A new learning environment for social change: the engineering and product design learning environment in Hong Kong

Kin Wai Michael Siu
Massachusetts Institute of Technology/The Hong Kong Polytechnic University

Introduction

Due to rapid and continuous changes in society and industry, an increasing number of engineering and product design graduates are recognizing that the knowledge and experience they previously obtained in universities can become outdated in a short period of time. Many of the workplaces of the graduates are oriented towards routine and repetition, making it difficult for the graduates to gain any updated knowledge and to progress in their professions. Although some are luckier in that their workplaces can provide them with experience and updated knowledge in specific areas, opportunities for them to explore wider perspectives are always very limited (Siu 2000a).

Whether the current university learning environment can motivate and make possible lifelong learning for engineers and designers is another question. When reviewing current practices in universities, it became evident that students still have to spend a large portion of their time following rigid timetables in fixed geographical locations. However, under the current economic situation, the work schedules of engineering and product designers have become even more demanding. They also need to visit and work in other places. The rigid arrangements of a university learning environment (that is, fixed class schedules and geographical locations) hinders such people from realizing their expectations of continuous learning, even in a part-time mode (Siu 2000a, 2001a).

Moreover, the current approach in engineering and product design education is to expect students to obtain knowledge and experience by exploring and gaining a better understanding about society. Students are therefore required to have more connection with the world outside the university. However, the current rigid arrangement in the university hinders and discourages students from achieving these goals and requirements.

Review of the current learning environments for engineering and product design training

Advantages of the conventional arrangement of learning environment

The conventional learning environment (including timetables and physical locations) in engineering and product design in general has several major advantages:

1. It is relatively more convenient for administration as it gathers students together according to a common schedule and at a fixed location.

2. It can minimize the resource expenditures, for example, workload of staff and cost for complicated administrative process.

3. The well-shielded space keeps the unpredictable and dangerous to a minimum. Although universities usually require students to sign liability waivers before participating in outside activities, this does not mean that universities can absolve themselves from liability when an accident happens. This is also why university professors and supervisors are discouraged from planning outside activities for students.

Limitations and constraints of the conventional learning environment
On the other hand, the conventional arrangement of learning results in some limitations and constraints in curriculum planning and implementation to meet current educational goals (Elliott 1999; Goh and Myint 2002):

1. It limits the flexibility that curriculum planners have in setting curriculum aims and objectives.

2. It limits professors and project supervisors in the selection of instructional strategies, as well as in the activities arranged for students.

3. The first two limitations further decrease the possibilities for curriculum planners to plan, and for students to try, other kinds of activities outside the university, and undermine the objectivity and completeness of evaluations of the curriculum and of students' performance.

These limitations and constraints have become more obvious, particularly with regard to the current rapid changes in industrial, social and economical conditions (Siu 2001a, 2001b).

In the past, engineering and product design students could stay in universities and practical training places, since the main educational goal of such subjects was to enhance the technical skills of students. Their thinking skills (most the focus was on analytical thinking, with little emphasis on creative thinking) were cultivated by getting the students follow a set of steps to solve some problems set by their professors and project supervisors (Siu 2001c). Today, more researchers point out that engineering and product design should also be a social, cultural, and environment-related subject (Bijker 1995; Dorf 2001; Lienhard 2001; Margolin and Margolin 2002; Pool 1997). Students are required to be aware of social, cultural and environmental problems, and to provide critical responses to these problems (Buchanan and Margolin 1995). In other words, students are expected not only to provide pre-determined model answers. To meet these requirements, students need to engage in more exploratory activities outside the university, and then use their own initiative to identify the important issues, conduct investigations such as observing human behaviour and conducting interviews, generate ideas and carry out evaluations with their clients, and then show further improvement. In order words, an inflexible learning environment will hinder students from attaining these educational goals.

As stated at the introduction, the work schedules of engineering and product design graduates have become even more demanding. They frequently need to work in places other than their home cities. Taking Hong Kong as a case, since the late 1990s, more than 90 per cent of new manufacturing engineering graduates need to work in mainland China. Most of them need to stay there for about four to six days per week. They also need to attend meetings or exhibitions in other countries. In this situation, these graduates find difficult to follow a very rigid timetable and adhere to firmly-fixed geographical arrangements for their continuous learning—even in a part-time mode (Siu 2001b, 2002).

