Continuing education for engineers and product designers: a student-centred approach

Kin W.M. Siu

Hong Kong Polytechnic University
Hong Kong, People's Republic of China

ABSTRACT: A programme has been offered to engineers and product designers with different educational backgrounds and working experiences. Evaluations of the programme have been conducted for five years. In this article, the author first reviews the social changes plus the needs of engineers and designers for continuing education. The structure of the programme is then analysed, along with feedback from the students involved. The author then relates the difficulties that these students encounter in continuing their professional development at universities. According to the student-centred arrangement experience, the author attempts to identify three opportunities to help students continue their education: that is, turning diversity into a resource, turning constraints into flexibility, and turning difficulties into motivation.

NEED FOR CONTINUING EDUCATION

It was not easy to study in a degree programme in a university in Hong Kong until the early 1990s, when the number of university places increased significantly. For one thing, at that time, only a limited number of university places were offered. This was also the reason why university education was considered elite education at that time. A large portion of students who finished their secondary education did not have the opportunity to study locally in degree programmes, even with quite satisfactory public examination results. Therefore, some graduates chose to further their studies abroad. However, at the time, not many families could afford to send their children away to study. One possible choice for such graduates was to study in part-time or evening programmes. Yet local part-time degree programmes at that time were very rare. Thus, the possible choices were certificate, higher certificate, diploma or higher diploma programmes, which were considered lower qualifications compared to a degree.

Although after the 1960s, living standards were rising, many were still struggling financially. Thus, even if some graduates managed to be accepted by a university, some of them opted to join the workforce instead in order to support their families.

Therefore, a significant number of professionals have only received educational qualifications lower than the degree level. This situation is particularly common in the fields of engineering and design. The major reason for this is that the engineering and design industries were not extremely concerned about the academic qualifications of their employees. Instead, industry was more concerned about their practical training, experience and practical work performance. This is the reason why so many well-known senior engineers and industrialists in Hong Kong now still only hold very basic academic qualifications.

The situation has changed in recent years in the fields of engineering and design. As more and more young graduates in Hong Kong hold a degree or higher qualifications, more professional engineers and designers with lower qualifications have been feeling the pressure to obtain a degree or higher level educational qualifications. Many engineers and designers are also starting to realise that they need to upgrade and update their knowledge continuously, not only in their working environment, but also in academic institutions. Consequently, increasingly more engineers and designers expect to go back to university for continuing education [1].

GENERAL DIFFICULTIES AND LIMITATIONS

Engineers and designers face several general difficulties and limitations to continuing their education in Hong Kong [2]. Firstly, the working environment and job requirements for engineers and designers are becoming more difficult than ever. Long working hours and working overtime has become the norm and is almost compulsory nowadays. It is difficult for engineers and designers to find time to continue their education.

Many engineers and designers are now also required to work outside of Hong Kong. For example, due to the relatively lower costs, many companies have moved their production factories to mainland China, making it necessary for most of the engineers and product designers for those factories to work in mainland China. Engineers and designers are finding it difficult to find suitable universities in mainland China to continue their education. Furthermore, good universities are not necessarily located close to the workplaces of these professionals. The learning approach and styles at universities differ from the professional experiences of these engineers and designers. Another major issue is that not many of the qualifications provided by universities in mainland China are as highly recognised as those obtained in Hong Kong.

Therefore, most engineers and designers who have received their education in Hong Kong prefer to continue their part-time study in Hong Kong. However, the key difficulties facing these professionals is the long travelling distance from their workplaces to the universities in Hong Kong and constraints in timetable arrangements.

Even if some engineers and designers have offices in Hong Kong, the need to frequently attend meetings, conferences, exhibitions, expos, etc, in other countries also results in unstable working hours and locations. This can have a significant effect on their study plans.

In addition, many engineers and designers graduated some time ago, and many find it difficult to adjust to academic life again [3]. The nature and contents of engineering and design subjects change rapidly, and those working in industry tend to specialise in a specific area. Thus, it is difficult for them to pick up their books again in university and take a relatively broader approach to the acquisition of knowledge. Also, as indicated before, some of these engineers and designers have only basic qualifications and their academic knowledge is quite outdated. As revealed by some of the mature students who were interviewed, they did not find it easy to absorb new learning materials, learning approaches and methods, and learning objectives and requirements (for example, ways of submitting their assignments).

In short, constraints in physical time and location, as well as students' own limitations, can hinder and demotivate engineers and designers from furthering their studies.

