Guidelines to Curriculum Improvement of Integrated Instructional with a Working in Innovative Technology Machinery Program (New Curriculum A.D. 2020), Faculty of Agricultural Technology, Rajabhat Maha Sarakham University

Chonlada Yodying[1] , Wiroon Monatrakul[2] , Rungsun Phongphattanaamphai[3] , Somsuk Trisupakitti[4] and Arithat Chuchotsakunleot[5]

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Abstract

The objective of this study was to develop the Bachelor of Science on Innovative Technology Machinery Program a using model of integrated instructional with a working. The data collection deployed an in-depth interview with faculty members in charge of the program, experts from other universities who hold expertise or qualification related to the program, and executives from businesses. The curriculum development procedure involves documentary analysis, collecting data by questionnaire, in-depth interview, and reviewing the curriculum together. The data was synthesized to draft the curriculum and assess the feasibility of the program. The curriculum review indicated that the developed curriculum comprised objectives, desirable characteristics of graduates, program structure, program content, instructional activities, assessment and evaluation. The program concentrated on 5 desirable characteristics i.e. (1) Morality and ethics (2) Knowledge (3) Cognitive Skills (4) Interpersonal skills and responsibilities and (5) Numerical analysis, communication and information technology skills. The curriculum structure consisted of general education courses 30 credits, specialized courses 86 credits, and elective courses

[1] Rajabhat Maha Sarakham University, E-mail : chonlada_rmu@hotmail.com

[2] Rajabhat Maha Sarakham University, E-mail : wiroonnnn@gmail.com

[3] Rajabhat Maha Sarakham University, E-mail : rungsun_2514@hotmail.com

[4] Rajabhat Maha Sarakham University, E-mail : somsuk_rmu@yahoo.com

[5] Rajabhat Maha Sarakham University, E-mail : ap2411.c@gmail.com

6 credits that accumulated the total of 122 credits. The program is consistent with the Standard of Higher Education Curriculum A. D. 2015 and related standards.

Keyword: Curriculum Development, Work Integrate Learning (WIL), Innovative Technology Machinery

Introduction

Thailand is in the middle income country and the development growth tends to carry on this trend that includes economy, science and technology. The economic status of Thailand from past to present stands on agricultural and industrial sectors that generates main income for the country. The government therefore focuses on agricultural and industrial development in order to maintain competitive advantages against other countries that favor an expansion of agricultural industry. In addition, the 12th National Economic and Social Development Plan (2017-2021) aiming to develop science and technology, research and innovation as well as ASEAN Community Partnership trigger more changes for Thailand in various aspects i.e. economic competition, migrant workers mobility, educational development, academic and technology advancement. For this reason, Thailand must earn readiness to keep up with these changes, to develop the country's capabilities in various fields in line with globalization, and to promote citizens a peaceful livelihood. The economic development of Thailand which relies on agricultural and industrial sectors as the country's main income. It is necessary to consistently develop knowledge and machinery technical skills in order to correspond the infinite needs of consumers.

Rajabhat Maha Sarakham University in realizing the strengths of communities, the Innovative Technology Machinery Program, Faculty of Agricultural Technology, therefore, designs the curriculum as a result of the 20-Year National Strategy (2018-2037) aiming at mobilizing the country for "stability, prosperity, sustainability based on sufficiency economy philosophy." This national vision focuses on capacity empowerment, quality of life improvement,

and income generation in moving forward to become developed country. This aim also includes promoting Thai people with quality, morality, ethics, discipline, respect for the law by means of learning reform and talent development, congruence with conceptual design education based on National Education Plan. This vision is driven by the key policy from the traditional approach to the innovative driven mechanisms under Thailand 4.0 Policy with an aim to promote Thailand to a high-income country that is driven by the economic sector (S-Curve) by embracing innovative products and technology industries to serve as key mechanisms for driving the new growth engines in the country.