In fact, inflexibility in timetables and locations for learning not only affects part-time students who want to further their study, but also full-time students. Besides constraining students from exploring outside of the university and thereby obtaining practical, inflexibility also makes it difficult for students to contact and build up better networks with the industry and with other parties who might be able to help them in their future careers.

Some solutions and their limitations and constraints
Some educators expect that the recent more commonly used credit-based system (or, modular course) can provide greater flexibility for students to learn (Betts and Smith 1998; Jenkins and Walker 1994; Maehl 2000), and that this kind of flexibility can overcome the limitations and constraints of the conventional learning environment. However, most current credit-based programmes in fact still

require students to attend classes according to very rigid timetables and at fixed locations with little flexibility. Moreover, one small change to a timetable can cause a ripple effect, resulting in many clashes. All of these factors can counter the initial objectives of the credit-based system, namely to offer a high level of flexibility and to encourage students to use their own initiative.

E-learning, as well as web-based learning and distance learning, is another breakthrough that has been made in the learning and teaching environment in the recent years (see Brande 1997; Carrison 2003; Driscoll 2002; Khosrowpour 2002; Pollard 2001; Rosenberg 2001; Rudestam 2002; Sloman 2002). Apart from some of its advantages in overcoming the limitations of geographical location and time for learning, this kind of learning still has several major shortcomings:

1. Although innovations in the Internet are allowing people to communicate easily from different locations, these innovations are insufficiently advanced to allow students to meet the same goals as are achieved in face-to-face conventional tutorials.

2. Some places do not offer e-learning or web-based learning facilities. For example, many Hong Kong engineering students cannot access these facilities when they work in mainland China, especially quite a lot of big production factories are located at the remote cities which are not so well developed in internet and telecommunication.

3. E-learning and web-based learning may not be very suitable for subjects which require students to have hands-on experience. This is also the reason why e-learning is more popular for subjects such as law, commerce and business, because less practical training is involved in the study of these subjects.

Re-constructing the learning environment to meet new needs

Three key areas of attention

To meet the new and varied needs of students as reviewed above, from *curriculum planning* to *administration* and *implementation*, attention should be focused on several key areas. First, the curriculum needs to offer options to cater to a wide range of student interests and preferences in learning. The curriculum also needs take into consideration the fact that students, especially part-time students, may enter university at different ages and possess different educational backgrounds and levels of ability. For example, in an engineering and product design degree programme class, there may be a student with a technical certificate in production and industrial engineering who has fifteen years of work experience in a particular area but possesses little knowledge of information technology. In the same class may be another student who is a fresh graduate with a higher diploma in information and systems engineering and possesses good skills in information technology but has no industry work experience.

Second, administrators need to think of the kinds of activities that should be organized for students to meet social changes and new industrial needs. Taking Hong Kong as case, within several decades, it has changed from being an entrepôt trading post to a manufacturing-oriented economy, then to an economy made up of a combination of manufacturing and service industries and, finally, to the international financial centre it is today. It is easy to imagine how important it is that engineering and product design training be sensitive to these kinds of social and industrial changes.

Third, the role of professors and project supervisors should be to guide students through a variety of experiences, the process being more important than the final outcome or product. For example, when more and more Hong Kong engineers and product designers compete for jobs in mainland China they will need to be able to offer not only engineering and technological knowledge and skills, but also critical and creative thinking and a high level of flexibility and adaptability to deal with constant and rapid changes in industry and the economy.

In sum, the above three key areas of attention illustrate the need for a *flexible* learning environment to suit varied needs, both of the students and of society and industry.

Experience in Hong Kong

In 2000, a part-time engineering and product design programme was co-established by a design school, an engineering department and an industrial centre at The Hong Kong Polytechnic University. To meet the new economic and industrial needs and also to give Hong Kong engineers and designers an edge over those in mainland China, a core aim of the programme is to nurture them to be more creative and innovative.

In the programme, a compulsory subject called Cultural and Social Issues in Product Design is offered to all students. The subject aims to provide knowledge and experience that will help students understand how product design relates to cultural and social factors. In the first year that the subject was offered, the students were required to form small groups to identify problems on their own and to propose solutions that would improve the everyday life of the people of Hong Kong. In order to understand the real needs and preferences of Hong Kong people and identify project titles, the students had to spend a large amount of time conducting field investigations and communicating with their target groups. Since the project titles were not fixed by the project supervisor (professor), the students needed to conduct *different* kinds of investigative activities according to their *particular* learning attainments. Because of these new arrangements, the supervisor's contact time with the students had to be adjusted. Apart from attending lectures that introduced the subject and presented core theory and making a final project presentation, the students were flexible about changing their timetables following mutual agreement between themselves and the supervisor. For example, the students now had the freedom to meet their supervisor during the day (for example, in group tutorials), or to carry out their investigations or project work in the evening with their fellow group members. This kind of flexibility was not possible in the past, as students had to attend classes in accordance with a fixed university timetable. This generally resulted in students planning and selecting their learning activities to fit in with the university timetable rather than to fulfil their real needs and interests.

