

Tailoring career intelligence: an example for electrical engineering students in Taiwan

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ABSTRACT: In this article, the authors detail a programme, offered by the Department of Electrical Engineering at the National Changhua University of Education (NCUE), Changhua, Taiwan, which utilises lessons, career exploration and field experience in order to promote occupational competences for electrical engineering students. In this article, the authors describe the goals, lesson sequence, teaching contents and methods, as well as the course objectives. Several suggestions are made to further its use. The programme helps students recognise where their potential job markets are and clarify their career directions through self-exploration, teachers' guidance, invited talks on special topics, visits to factories and companies, and so on. Course activities facilitate students' analyses of their capabilities in order to reconstruct and reinforce the work skills and working attitudes that they need in the electrical engineering industry.

INTRODUCTION

There are more than 10,000 electrical engineering related industries in Taiwan, with a production value of close to US\$300 million per year [1]. The related industries, including electrical engineering appliances, information products, household electrical appliances, telecommunication products, electrical parts, etc, are stable and less affected by other industries. Yet these related industries can also stimulate the development of the others and are the main industries for the economic development of Taiwan.

Recently, innovative R&D capabilities and a superior workforce have been hot topics; from this, the focus on economic development is influencing changes in work-based education at colleges. The cultivation of apposite persons for employment is the practical goal of a school programme. However, it is usually ignored or else does not have a great deal of effect on student learning.

The number of electrical engineering undergraduate students in Taiwan is 22,678, which is three times larger than figures from ten years ago [2]. Nevertheless, many entrepreneurs of small and medium-sized enterprises (SMEs) still experience difficulty in finding suitable people to work for them from the many job applicants available who have college degrees or higher.

In order to advance and reinforce students' specialised areas of expertise, correct work ethics and positive attitudes, the newly established Department of Electrical Engineering at the National Changhua University of Education (NCUE), Changhua, Taiwan, has designed career intelligence curricula. The content of the curricula not only includes professional courses, but also integrates professional courses with broader applications to industry into the curricula of undergraduate and

postgraduate programmes. Students are requested to take the core courses and part of professional courses from their freshman year to the junior year, which helps them acquire the theoretical concepts of electrical engineering. However, these courses will not help students with their work in industry, which demands the capability to integrate their learning and practice.

In order to improve the situation, the Department of Electrical Engineering at the NCUE has tailored a course in a career intelligence programme to help students to recognise where their potential job markets are and clarifies their career directions through self-exploration, teacher guidance, special topics, visits to factories and companies, and so on. With course activities, students analyse their capabilities constantly in order to recognise and reinforce their work skills and work attitudes that they need in the electrical engineering industry. If the gap between students' capabilities and what is actually required in the electrical engineering industry is large, then students need to study more professional courses in their senior year while at the University.

The educational concept behind the career intelligence programme is based on D.E. Super's theory about people's vocational development stage, in which people from the age of 15 to 24 are in their career exploratory period [3]. During this period, students are supposed to develop their competences and work attitudes. Phillips, Blustein, Davis and Whote suggest that school teachers should develop better practical courses for student learning, such as organising Work-Based Learning (WBL) activities and facilitating an adult world orientation, as well as helping students to prepare for their transition for work [4]. Johnson and Stoker found that the breadth of vocational interests in colleges was positively related to occupational classification stability, even 30 years after students had graduated [5].

A career intelligence programme provided by the Department will certainly help with students' learning, as well as their career development and judgement competences. Several researchers support the above statement, such as Burns, McMasters, Devon, etc [6-8]. Indeed, McMasters affirmed the following:

We need to provide students with a solid foundation for subsequent graduate study, professional practice and continued career-long learning in an environment where career change may become the norm for job security and employability [7].

Thus, the vocational development stage is the time when students should prepare for their occupational development. In other words, students will develop their career development and judgement competences after taking specially designed courses offered by the career intelligence programme. Teachers should lead students so that students become more familiar with their career field while still at college. Therefore, tailoring a career intelligence programme for different departments is necessary for students of different learning programmes. Such an arrangement better suits the career educational goals established by university departments and benefits students to so that they have a smooth transition from school into the workplace.

THE ESSENCE OF THE CAREER INTELLIGENCE CURRICULA

The Department of Electrical Engineering at the NCUE was founded in 2001. In the same year, students enrolled in its undergraduate and Master's programmes. Its doctoral programme started in 2002. Its professional curriculum does not differ much from the traditional curriculum found in the other departments. In the professional area, students have to take core courses (from the first year to the third) and professional ones (from the third to the senior); general education courses are taken according to school regulations. Such curricula facilitate career intelligence in exploration, allocation and becoming a professional.