Recognizing the importance of Work-Integrated Learning (WIL) curriculum, the committees in charge of the Bachelor of Science in Innovative Technology Machinery Program, Faculty of Agricultural Technology, Rajabhat Maha Sarakham University viewed that this educational policy would be beneficial for student development to be excellent in knowledge, skills, application, work skills and specific skills relevant to the profession. The program thus proposes a research project issue on The Development of Bachelor of Science in Innovative Technology Machinery Based on WIL Model. The research team expects that this research would offer (1) network of WIL educational management and (2) development of Bachelor of Science in Innovative Technology Machinery Program (TQF 2). The results would lead to the development of teaching and learning excellence.

The Faculty of Agricultural Technology, Maha Sarakham Rajabhat University recognizes the importance of developing new breed graduates and talented people to meet the needs of manufacturing sector according to the policy of Thai higher education reform by building practitioner graduates, Active Learning, Problem-based Learning, Project-based Learning, educational for employment, education by private sector participation. And, the faculty therefore worked on designing the Bachelor of Science in Innovative Technology Machinery by means of an in-depth training process, hands-on activity, classroom instruction, and working collaboratively with others to attain competencies desired by business

settings so they will be able to devise innovations and technologies to endorse the 10 targeted industries in the future.

Work Integrated Learning (WIL) is an integrated learning platform that incorporates students, teachers and future entrepreneurs into the curriculum design. This opens an opportunity to apply education theories and the real job practice. The key focus of this process is to develop a network of partnership among students, entrepreneurs and educational institutions (Homanek, et al., 2017; Martin & Hughes, 2009) This agreed with the study by (Chinintorn & Plaimas, 2010) in their investigation on the success factors of WIL Approach Thai higher education which found that there were 2 success factors i.e. (1) 3 collaborative factors including school, workplace and professional associations (2) 6 administration factors including curriculum, teaching, students, teachers, workplace and finance. (Kramer & Usher, 2011; Franz, 2007) stated that WIL is an integration between academic learning and professional experience outside the classroom. Students have an opportunity to experience work experience under real working conditions which defines assessment of the success in WIL implementation and this is used as a measurement device in education system of Australia and England. (Homanek et al., 2017; Smith, 2012; Franz, 2007) examined WIL model worldwide and revealed 9 models i.e. (1) Pre-course Experience (2) Sandwich Course (3) Cooperative Education (4) Cognitive Apprenticeship or Job Shadowing (5) Joint Industry University Course (6) New Traineeship or Apprenticeship (7) Placement or Practicum (8) Fieldwork (9) Post-course Internship. However, WIL model in Thailand conforms to 4 main models i.e. Dual Vocational Training (DVT), Cooperative, Apprentice, Internship (Chinintorn & Plaimas, 2010)

WIL offers benefits to 3 key areas and persons in education system: (1) higher education system in that WIL offers accessibility to new knowledge, techniques, and tools that can be used for curriculum improvement and instructional management; expanding networks and connections among entrepreneurs, education institutions and students that truly correspond to the needs of labor markets as students having a chance to get real experience by

working at the actual workplace. (2) business owners get efficient staff that meet the needs and budget-wise costs in which specific tasks are transmitted directly to trainees. And thus, business owners the trainees working results to design workforce selection framework in the future (3) students have the opportunity to work in the real workplace, develop teamwork skills, communication skills, interpersonal relationship skills, and awareness of self-development in their career path and professional skills (Homanek, et al., 2017; Abeysekera, 2006)

Therefore, Work Integrated Learning (WIL) Approach should be embedded in the curriculum and functioning as one of the subjects in the program. WIL offers a learning experience in which students learn and expose to real-life work experience and students can attain true content knowledge from hands-on experience. Students are able to develop skills to handle various tasks from real working environment at the workplace while participating in WIL project. In addition, WIL promotes collaboration between higher education institutions and entrepreneurs which offers an opportunity for the involved parties in building connection and co-working in considering advantages and disadvantages of the course management in order to better develop the curriculum (Homanek, et al., 2017)

Objective

To develop the Bachelor of Science on Innovative Technology Machinery Program a using model of integrated instructional with a working.