Flexible learning environment

Figure 1 illustrates the conventional timetabling, in which flexibility is very limited. Figure 2 illustrates the concept of flexible timetabling, where learning activities can take place at various sites with various lengths of time spent at the different sites, including home. (The concept of the 'time-space diagram' is adopted from Hägerstrand (1978)). For instance, in Figure 2, Student A can attend a class or tutorial with a small group of students, then join another group of students in conducting a field investigation outside the university, and then go to other places to obtain some special industrial training. Student B can spend some time attending the class with Student A, and then use a large portion of time to conduct investigations and obtain industrial training with other students, and further join the investigations of other groups of students. Student B can spend some time attending the class with Student A, then use a large portion of time to conduct investigations and obtain industrial training with other students, and then join in the investigations of other groups of students. Students C, D and E can carry out individual activities before going to an industrial centre for general industrial training together, then attending different classes at the university.

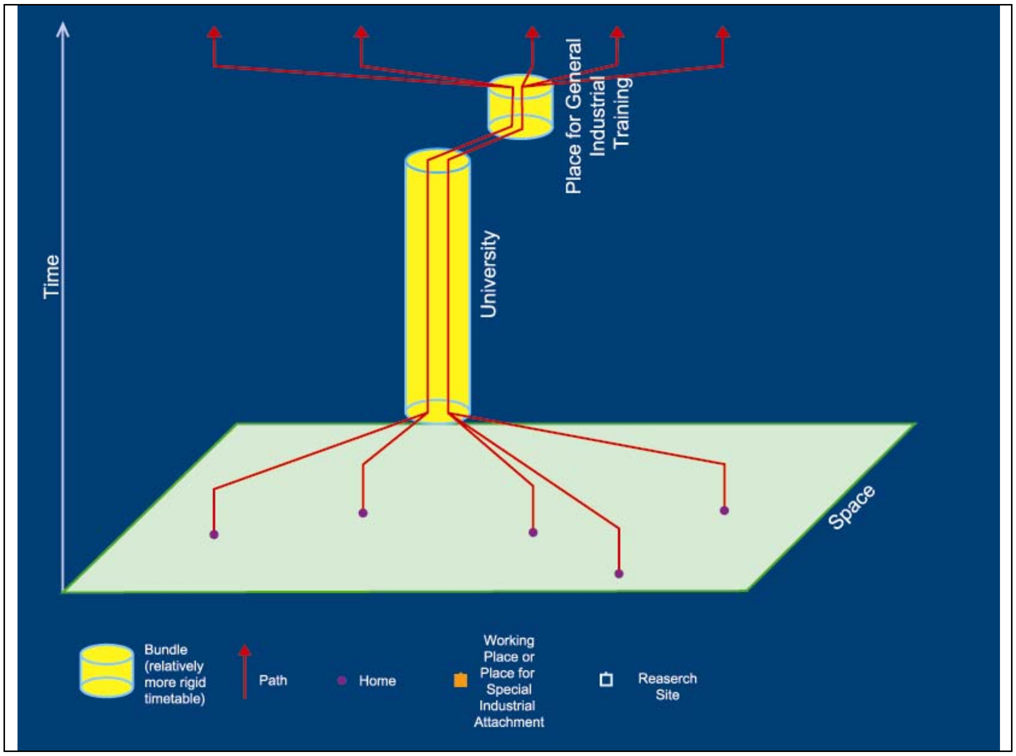

Figure 1 Diagrammatic representation of daily time-space paths of engineering and product design students under a conventional fixed timetable.