Exploration

Exploration assists students in investigating their professions. All students have to take core courses from the first year to the third. In the meantime, they must also finish at least 20-30% of the professional courses, depending on their individual situations. In order to let students to extend their interests accurately, this curriculum is designed to ask students to reflect on their own learning interests and prior learning experiences through an exploration of the following:

- The professional demands of the domestic electronic engineering industry;
- Teachers' lectures on special topics;
- The sharing of experience from electronic engineering industry experts;
- Students' self-analyses of their capabilities.

Allocation

Allocation means understanding various professional fields and choosing a specialty field for a future career. The programme is

offered in the second semester for junior students of the Department of Electrical Engineering at the NCUE. Students choose special topics in the various fields of systems, telecommunications or VLSI, respectively, to undertake a six-week exploration in each field. Students may also compare their professional knowledge with the working skills demanded by industry, standard curriculum, relevant research, experts' opinions and their own capabilities. Students may also analyse their interests and relative positions in their specialty field in electrical engineering industry for their future career.

The results of students' self-analyses can serve as an important indicator for what specialty courses they should focus on. Therefore, this course provides continuity and connection in the fourth year studies for students and helps students to understand more deeply about the different fields in the electrical engineering industry, and to decide their career directions.

Becoming a Professional

Becoming a professional is to establish professional confidence. After the course instruction in the second semester of students' junior year, senior students can choose elective courses related to the profession that they have chosen. Students are divided into groups according to individual interests and professions. Each group takes on a deeper exploration and study on the courses related to the particular field, each group focuses on. Also, using R&D special projects provided by enterprises, students can integrate their professional capabilities with actual application and see how the R&D results turn out when cooperating with enterprises. The purpose of arranging this course in the second semester of the third year is to link up students' course studies, offer them a whole set of occupational intelligence, and establish their professional confidence.

THE GOALS, TEACHING METHODS AND EVALUATION OF THE PROGRAMME

Many entrepreneurs have expressed their frustration about youths' lack of proper work attitudes or youth's inability to follow work ethics. In order to avoid such a situation, the Department of Electrical Engineering at the NCUE has adopted a course that is not limited to the cultivation of professional capabilities only, but also teaches students to respect their profession. Therefore, the programme is designed to help students with the following:

- To be practically aware of their potential job markets;
- To clarify their career directions;
- To respect work ethics through self-exploration, teacher guidance, invited talks given on special topics and visits by industry professionals.

Considering the curriculum articulation, the programme starts at the second semester of the third school year for electrical engineering majors. The programme is offered to the junior students of the Department of Electrical Engineering at the NCUE. It is tailored specifically to satisfy the needs of the Department of Electrical Engineering. In all, 25 students took this 18-week course in the spring term of 2004, from 23 February to 21 June, three hours per week, totalling 54 hours.

This programme established the four following goals, namely:

- Gaining self-understanding;
- Realising industrial professional capabilities and interests;
- Learning career development and planning;
- Strengthening basic career intelligence and abilities.

The teaching methods include the following:

- Topic lectures;
- Students' presentations, group discussions and sharing of views;
- Special topic talks by industry experts;
- Visits to enterprises.

Learning evaluations cover the following aspects:

- Learning portfolio: this is composed of weekly schoolwork and reports on special topics designed by the instructor; the instructor grades the portfolio at the end of the course;
- Participation and self-development: Students' learning attitudes are evaluated by class participation, the extent of participation in discussion activities, as well as self-development.

THE CONTENT OF THE PROGRAMME

Detailed below are the key components of the programme, such as an introduction to the course's topics, goals, contents and instructional hours, as well as its implementation in the programme:

Course Introduction

In the first three hours, the teachers introduce the course structure, career basic cognition and course goals. Teachers help to facilitate students' development with regard to basic career intelligence and cognitive abilities.

Self-Understanding

Students take tests in self-understanding; these contain self-understanding of family, school, individual experiences, interests and career directions. Students get to know themselves better and gain greater insight into their peers' situations. The goal here is to make students understand themselves better. This lesson covers three hours.

Understanding the Industry Environment and Job Markets

Students are asked to research 10 electrical engineering enterprises that they aspire to work for and understand these enterprises' products, job openings, requisite professional capabilities, business strategies, welfare and other relevant information. Teachers organise students to have a discussion on the enterprises' special qualities and the professional capabilities demanded. During these six hours, students are encouraged to understand the domestic areas of the electrical engineering industry and the job markets, foster students' interests in the industry and help students have a general understanding of career development and planning.