STRUCTURE OF THE PROGRAMME

In order to offer engineers and designers the opportunity to continue their education, a degree programme was co-established in 2000 by a design school and two engineering departments at a university in Hong Kong. The programme is offered in a part-time mode and is targeted at engineers and designers who work in design-related industries, and who wish to further their education and extend their experience at a university. Most students accepted into the programme are those who have not obtained a degree qualification in the areas of engineering and product design.

To meet new economic and industrial needs, as well as to give Hong Kong engineers and designers an edge over those in mainland China, the core aims of the programme are to nurture them to upgrade and update their knowledge and experiences. The core subjects of the programme seek to provide a wider overall perspective, while the elective subjects specify particular areas that fit the diverse needs and interests of students. For example, some subjects aim to nurture students with a conventional engineering background to be more creative and innovative, while other subjects seek to give students, who have a product design background, a better foundation in technology and engineering.

Evaluations of the programme and some subjects were conducted while the programme was being run. Besides questionnaires and formal end-of-term meetings between staff and students so as to obtain students' general feedback on the overall arrangement of the programme, class observations and interviews with students in some design subjects were conducted. Students who were interviewed were randomly selected in class. They were invited to comment on the arrangement of the programme and the subjects, and voice their opinions about their studies, including any difficulties they encountered. Some teachers were also interviewed for their comments on the programme curriculum and student performance.

STUDENT-CENTRED ARRANGEMENT

Difficulties raised by students, as well as teachers (that is, tutors and project supervisors), were given serious consideration. Although different actions were implemented in different subjects regarding particular situations and needs, *student-centred* was at the core of the actions taken (see also ref. [4]). Actions undertaken are listed below.

Awareness of Students' Needs

The teachers were briefed to be aware of students' particular limitations, constraints, needs and expectations for their learning. In fact, this kind of awareness not only strengthened the mutual understanding between teachers and students, but also minimised the possibility of confrontation between the two parties, and contributed to a better learning atmosphere. For example, one teacher questioned why so many evening (part-time) students come to class late all the time, in contrast from the practice of full-time students.

In fact, after a more in-depth discussion between the teacher and students, the teacher discovered that most of his students had tried their very best to come to class. However, many of them needed to cross the border from mainland China to attend class and would have to return to work the following morning. Moreover, it was often not easy for them to leave their workplace early. The fact that they attended class (although very late) in fact showed that they were sincere about learning.

Flexible Study Mode

As stated above, students have different needs and expectations and face different limitations and constraints when they return to universities to study again. For example, some may prefer to graduate and obtain a certificate as soon as possible; some may want to enjoy learning under a more relaxed atmosphere, while some may only be able to afford to spend a little time studying, as they need to take care of their children. Thus, from the beginning, the programme has allowed a high degree of freedom in the length of study and selection of the subjects in order to cater for the different and continuously changing needs of students.

Obviously, this kind of flexibility can lead to difficulties in programme administration and curriculum implementation. Moreover, too much flexibility and freedom may sometimes lead to negative outcomes. For example, the programme coordinators pointed out that a student might tend to drop out if the length of study was too long. In contrast, suitable pressure (in particular peer pressure from students themselves) could push students into becoming more perseverant about learning.

Flexible Timetable and Learning Environment

Not only is there flexibility in the learning structure of the whole programme, but a certain kind of freedom and self-initiative is also allowed in each subject. Besides attending regular lectures, students are encouraged to set up their own schedules for other learning activities, for example, project

tutorials, investigations and studio work. According to the evaluations, such flexibility cannot be successfully implemented in all subjects. Some subjects are more difficult to schedule in a flexible manner, such as those that rely heavily on regular lectures and seminars, and assessment that is mainly based on examinations. Students need to participate in these activities according to a very rigid timetable.

On the other hand, those teachers who were interviewed further pointed out that the project approach was good as flexible timetables and learning environments were possible. This is because, in general, the objectives, activities and outcomes of the projects are varied, so there is no need to force all students into a fixed physical environment and at fixed timeslots all the times. Moreover, excessively rigid arrangements can sometimes hinder the development of projects. For example, some students may need to conduct field investigations and interviews at the same time that they need to attend a lesson.

Tailor-Made Curricula and Learning Materials

One of the characteristics of part-time programmes (or continuing education programmes) is that there is a higher chance that students will come from various disciplines and have diverse learning and working experiences [5][6]. For example, students enrolled in the programme in 2000 had good working experience, but low academic qualifications. In 2002, a significant number of students were recent graduates, but lacked practical working experience – some had not even gained any working experience, but enrolled in the programme when they could not continue their education in day-time programmes. These students found it relatively easy to fit into university life.

