The impact of industrial placements on students' learning experiences

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ABSTRACT: The purpose of this article is to discuss the impact of industrial placements on engineering students' learning. A project was undertaken by the authors to investigate the perceived benefits of planned workplace learning. The subjects were full-time engineering degree students from a university in Hong Kong who had completed an industrial placement programme from 2002 to 2003. The number of students studied was eight. A quantitative approach was utilised in this study. A statistical analysis of students' academic performance was carried out in order to test the conjecture that industrial placement can enhance the technical knowledge of students. A control group of participants, who had similar academic performances in the second year, was established before the final year examination in order to test whether or not there was a significant difference in the academic results between the placement and non-placement groups after their placement. The findings suggest that most students perceived to have made gains in their professional skills and broadened their visions in the field of the building industry. The implications of the findings for theory and practice are also discussed in the article.

INTRODUCTION

Industrial placement – or work placement – is the term commonly used to describe structured training in which a student is required to work in a company or organisation at the actual workplace setting with the purpose of learning on the job [1]. The origin of industrial placement can be dated back to about 60 years ago to the Percy Committee Report, UK, on Higher Technological Education [2]. In Northern America and Australia, it is sometimes referred to as cooperative education. It has been defined as follows:

> *… an instructional method that links classroom instruction and work for the purpose of enhancing the total educational program of students. It can exist in several modes – sandwich degrees, scholarships or flexible forms of placements such as international industrial attachments, twinning programme, industry-funded co-op scholarships and so on* [3].

Supervised work experience as an integral part of degree courses in the UK is, for the most part, a post-war phenomenon [4]. Since the 1950s, these programmes have expanded rapidly. According to the Association for Sandwich Education and Training, UK, there were about 130,000 students enrolled on sandwich courses in 1991 [5]. In addition, supervised work experience is often an essential part of the courses for training of teachers, doctors, dentists, social workers and those of other professionally oriented disciplines; however, the term *sandwich course* is rarely used [6]. Industrial placement is optional for some professions in their undergraduate programmes, eg engineers, hotel catering service employees and marketing employees.

Since the mid-1980s, there has been an increasing interest in supervised work experience. However, there has also been very little systematic research on the topic of how an industrial placement is to be managed so that it can be a genuine educational experience for students. Ashworth and Saxton collected some fragmented literature and carried out an investigation into two key questions, namely:

- How can the placement be managed so that it is a genuine educational experience?
- What are the main roles of the placement tutor and industrial supervisor [7]?

There was recognition in the literature of the need for, and value of, industrial placements. Moreover, limited empirical research was found on the role of industrial placements in the education of engineering students in the Hong Kong context. Most of the existing literature has focused on curriculum design issues, rather than an evaluation of the impact of the experience on students. Thus, the question of whether, or the extent to which, industrial placements would significantly improve students' academic performance and personal skills still remains unresolved.

The Hong Kong Context

In Hong Kong, the education system has been following the tradition of British practice because it was one of the British colonies since 1898 (Treaty of Nanking). There is also an interesting point; Hong Kong is a mixture of western and eastern culture. *Apprenticeship* is an old form of learning in Chinese Society. It is usually explained this way: An apprentice follows his/her master for years learning a specific skill, eg shoemaking, auto repairs. There was no scheduled or rigid learning scheme throughout the entire process. The apprentice could observe the master in his/her daily work, but the master had no obligation to explain the skills. The apprentice had to live with the master. It usually took several years or even a decade. The master usually *retained* some secret skills that would never be transferred to their fellow apprentice. A rigid and well-planned training scheme was sought in the mid-1980s. This paralleled the blooming of the Hong Kong manufacturing sector. The government had tried to break the old tradition so that the competitiveness could be strengthened. A three/four-year structured apprentice scheme was established in 1982 [8]. This was subsequently revised to the latest version [9]. It was the preliminary shape of workplace learning in Hong Kong. It aims at providing the necessary skills and knowledge to young workers engaged in specified industries.

