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Comparing the engineering program feeders from SiF and convention models

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Abstract. This research aims to compare the relationship between two types of engineering program feeder models within the technical education systems of Rajamangala University of Technology Lanna (RMUTL), Chiangmai, Thailand. To illustrate, the paper refers to two typologies of feeder models, which are the convention and the school in factory (SiF) models. The new SiF model is developed through a collaborative educational process between the sectors of industry, government and academia, using work-integrated learning. The research methodology were use to compared features of the the SiF model with conventional models in terms of learning outcome, funding budget for the study, the advantages and disadvantages from the point of view of students, professors, the university, government and industrial partners. The results of this research indicate that the developed SiF feeder model is the most pertinent ones as it meet the requirements of the university, the government and the industry. The SiF feeder model showed the ability to yield positive learning outcomes with low expenditures per student for both the family and the university. In parallel, the sharing of knowledge between university and industry became increasingly important in the process, which resulted in the improvement of industrial skills for professors and an increase in industrial based research for the university. The SiF feeder model meets its demand of public policy in supporting a skilled workforce for the industry, which could be an effective tool for the triple helix educational model of Thailand.

1. Introduction

Innovation in education has led to the development of life skills acquisition, using both integrated learning and contextual teaching/ learning models. Both learning models have a similar aim of developing students' life skills [1]. In Thailand, a study by the National Economic and Social Development Board or NESDB [2] found that a disparity between demand and supply in science and technology (S&T) manpower, especially in terms of quality. The main reason was discontinuity in knowledge, skills and attributes between the expectation of the industry and the capacities of educational institutions, particularly when it came to the chasm between practical and theoretical modes of learning. The study went on to suggest that overcoming such demand and supply disparity

in the quality of manpower. There was a need for every college and university to established in-depth cooperation with industrial enterprises [3]. Therefore, Rajamangala University of Technology Lanna (RMUTL), in Chiangmai, Thailand decided to implement a project focused on the "School in factory" (SiF) models through an effective collaboration including three parties (triple helix), namely industrial partner (Siam Michelin Co., Ltd), the academic sector (RMUTL) and government agency (National Science Technology and Innovation Policy Office, STI). The objectives were to solve the problem of shortage in qualified technicians, reduce the turnover rate of employees and increase the country's productivity.

Within the SiF project, Siam Michelin Co. Ltd was the main stakeholder, offering the work venue, and "in cash investment" such as: students' school fees, monthly allowances, accommodation costs, and payment for lecturers, facilitator and on-site trainers. The RMUTL provided an "in kind investment" such as the contributions to lecturers, facilitators and school management. The STI, as the government agency, fosters and supports this form of participatory educational management. Students graduating from this program receive a diploma certificate from Rajamangala University of Technology Lanna. The pilot project was first launched in 2012. It is a two-year educational program. Each year, students spend three months studying at the university and nine months at the factory. The intake of students on the SIF project are students who graduated from higher secondary school (general education) or vocational certificate programs. In view of this diversity in students' background, the university assisted them with two months training program in basic and higher professional skills before attending the factory [4].

This paper addresses two typologies of feeder models, which are the conventional and the school in factory (SiF) models. The new SiF model was developed as a collaborative educational project between the industry, government and academic sectors using work-integrated learning. The present research discussed and compared the features of the SiF model and the conventional models in terms of learning outcomes, budget for study, and advantages and disadvantages from the point of view of students, professors, the university, government and industry.

2. Methods

This research purposed to survey and make a comparison between the two types of engineering program feeder models in the technical education systems. The target group was the first year students (30 students) in the bachelor degree in industrial engineering of the Faculty of Engineering, at Rajamangala University of Technology Lanna (RMUTL), in Chiangmai, Thailand. These students would either (i) followed the conventional model, or (ii) participated in the school in factory (SiF) model which was an innovative model developed in collaboration between three parties: industry (Siam Michelin Co., Ltd), government (National Science Technology and Innovation Policy Office) and the academic sector (RMUTL), using work-integrated learning.

The information was collected in relation due to (i) learning outcomes – grade point average (GPA) and grades in the main subjects of the students in the first year of the 2016 academic year (semester 1 and 2), (ii) the budget involved in studying within the two types of engineering program feeder models, and (iii) the advantages and disadvantages for students, professors, the university, government and industry – acquired by personal communication.

3. Results and Discussion of Research

The research establish a result of the feeder students from the SiF models that showed positive learning outcomes with a GPA above average, as well as greater skills and ability to study as demonstrated by the grades in the main subjects displayed in table 1.

Table 1. Learning outcomes (GPA and grades) in the main subjects for feeder student for the SiF and the conventional models

List of Grades	SiF Models (10 students)	Conventional Model (20 students)	
GPA	2.81[a]	2.67[b]	
Calculus 1	2.96	2.87	ns
Physic 1	2.83[a]	2.69[b]	
Calculus 2	3.65[a]	3.19[b]	
Physic 2	2.92	2.88	ns
English in everyday use	2.46	2.46	ns
Chemistry for engineer	3.08	3.00	ns
Production process	2.46[a]	2.10[b]	
Engineering Drawing	2.79[a]	2.60[b]	
Engineering Material	3.38[a]	3.22[b]	

Data are expressed as mean values.
Mean values with different superscripts in the same column differ significantly at $P \leq 0.05$.
The symbol ns means that the mean values are not significantly different.
Grades are weighted as follows: A (Excellent), 4.0; B+, 3.5; B (Good), 3.0;C+, 2.5; C (Satisfactory), 2.0; D+, 1.5; D (Barely Passing), 1.0; F (Failing), 0.