Industry Professional Capability Checklist

This lesson helps students to understand the professional capabilities required in various areas of the electrical

engineering industry, and helps to prepare students to get into the job markets, guide their learning aptitudes and interests, and aids them in initiating their career development and planning. Students complete a capability checklist in order to analyse their actual capabilities and competences expected in their future careers, and to compare the differences. This lesson covers six hours.

Seminars on Special Topics

There are two special topics, with each lasting three hours. The General Manager of Cashido Corporation, Mr Shi-Chang Chen, provides his ideas about business creation and enterprise operations for students to think about the qualities of people who need to be recruited to his company. Utilising collective brainstorming, students come up with five important work attitudes, namely: stability, diligence, amicability, honesty and professionalism. Of these traits, four cover people's emotional intelligence (EQ), and one is about IQ. The topic of this section leads students to build their basic career intelligence and cognitive abilities.

The Project Manager, Mr Bieg-Lin Ye, of Holtek Semiconductor Inc., uses his experiences in special projects execution to analyse the application of the current microcontroller units (MCU) market, in which 8-bite is still the major appeal. Particular applications and the costs involved of 16-bite and 32-bite units are yet to be developed and properly applied. This helps to initiate students' industrial-professional capabilities and their learning interests.

Topic Lecturing

Topic lecturing serves to strengthen students basic career intelligence and cognitive abilities. It incorporates 12 hours. One element covers patent cases, which are used to explain the innovation process including idea generation, invention and patent application. The basic concepts of patent rights, such as patent law, types and requirements, as well as the length of rights, are also introduced to students.

Another component is R&D sample projects and reports, which are introduced to students to help them understand the format and style in planning projects and reports. The other parts cover teaching materials about ISO9000s, ISO14000s and SA8000; these help students to understand the significance of quality and environmental problems that may occur in the R&D cycle.

Enterprises Visits

Three enterprises have been visited as part of this component of the course to foster students' interests in the optoelectronic industry. Students have visited the firm of TFT-LCD, Chi Mei Corporation, in order to understand the features of its latest TFT-LCD product, experience the Chi Mei work culture and understand the demands placed on its workforce.

To develop students' interests in the microcontroller unit (MCU) industry with regard to integrated circuit (IC) design, students visit Holtek Semiconductor Inc., known for its IC design, whose major products include general-purpose and special-purpose microcontroller units. The visit covers being introduced to Holtek's product lines, production applications, the status quo of the company, as well as workforce demands.

Helping students understand media storage and engender interest in the CD, CD-RW, DVD, DVD-RAM and OLED industry, students visit the optical disc factory, Ritek Corporation, to understand the types of media storage, the R&D history of optical discs and its developmental directions, product lines, and the demands placed on the workforce.

OUTCOMES OF THE PROGRAMME

There are three main reasons for one to believe that the programme has proved to be really useful. Wolfe's five informal but effective methods (developed in 1969), which usually work well for the evaluation of a new programme, have been utilised here to evaluate this programme [9]. This results are as follows:

- *Cosmetic method*: As a whole, course topics and contents meet the goals of the curriculum;
- *Cardiac method*: Course instructors know that this curriculum works well and is good for students through their interactions with students;
- *Colloquial method*: At the end of the term, students express what they feel about the course, and everyone agrees that they have learned and grown from it;
- *Curricular method*: This curriculum does not interfere with the proceeding of other courses and helps students' understanding of other professional courses;
- *Computational method*: The programme can be analysed through students' learning portfolios.

The following lists various learning outcomes that have been obtained from students:

- Students would come to teachers to discuss their lives, interpersonal relations, studies, career and so on;
- Students have a greater understanding of the relationship between R&D and economic efficiency in the electrical engineering industry;
- Students become more active in pursuing advanced knowledge of the electrical engineering industry;
- Students reinforce their understanding through human resource analysis and self-examination of their professional capabilities;
- Students' schoolwork turns out to be more organised than the chaos previously seen in their submitted assignments;
- Of note is a statement from one student, Li-Hueng Yuan, regarding the learning reflection on this course: *Because of the request of this course, our teachers asked us to find some information about enterprises' recruiting qualifications. We had no idea how to start it and even felt quite annoyed. But after collecting data and organising them, I came to learn a lot and have a different understanding of the so-called high technology people.*

Furthermore, good feedback was received from various entrepreneurs involved in the course, such as Mr Shi-Chang Chen, the General Manager of Cashido Corporation, who affirmed the following:

Some young people had lost their work ethics and passion. The career intelligence programme will teach them to understand the general rules in the

workplace and follow them. Obviously, it is a good beginning to have career intelligence education in school. If the entrepreneurs cooperate with career intelligence courses, they will not need to provide a lot of training for the newly graduated people.