A sandwich degree has been the main form of industrial placement for engineering education since the 1980s. There are two similar, but slightly different, modes of sandwich degree programmes. The first one is the *thick* sandwich programme, which is also the most common mode implemented in Hong Kong nowadays. Students work in industry for their entire third year of university study, and continue their fourth or final year degree study back at their universities. *Thin* sandwich programmes require students to work for six months in industry for the second half of one academic year, usually in their second year. Students then spend another six months in industrial placement in the first half of their third year of the study. It implies a continuous training of 12 months, but split over two academic years.

At Hong Kong Polytechnic University, formerly called Hong Kong Polytechnic, industrial placement was first introduced in the 1980s for engineering degree programmes. A survey conducted by Hong Kong Polytechnic University showed that employers tended to have a preference for graduates with industrial experiences [10]. The main reason given by the employers is that students who have such experience can work independently in a short period of time.

THEORIES UNDERPINNING INDUSTRIAL PLACEMENT

Industrial placement is usually classified as a particular form or sub-set of workplace or Work-Based Learning (WBL). There are a number of features unique to learning in the workplace as defined by Watkins [11]. First, it is usually task-focused. Second, it occurs in a social context that is characterised by status differences and the risk of one's livelihood. Third, it is collaborative and often grows out of an experience or a problem for which there is no known discipline or knowledge base. Work-Based Learning typically focuses on work-based problems and issues. Learners start with a problem and examine it from as many angles as possible, before building conceptual models and solutions, implementing the solutions and then evaluating the impacts.

Work-Based Learning was defined by Johnson as:

> *… an independent learning through work. It is a self managed process supported by learning contracts, higher education and workplace mentors and various types of learning and guidance materials. It leaded to a family of Continuing Development Awards* [12].

Raelin argued that Work-Based Learning is defined differently from traditional classroom learning in that *it is centred around reflection on work practices. There are three critical elements in the work-based learning process* [13]. These are as follows:

- It views learning as acquired in the midst of action and dedicated to the task at hand;
- It sees knowledge creation and utilisation as collective activities wherein learning becomes everyone's job;
- Users demonstrate a learning-to-learn aptitude that frees them to question underlying assumptions of practice [13].

On the other hand, classroom learning

> *… is based more on acquiring a set of technical skills; formal teaching activities; providing students with knowledge, skills and concepts; and emphasis on the development of cognitive skills* [14].

METHODOLOGY

For the purpose of the study, a semi-structured interview was conducted prior to the statistical treatment. This is because it could provide information on the captioned subject. There were two key areas to be addressed, namely:

- Did students, who had participated in the industrial placement, perceive any change in their learning and competence in terms of academic performance, technical knowledge and generic skills?
- Was there any significant difference in the academic performance between students, who had participated in the industrial placement, and those who had not, as measured by their academic achievements?

The second part of the study entailed a statistical analysis of students' academic performance. The main advantage of a statistical study is to provide objective information according to well-established protocol of analysis, and to give a more precise estimate of the impact. In order to address this area, the academic achievements and performance of students, who had completed the industrial placement in the academic year 2002/2003 and returned to the University to complete their final year study in 2003/2004 ($n = 8$), was compared to that of a *comparable* group of final year students in the same year, who did not undertake work experience. The control group ($n = 8$) was set up before the final year assessment with respect to the students' academic ability as reflected in their second year Weighted Grade Point Average (WGPA).

It should be noted at this point that the Grade Point Average (GPA) is a grading score from 0 to 4.5. The interpretations of the scores 4.5, 4, 3.5, 3, 2.5, 2, 1.5, 1 and 0 are A+, A, B+, B, C+, C, D+, D and F, respectively. The Weighted Grade Point Average (WGPA) is a summary of students' academic performance within a certain period, eg second year. It is calculated by the GPA of individual subjects taken by the student with a predetermined formula.)

The academic performance and competence of students was measured by their WGPA in the final year, as well as their performance in the subject *Design Project*, which was a miniature of what students were facing in industry. The design project's GPA was utilised to assess the building design knowledge and skills of the two groups. The WGPA of students in Years 2 and 3 also formed part of the evaluation data.

Chi-square tests and t-tests were carried out in order to test if there were significant differences between the two groups before and after the placement experience in terms of the means and distribution of their WGPA.