The project as developing the technical education SiF models of high vocational certificate in industrial technique (2 years), was funded by Siam Michelin Co. Ltd, in the amount of approximately 3,808,400 bath for 11 students in the program. Each student gain full financial support for attendance as follow: free tuition and fees for the whole course and living expenses, notably room - 2,500 bath per month, personal expenses - 7,600 bath per month, books and supplies - 2,000 bath per year, student uniform - 4,000 bath per year, welfare - 2,000 bath per year and health insurance - 2,500 bath per year. The conventional model students, on the other hand, had to pay for tuition and fees: approximately 7,500 per semester and also to support themselves with regards to living and personal expenses or obtain student government loans.

The SiF models provided an opportunity for total immersion in the industrial environment and skill setting. On such excursions, the student practices their industrial skills and critical thinking abilities outside of the controlled class setting. Being able to ask experts about their particular area of study on the spot requiring thinking. They were able to learn real-world lessons. This model offered activities and programs that integrate academic learning in its application in the workplace. The practice was real and occurred in the workplace.

This model can have several advantages for students; the course was designed to put theory into practice in order to enhance students' skills in terms of reflection on future practice. This was the opportunity for students to see their subject area in practice. The SiF model also helps to develop 'soft' skills such as communication, teamwork, leadership and career development. Teachers in this project found satisfaction in seeing students develop and mature. Most of them accepted their role as a participant in a learning process and took genuine responsibility for their learning whilst undertaking the SiF project.

The RMUTL University's strategic interest in the project focused on work integrated learning (WiL) and this was an important project for them due to the potential that WiL has in enhancing graduate competencies. So the university decided that one of the main priorities was to incorporate an opportunity for work based, experiential learning opportunities in undergraduate programs. The intention was to enhance and extend work-integrated learning strategy, to enhance the quality of

teaching and corporate/community engagement. During the SiF project, the university addressed the professional development requirements and also ensured that the university's wide procedures and regulations were amended in order to enable a more flexible integration into the programs of study. One of the outputs from the SIF project was to develop a curriculum based on industrial expertise in assessment methods, by working with employers who have experience in assessing employability skills. This will continue the Work Integrated Learning (WiL) curriculum used by other universities in Thailand. Moreover, it also sought to identify new and innovative research opportunities linked to immediately practical contexts.

In Thailand, the government and the Ministry of Education use WiL as a key-approach and have launched in 2009 a documen "Guidelines for the Development of WIL Programs". The aim was to encourage universities to implement WiL efficiently, and in 2007 roughly 50% of all institutions from higher education had adopted cooperative education [5]. On the industry side, the SiF project was aimed at improving the employability of graduates by giving them valuable practical experience that is directly related to thecourses offered by universities. TheSiF project also improves the transition from university to work and increase productivity outcomes for the employer and the economy. In the project, students can understand, adapt and apply skills in the workplace. The industry helps ensuring the students are able to plan, investigate and navigate careers in an environment where conceptual, adaptive, personal, technical and vocational skills are essential. On the government side, WiL programs help establish competencies that reduce the personal and community risk of economic downturn. Beyond that, it helps produce a highly skilled workforce to meet industry and community needs.

For Rajabhat Universities, the development of WiL can be a developmental process that creates new tools, models, and methods for the administration of education in the service industry field. The researchers found that WiL provided opportunities for students to acquired real-life work experience and offered opportunities to develop their social skills. They can be a tool for problem solving, as it was an experience learning method with which students had opportunities to adopt knowledge, working skills, and other specific skills in relation to their occupation. From the instructors' perspective, instructors gained real experiences and knowledge. From the perspective of the educational institutions, WiL brought about learning exchanges, acceptance, and trust in the quality of graduates among entrepreneurs. Finally, the advantages for the industry or entrepreneurs, was that they acquired competent employees able to meet their demands, and did not waste time with new employee; this boosted the industrial partners' image [6].

Promwong and Pittayasophon reported that in Thailand, the adoption of work-integrated learning **(**WiL**)** needed government support to achieve effective collaboration in order to reach specific social objectives**.** Moreover, in order to attain an effective triple helix model, good governance and a culture of integrity seemed to be basic challenges **[**3**].**

Gellerstedt et al**.** reported, about WiL and higher education, that it is important that higher education takes responsibility for increasing the professional readiness of students, and for finding a systematically strategy to support WiL education**.** People were indeed must prepare for a profession that demands lifelong learning**.** These were therefore the qualities needed to become an efficient student in higher education; they are very much the same abilities required for effective professional practice **[**5**].**

4. Conclusion

The results of this study indicate that the developed SiF feeder model is the most pertinent ones to meet the needs of the university, the government and the industry. The SiF feeder model showed positive learning outcomes with low expenditures per student by family and university were alike. In parallel, the sharing of knowledge between university and industry has become increasingly important, which resulted in an improvement in the industrial skills of professors and an increase in industrial based research for university. The SiF feeder model meets the demands of public policy in supporting

a skilled workforce for the industry, which could be an effective tool for the triple helix educational model of Thailand.

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