Mr Beig-Lin Ye, the Project Manager, of Holtek Semiconductor Inc, mentioned the importance of the career intelligence programme, as follows:

Since the world around the industries has changed and is continuing to change, technological competition is one of the important factors to create a successful enterprise. And this programme is a good chance for students to get what kind of technology skills they should be mastered and how to use it. If students study hard, they will have an advantages competition in a labour market.

Mr Rui-Chang Su, the Deputy Manager of Ritek Corporation, welcomed students during their visit to his company, and stated the following:

We had not allowed any education groups to visit us for many years, but my General Manager was touched by your learning purpose. So, we decided to show you our R&D history, the products we made before and our automatic product process in the clean room. It would help you to know more about the history and the development of media storage products in Taiwan, and useful for your career decisions in the future.

REVIEWS AND SUGGESTIONS FOR THE PROGRAMME

Although enterprises and students agree that this programme is worthy of praise, there is still room for growth and development. The following suggestions should make for a better programme to be offered in the future:

- The number of students in one class should not exceed 15; this can ensure better interaction between teachers and students;
- The programme can be extended to the first semester of the junior year to give students more time to proceed to a deeper exploration regarding industry information, individual abilities and work knowledge;
- The Department should reconsider the curriculum design as a whole according to a review of students' exploration of industry information and their individual abilities by career intelligence;
- The Department should open a complete set of profession application courses to complement it in order to make the programme more effective and practical;
- Course teachers should have, in addition to academic knowledge, actual enterprise experience over two years and have a clear picture about the relation between production, sales, human resources, R&D and finance in an enterprise;
- Course teachers should maintain a high level of self-development abilities in order to catch up with industry developments and to create new course content and teaching materials.

CONCLUSIONS

It is easy to receive knowledge, but harder to internalise it and then turn it into action. The programme described in this article shares the same educational purpose as general education. However, the former is more meaningful, as it allows students to personally become involved in developing course content and instructional materials, sharing and discussing in the instructional process, and further internalising their learning through a continuous process of deconstructing and constructing themselves.

Universities' electrical engineering education stresses academic performance, while electrical engineering industry suffers from finding potential individuals to carry out jobs. Given this dilemma, it is necessary to bridge this gap between electrical engineering education and the industry. This programme is a trail for this purpose. Although the programme only just started for one semester, it has generated a practical effect upon students' learning with many favourable indicators.

The characteristics of this programme are as follows:

- Connection of course content and practical learning experience: the programme emphasises both university electrical engineering education and the cultivation of professionals demanded by electrical engineering industry. Thus, the connecting relationship between university and industry is very important.
- Practical value of self-made course materials: course instructors develop their own teaching materials based on students' reactions to the course and the topics of the course content, providing relevant information as references and improving the practicality and accuracy of teaching materials.
- Linked network resources for education and industry: students can link up academic units and enterprises and determine their interactions through the linked network composed of the Department of Electrical Engineering at the NCUE, the Incubator at the NCUE and enterprises.
- Self-management and project management learning by students: students learn self-management and decide on the field that they want to engage in further study.

According to the experiences gained so far, the Department of Electrical Engineering at the NCUE has started the design of a specific curriculum for its future students. This will not only teach students professional technologies, but also include competences in management for the electrical engineering industry.

ACKNOWLEDGEMENTS

For the success of the programme of electrical engineering and enterprise-visiting activities, the authors would like to express their deepest gratitude to many individuals and enterprises for their help and participation, namely: Mr Shi-Chang Chen, General Manager of Cashido Corporation; Mr Zhi Zhang, Deputy CEO; Mr Rong-Zong Cai, Marketing Manager; Mr Beig-Lin Ye, Project Manager; Mr Jin-Can Ren, Project Manager; and Mr Zhi-Liang Lai, Deputy Manager, of Holtek Semiconductor Inc.; Mr Bo-Wen Zheng, Deputy Manager, and Ms Yu Chen, Administrator, of Chi Mei Optoelectronics Corporation; Mr Qing-Zhong Luo, General Manager, Mr Rui-Chang Su, Deputy Manager, and Mr Wei-Xiang Wang, Deputy Manager, of Ritek Corporation.

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8th UICEE Annual Conference on Engineering Education
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edited by Zenon J. Pudlowski

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