Table 1: T-test for second year WGPA scores of placement students and students not taking placement (Control group).

Group	Mean	SD	n	df	Variance	Critical t at 0.05	t	P
Placement	2.71	0.31	8	14	0.10	1.76	-0.21	0.42
Control	2.68	0.30	8	14	0.09			

Critical t = 1.76; t = 0.21; p=0.42

Table 2: T-test for final year AGPA scores of placement students and students not taking placement (Control group).

Group	Mean	SD	n	df	Variance	Critical t at 0.05	t	P
Placement	2.88	0.12	8	14	0.01	1.76	-2.19	0.02
Control	2.68	0.22	8	14	0.05			

Critical t = 1.76; t = -2.19; p=0.02

Table 3: t-test for final year *Design Project* GPA scores of placement students and students not taking placement (Control group).

Group	Mean	SD	n	df	Variance	Critical t at 0.05	t	P
Placement	3.25	0.38	8	14	0.14	1.76	-2.70	0.01
Control	2.81	0.26	8	14	0.07			

Critical t = 1.76; t = -2.70; p=0.01

The test started with the hypothesis that *there was no significant difference between the two groups*. This was to be carried out using a statistical treatment. *If two sample groups' means are compared with each other, it can be done by a hypothesis test* [15].

The proposed method was independent samples t-test [16]. The data was the final year AGPA scores and the GPA scores for the *Design Project* subject for students coming back from their industrial placement and those of a comparable group of students without the industrial placement experience. The *control* group of students without placement experience was selected based on their similar year-two WGPA scores compared with the placement students.

The first step began with a null hypothesis test of no significant difference in their year-two WGPA scores. If the test supported the null hypothesis, ie there was no significant difference of second year WGPA results between the control group and the placement group, then it could proceed to the second test. The second test was to test the null hypothesis that *there was no significant difference between the WGPA in the final year and in their mean GPA in the* Design Project. Furthermore, Chi-square tests were conducted to examine if there was any significant differences in the distribution of the degree class of honours between the two groups. The test results showed that there was no difference between the placement and control group at the second year level; they were at similar academic standing. The same tests were undertaken for their final year WGPA and GPA scores for comparison. The results (Tables 1-6) showed statistically a difference of the two groups.

Table 4: Class of honours of placement and control groups in the second year.

Grade	Placement Group	Control Group	Total
B & B+ (2^{nd} D1)	1	1	2
C+ (2^{nd} D2)	5	5	10
C (3^{rd})	2	2	4
Total	8	8	16

Critical χ^2 = 5.99; χ^2 = 0; df = 2; p=1 (GPA 2.0 to 2.49 = C; GPA 2.5 to 2.99 = C+; GPA 3.0 to 3.2 = B; GPA 3.21 to 3.39 = B+)

Table 5: Class of honours of placement and control groups in the final year (the final degree class of honours).

Grade	Placement Group	Control Group	Total
B (2^{nd} D1)	4	1	5
C+ (2^{nd} D2)	3	4	7
C (3^{rd})	1	3	4
Total	8	8	16

Critical χ^2 = 5.99; χ^2 = 2.94; df = 2; p=0.23 GPA 2.3 to 2.7 = C (third class honours); GPA 2.71 to 2.9 = C+ (second class honours division II); GPA 2.91 to 3.4 = B (second class honours division I)

Table 6: Grade of the placement and control groups in the final year *Design Project* subject.

Grade	Placement Group	Control Group	Total
A	1	0	1
B+	1	0	1
B or below	6	8	14
Total	8	8	16

Critical χ^2 = 5.99; χ^2 = 2.29; df = 2; p=0.31

CONCLUSIONS

Many researchers have noted the advantages of learning on the job. Most of the students involved admitted that they regarded the industrial placement as the springboard for their career. Some students believed that they could benefit from the integration of theory and practice by relating the knowledge and insights acquired during the placement to the practical aspects. Applied knowledge is gained through the exploration of real world problems [17]. It can be seen that the merging of theories and practice is critical in learning process. The students had undergone self-evaluation and achieved an affirmation about the importance of the learning experience.