To deal with such diversity, only key objectives were fixed in the syllabus of each subject. All of the other contents of the syllabus were flexible so that they could be tailor-made for students. Most students were assessed on projects. These arrangements provided freedom both to students in selecting contents suitable to their own needs and interests, and to the teachers in assessing students from different perspectives. For example, many students who attended a design subject in 2002 were good at toy design and manufacturing. To balance learning on the one hand, the contents of the subject were purposely designed to motivate students to gain knowledge and experience that was separate from toy design. On the other hand, the project set for students required them to present their project solutions with a more in-depth analysis related to the manufacturing process by drawing on their experiences.

TURNING DIVERSITY INTO A RESOURCE

As indicated before, most part-time students come from different engineering and design disciplines, as well as different experiences (see also ref. [7]). This diversity of students leads to difficulty in three areas in the running of the programme, namely: administration, curriculum planning and implementation. Conversely, evaluations of the programme and some individual subjects have also indicated that, if diversity is handled well, it can be turned into a resource, as follows:

- Students with different knowledge and experiences can help each other to widen the scope of their knowledge and experiences. In other words, the particular strengths of a student can become the strengths of others. Or at least, these individual strengths can benefit and assist learning activities. For example, one student was knowledgeable about mould designs, the moulding process (particularly send casting) and the application of materials. Many graduates of recent years are weak in these areas. When dealing with a group project related to street furniture design, this student gave the whole group a great deal of help and stimulated them to give more serious consideration to the moulding process and to properly choose materials for the outdoor environment.

- Class observations indicated that students with more working experience tended to be more subjective and slightly stubborn in some matters. It is difficult for these students to put aside their existing ways of thinking. In contrast, students with less working experience (ie fresh graduates) were always unwilling to make any decisions, especially in a group-working environment. However, as one teacher reflected, a good arrangement of putting students with different experiences together can strengthen the quality of group work. Of course, this positive consequence may not exist if a *good* arrangement cannot be made. That is, a good arrangement includes providing proper guidance to students to help them distribute their workloads and responsibilities.

- Diverse expectations can easily affect the harmony of the students. For example, some students may only expect a pass grade and hope to obtain a degree. These students tend to fulfil the subject requirements only marginally. Yet, some students, particularly those who want to further their education at a higher level, may expect to be at the top of the class. They tend to like to approach the teachers and complain about the performance, contribution and in-group work of members of their group. According to observations in classes and feedback from teachers, a good arrangement of collaboration among students that allows them to push each other constructively is very important. As was also agreed by students, a group project can force some *lazy* students to work harder, or let them down (see also refs [8][9]). Teachers reflected that the more a teacher was involved in in-group discussions at the beginning of a group project, the better and more positive the outcome would be. Once group members were on the right track, the teacher could then gradually decrease his/her involvement.

TURNING CONSTRAINTS INTO FLEXIBILITY

As stated earlier, students face many constraints in continuing their education at universities. To turn such constraints into flexibility, the first thing that must be done is to accept such constraints as normal and to try to find ways to solve the problems from other perspectives; examples are given below.

Establishing Policies, Rules and References

Programme and subject planning always mean establishing a set of policies, rules and references in guiding a programme to run effectively. Constraints exist when a student's personal situation does not fit such policies, rules and guidelines. The teachers interviewed agreed that part-time students generally have more constraints in their learning. This means that they find it more difficult to conform to established policies, rules and guidelines. To deal with this situation, after running the programme for one year and obtaining feedback from an end-of-term meeting with students, some teachers started looking at such constraints from another perspective. For example, instead of punishing those students (ie negative reinforcement) when students were unable to meet the requirements, such as

attending classes on time, as discussed above, one teacher tried to adjust the contents of the subject and the learning activities. Very simply, he tried to reduce the number of formal lectures and seminars, and asked students to divide themselves into small groups to engage in more exploratory learning activities, for example, self-learning and small group study reports. During the interview, the teacher agreed that he first needed to accept more flexible subject contents and, in particular, more unpredictable learning outcomes. Students were also required to realise that there would be no more ready-made materials handed to them, nor would they be *spoon-fed* learning activities.

