements, was able to increase the students' awareness and their adaptive ability in making the transition to university life.

According to the feedback of student mentors, the program was successful in creating a learning community. As effective communication is a top criterion for establishing a good relationship with mentees, most student mentors expressed that the most important thing that they have learned was communication skills. A mentor wrote that he/she "learned to give advice without bias" and "learned to listen rather than just to hear." Through organizing the departmental events, students' leadership skills were also sharpened. Interestingly, like the mentees, some mentors indicated that the program led them to better understand themselves and university education. At the same time, they have developed a stronger sense of belonging to the department through their service as mentors.

There is an obvious synergy between CENG001 and the peer mentoring program. To further improve the program quality, this partnership could be further strengthened; for example, by providing more targeted mentor training, asking mentors to attend CENG001 lectures, and relaying the course news from CENG001 to student mentors on a regular basis. A quarter of student mentors felt that the mentee to mentor ratio should be lowered to three such that each mentee could receive more attention. More active faculty participation in the mentoring program would also provide different perspectives for students and increase its impact.

SUMMARY

In this paper we report a simple and effective model, namely the integration of a first-year development course and a peer mentoring program, that proactively deals with the adjustment issues of first-year chemical engineering students. All available data show that participating students, both mentors and mentees alike, learn and grow from a purposeful combination of in-class and out-of-class activities and, in the process, develop a stronger sense of belonging to the department. As a result of these preliminary but encouraging findings, the department has initiated an assessment project to follow a cohort of students in their development of teamwork competence throughout the undergraduate curriculum (in particular in laboratory courses and final-year projects where students work in teams). This project should lead to more direct evidence

of the attainment of key learning outcomes of CENG001, in particular teamwork skills.

The positive responses of students to CENG001 are similar to a professional development course one of the authors (Ko) previously taught.^[8] It thus appears that there is room for “non-technical” courses in an engineering curriculum, especially in view of the desire to educate well-rounded engineering students for the modern workplace. Since these courses deal with generic learning outcomes that are not discipline-specific, they can be easily adopted by other academic departments both within and outside engineering.

On a personal note, we have enjoyed being part of this integrative effort as it has enabled us to interact with many students at a personal level and thus get to know them and the problems they face better. It is particularly pleasing that the approach described in this paper is innovative because it adheres to an old-fashioned ideal, namely that teaching at its best is a human activity—in particular about enhancing human capacity.

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