Reflection is important to learners and it is explained in depth from Kolb's learning cycle [18]. The working environment plays an important role in the encouragement of reflective action [19]. It is valuable for students to have authentic and guided working experience. The placement experience is totally different from experiments and cannot be replaced by laboratories.

Each profession has its own mix of specific knowledge, theoretical principles, trade practice, process knowledge and communicative competence. The precise mix will be intuited knowledge through engagement over time within each profession with practical training [20]. Working in industry is the best way to learn professional attitudes.

The *Six Category Intervention Analysis* carried out by Heron argued that working experience can enhance interpersonal skills [21]. Industrial placement offers an opportunity for students to work in industry and acquire experience in interpersonal skills. All students expected a better chance of employment in industry. A study conducted by Blackwell et al has shown that students from sandwich courses had a higher employment rate [22].

The results from the statistical analysis carried out further supported the idea of learning from working. Students returning from industrial placements displayed better academic performances, which were supported by t-tests and Chi Square tests. Although the sample size was only eight, it was still a positive sign of success.

REFERENCES

1. Schaafsma, H., Back to the real world: work placements revisited. *Educ. + Training*, 38, **1**, 5-13 (1996).
2. Percy Committee, Higher Technological Education. London: HMSO (1945).
3. Ryder, K.G. et al, *Cooperative Education in a New Era. Understanding and Strengthening the Links between College and the Workplace*. San Francisco: Jossey-Bass (1987).
4. Davies, L., *Experience-Based Learning within the Curriculum*. London: Council for National Academic Awards (1990).
5. Association for Sandwich Education and Training (ASET), Association for Sandwich Education and Training 1991 Directory. Sheffield: ASET (1991).
6. Bourner, T. and Ellerker, M., Sandwich placements: improving the learning experience – part 1. *Educ. + Training*, 40, **6/7**, 283-287 (1998).
7. Ashworth, P. and Saxton, J., *Managing Work Experience*. London: Routledge (1992).
8. Hong Kong Government, Laws of Hong Kong, Chapter 47: Apprenticeship Ordinance. Hong Kong (1982).
9. Hong Kong Special Administrative Region Government, China, Laws of Hong Kong, Chapter 47: Apprenticeship Ordinance. Hong Kong (1997).
10. Hong Kong Polytechnic University, Preferred Graduate Development Programme. Hong Kong: Hong Kong Polytechnic University (2002).
11. Watkins, K., *Facilitating Learning in the Workplace*. Geelong: Deakin University Press (1991).
12. Johnson, D., The opportunities, benefits and barriers to the introduction of Work-based Learning in higher education. *Innovations in Educ. and Teaching Inter.*, 38, **4**, 364-368 (2001).
13. Raelin, J.A., *Work-Based Learning: the New Frontier of Management Development.* Englewood Cliffs: Prentice Hall (2000).
14. Department for Education and the Environment (DfEE), Work-Based Learning Briefing Paper. Higher Education Quality and Employability, February (1996), http://www.dfee.gov.uk/heqe99
15. Kiess, H.O., *Statistical Concepts for the Behavioral Sciences.* Boston: Allyn & Bacon (1989).
16. Diekhoff, G.M., *Basic Statistics for the Social and Behavioural Sciences*. Upper Saddle River: Prentice Hall (1996).
17. Hirst, P., *Knowledge and the Curriculum*. London: Routledge & Kegan Paul (1974).
18. Kolb, D., *Experiential Learning*. Englewood Cliffs: Prentice-Hall (1984).
19. Taylor, E.W., Building upon the theoretical debate: a critical review of the empirical studies of Mezirow's transformative learning theory. *Adult Educ. Quarterly*, 48, **1**, 34-59 (1997).
20. Boud, D. and Garrick, J., *Understanding Learning at Work*. New York: Routledge (1999).
21. Heron, J., *Six Category Intervention Analysis* (2nd edn). Guildford: Human Potential Research Project University of Surrey (1986).
22. Blackwell, A., Bowes, L., Harvey, L., Hesketh, A.J. and Knight, P.T., Transforming work experience in higher education. *British Educational Research J.*, 27, **3**, 269-285 (2001).