Combining Different Students' Backgrounds in Group Work

Students coming from different disciplines and/or with different experiences sometimes also imply constraints in providing more in-depth knowledge. This situation is more significant if such students are forced to learn together. For example, some students with a design background are weak in mathematics and technological subjects. A design graduate with only a passing grade in mathematics in their HKCEE or GCE results is not unusual. As one teacher reflected in a staff meeting, requiring such students to learn calculus or computing with students with engineering backgrounds is a nightmare. Thus, most of the time, the context and requirements of the subjects are *normalised*. Consequently, both students with engineering and design backgrounds cannot benefit from the lessons.

To overcome such constraints, two approaches have been taken for some subjects. First, as is most commonly practised at present, the programme provides more elective subjects that fit students' diverse needs. As discussed in the previous section, this approach allows students a certain degree of freedom to make choices. However, it also creates practical constraints in programme administration and decreases the opportunity for students with different backgrounds to learn together. Thus, to overcome this drawback, the second approach is to provide more learning aids in class to help students with different backgrounds and qualifications to *learn together*. For example, software and learning kits are provided for students to allow them to skip many repetitive and meaningless mathematical calculations that are not useful for their future careers. In other words, students are required to focus on basic theoretical understandings and different applications. In fact, as both teachers and students agreed, such an arrangement results in a more flexible programme and subject planning. It also allows students with different backgrounds to have more chances to learn together and support each other.

Geographical Constraints

As indicated above, geographical constraints are a key issue in implementing the programme. Besides allowing students more flexibility to initiate their learning timetable, they can also be allowed to learn at different locations. Advances in Internet services and the popularity of using computers in learning have given a big boost to remote-location learning. However, according to the evaluation of the programme, up-to-date, real-time Internet learning still has its constraints. For example, not all students working in mainland China have access to a computer and the Internet at some of their workplaces, particularly in factories in the western region of the country. Moreover, requiring students to engage in real-time Internet learning also creates inflexibility in students' time arrangements. Nevertheless, the Internet offers a great advantage in terms of communication and in the delivery and transfer of materials [10]. For example, many students indicated that they could discuss their assignments and transfer large-sized files easily nowadays. In short, by using advanced technology well, students find it easier to overcome some of the constraints to learning, which in turn motivates them to continue their education.

TURNING DIFFICULTIES INTO MOTIVATION

When faced with difficulties in learning, part-time students commonly react in two ways. First, some of them will give up their studies. This is why the dropout rate for part-time students is generally higher than for full-time students. Part-time students also tend to think that they can easily resume their education at any time or that terminating their studies would not result in any great loss (at least not as serious a loss as for a full-time student). However, the fact is that the percentage of students who drop out and then resume their education is not high. Second, some students like to use tactics to escape from their difficulties, rather than face any difficulties directly. To discourage such *tactics* and tendencies to *escape*, some considerations have been given to positive actions to motivate these students; these are detailed below.

Support for Part-Time Students

According to observations, one of the major difficulties for part-time students is that they do not realise how difficult it would be to resume their studies. Some students indicated during the interviews that the difficulties encountered in studying, such as reading books, were different from those in working. In other words, they were not sufficiently or correctly prepared to continue their education. Experience gained from about five years of running the programme indicates that there are two major ways to give such students support. First, showing understanding and concern for the individual, and giving students additional support, are all important. For example, in 2003, some students with a design background were weak in mathematics; they were given remedial classes on weekends and were able to gain support to review their knowledge. Several students agreed, after obtaining the additional support, that they felt they were not alone. Most importantly, they felt that the objectives set in the programme and the subjects were attainable.

Second, the support that is offered needs to provide satisfactory outcomes to these students. For example, after taking the remedial mathematics classes, many students gained enough confidence to feel that they (ie design students) could also learn something in the field of engineering. As the teachers agreed, the key factor was that the level of learning should not be so high that students are unable to handle it, particularly at the beginning. Only through such confidence-building measures could students gain the motivation to learn, and they were also willing to continue to learn. Obviously, such additional support requires additional resources. Yet, as one of the administrative coordinators of the programme indicated, such an investment is worthwhile because it is much better than losing students and because it can also help to ensure the quality of the programme's outputs.

Encouraging Peer Group Support

In general, part-time students have relatively less peer group spirit than full-time students. This is understandable, as they

come from different areas and backgrounds, have more diverse expectations, and work in different locations. The most important point is that they lack – or are unwilling to – spend the time to stay together. In evening classes, students will come to class late and leave immediately after the class ends. In turn, these students do not tend to communicate much with each other.