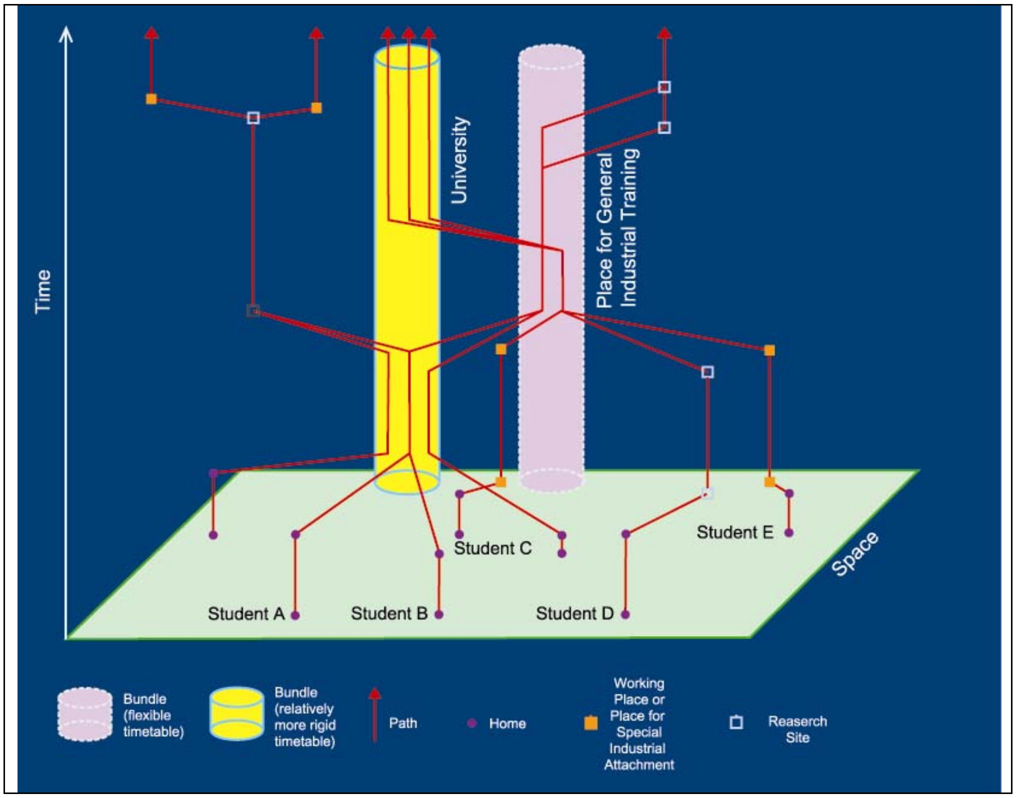

Figure 2 Diagrammatic representation of possible daily time-space paths of engineering and product design students under a flexible timetable.

Although the illustration in Figure 2 is rather exaggerated and the activities of students during the course of one day would not in practice be so complicated and diverse, the figure illustrates a model of a learning environment in time and space, whose flexibility allows students to attend classes, tutorials and industrial training, to conduct investigations, or even to stay at home for study according to their own needs. Of course, on most days, the students will still need to spend the major portion of their time on their full-time jobs.

In other words, with reference to Figure 2, 'learning environment' in a broader sense should be considered not just as the region labelled 'university' in the figure but as the totality of learning places in the figure (that is, home, university, workplaces, and places for industrial training and investigation).

Limitations and constraints

The concept proposed in Figure 2 claims to allow more flexibility for students to learn. However, according to two subject evaluations conducted in 2000 and 2001 (Siu 2001a, 2001b), it also has drawbacks, particularly from the administration point of view. It is easy to see from the figure that the reason stems from the complicated time arrangements for teaching and learning activities. In fact, although the proposed timetable arrangements should be appreciated by students, the coordination with other subjects and the increased workload on professors, project supervisors and administrative staff present problems, which impose constraints on the new arrangements. This is why the proposed model needs to be further refined and adjusted for different practical situations.

Conclusions

Today, relatively less attention is still paid to the teaching and learning activities of engineering and product design students that are undertaken outside universities. Teaching and learning are still strongly tied to the physical constructions of universities and to rigid, predetermined timetables. In order to achieve greater flexibility in planning curricula and arranging activities so as to benefit the development of creativity, innovation and critical awareness in students, educators need to reconstruct the learning environment by reorganizing learning activities.

It cannot be denied that a flexible learning environment may cause inconvenience to administrators and teaching staff. However, this does not seem a sufficient excuse for neglecting all the benefits that a flexible learning environment can offer. Instead, a higher priority should be placed on giving students more flexibility to arrange their activities than on giving administrators the flexibility to arrange resources and professors the flexibility to arrange their work timetables.

Author's notes

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