However, according to observations in the programme, peer groups are an important resource to turn students' difficulties (as well as concerns) into motivation. However, group work in part-time programmes tends to fail because teachers rely too much on self-initiated group cooperation. For example, students are always required to hold group activities outside class, such as meetings and for the handling of group assignments.

However, as indicated above, the fact is that part-time students are seldom willing to spend *extra* time to finish their assignments. Thus, allowing more group work in class is very important. This is because students can gain additional support from their peer group to work together to solve difficulties and, therefore, find it unnecessary to spend too much *extra* effort in doing their work.

Reinforcement to Achieve Higher Motivation

Motivation comes from being able to see the need for, and importance of, doing something [11]. When a difficulty is not easy to eliminate, letting students to see the need for, and importance of, a requirement is very important [12]. Part-time students always like to ask one question, particularly when they face difficulties: *Why do we need to learn or do this?* Therefore, providing a clear explanation and positive reinforcement for students, who face such difficulties in learning tasks, is crucial. According to the feedback from some of the teachers, directing students' focus on the advantages of a task can minimise their negative feelings when faced with the difficulty of accomplishing that task.

SUMMARY

More engineers and designers expect and are willing to spend time to continue their education [13]. This is not only because of new job requirements that engineers and designers need to upgrade and update their knowledge and experience, but also for self-satisfaction [14][15]. According to the case of a part-time programme offered to students in engineering and product design discussed above, some arrangements have been identified that are necessary to help students deal with the difficulties that they might encounter in their studies.

Through such arrangements, diversity can be turned into a resource, constraints turned into flexibility, and difficulties turned into motivation. Experience shows that for such arrangements to be successful, administrators and teachers should have the same mission and goals in implementing the arrangements, such as flexible timetable arrangements and flexible learning environments. It would be difficult to achieve success without a consensus among administrators and teachers, and their contribution and collaboration.

Resources are also important. Some people may argue that the above arrangements may be costly. Yet the fact is the experience gained in running the programme indicates that such improvements, as well as the assurance of quality that they bring, generate assets for the programme, leading to high enrolment rates.

It cannot be denied that more and more part-time programmes are being offered in the market. More programme organisers are finding that it is not easy to attain or maintain success. Only by continuously reviewing and rearranging the programme to create a better environment for learning can students be helped to transform their difficulties into opportunities.

ACKNOWLEDGEMENTS

REFERENCES

1. Lee, W.C., A Survey on the Lifelong Learning Needs of Hong Kong University Graduates. Hong Kong: The University of Hong Kong (2002).
2. Siu, K.W.M., Re-construction of learning space for design education. *Design and Educ.*, 8, **1**, 20-28 (2000).
3. Siu, K.W.M., Reconstructing the learning environment for the new needs in engineering training. *Engng. Science and Educ. J.*, 10, **3**, 120-124 (2001).
4. Glasgow, N.A., *New Curriculum for New Times: a Guide to Student-Centred, Problem-Based Learning.* Thousand Oaks: Corwin Press (1997).
5. Jarvis, P., *The Theory and Practice of Learning.* London: Kogan Page (2003).
6. Tight, M., *Higher Education: A Part-time Perspective.* Bristol: Society for Research into Higher Education & Open University Press (1991).
7. Huddleston, P., *Teaching and Learning in Further Education: Diversity and Change* (2nd edn). London: RoutledgeFalmer (2002).
8. Falchikov, N., *Learning Together: Peer Tutoring in Higher Education.* London: RoutledgeFalmer (2003).
9. Faulkner, D., Littleton, K. and Woodhead, M. (Eds.), *Learning Relationships in the Classroom.* London: RoutledgeFalmer (1998).
10. Tiene, D., *Exploring Current Issues in Educational Technology.* New York, NY: McGraw-Hill (2001).
11. Reeve, J., *Understanding Motivation and Emotion* (4th edn). Hoboken: Wiley (2005).
12. Evan, N., *Making Sense of Lifelong Learning: Respecting the Needs of All.* London: RoutledgeFalmer (2003).
13. Siu, K.W.M., A new learning environment for social change: the engineering and product design learning environment in Hong Kong. *World Trans. on Engng. and Technology Educ.*, 2, **1**, 73-77 (2003).
14. Center for Educational Research and Innovation, Motivating Students for Lifelong Learning. Paris: Organisation for Economic Co-operation and Development (2000).
15. West, L., *Beyond Fragments: Adults, Motivation, and Higher Education.* London: Taylor & Francis (1996).