Methodology

The following procedures were designed for methodology in the research on The Development of Bachelor of Science in Innovative Technology Machinery Based on WIL Model.

1. Building Network

The processes of networking with workplaces were the following.

1. Lecturers in charge of the program coordinated with related persons

1.1 Four external experts whose qualifications related to the program from two universities i.e. Kalasin University and Rajamangala University of Technology Isan

1.2 Executives from 4 workplaces i.e. Jinjiang Group Co., Ltd., Sarach Marketing Co., Ltd., Partnership and STS Concrete Center Ltd, Partnership

2. Composed the letter contacting the workplace
3. Waited for response from the workplace
4. Lecturers in charge of the program embarked on job shadowing with the workplace

1. Curriculum Development

Steps for curriculum design (TQF 2) were the following.

1. Studying and analyzing the curriculum

- General information of community, education background, economy, industry, career etc.
- Analyzing university potentials e.g. lecturers in charge of program, budget, equipment, and supporting devices etc.

2. Drafting the curriculum

- Program objectives, structure, instructional management, assessment and evaluation
- Thai Qualifications Framework for Bachelor Degree A.D. 2015

3. Curriculum Quality Assurance

- Curriculum critique by lecturers and external experts and executives from workplaces

- Reviewing by university committees e.g. academic forum, faculty administration committees, faculty committees, academic council, and university council

4. Curriculum Implementation

Results

Bachelor of Science in Innovative Technology Machinery A.D. 2020 was developed by improving the original curriculum (B.Sc. Agricultural Machinery) which involved synthesizing the needs of the workplaces and adopted Work Integrate Learning (WIL) Approach. The results of the curriculum development consisted of the vision for producing quality graduates and developing quality workforce, in line with the standards and corresponding to the needs of the labor market, society, and country. The aim of the course is to develop the graduates' characteristics which constitute knowledge and skills in careers that correspond with the needs of entrepreneurs and the labor market.

The course structure consists of general education courses 30 credits, major courses 86 credits (compulsory major group 77 credits and elective major group 9 credits) and elective courses 6 credits, a total of 122 credits. The guidelines for instructional management rely on Work Integrated Learning (WIL) Approach promoting skilled competence, techniques and technology for quality and excellence in corresponding to National Education Standards and the National Education Plan, the needs of labor market and self-employed career choice in the future. The researchers designed the curriculum directly from the needs of users. The expectations of the course when students complete each academic year were outlined in Table 1.

Table 1 Expected outcome of the curriculum when students finish their study each academic year

Years of Education	Expected outcome of the curriculum
1	1. Students show discipline, punctuality, respect to the rules and regulations of the organization. 2. Students are able to explain principles and theories, and apply theories to mechanical works. 3. Students acquire scientific and technological thinking skills in machinery to successfully solve problems in their professions. 4. Students show interpersonal relationship in working with others without conflict. 5. Students are able to apply mathematical and statistical knowledge in analysis and processing for solving problems and presenting the information accurately.
2	1. Students can adapt to the culture of the organization, show honesty and sacrifice for the common good. 2. Students can analyze and solve problems by applying technology and tools efficiently according to the situation. 3. Students are able to think critically by applying knowledge in real situations. 4. Students acquire adequate life skills and able to live life in a new age happily according to social rules. 5. Students are able to use information technology to search, collect, design information and machines appropriately for the machinery industry.
3	1. Students are able to comply with customer conditions, refrain from taking advantage of others and society, show responsibility, know how to self-management, people management, and work management. 2. Students acquire job competency and professional presentation skills. 3. Students are able to analyze and summarize problems that occur in real situations correctly based on academic principles. 4. Students are responsible, committed to overcome obstacles, and willing to feedback in seeking solutions to the problems. 5. Students are equipped with communication competence, understand commands from supervisors, implement correctly, completely, and achieve the requirements.

Years of Education	Expected outcome of the curriculum
4	1. Students acquire morality, ethics, code of conduct, public mind and awareness of the common good. 2. Students are able to develop and apply machines by integrating knowledge and skills for creation in real-life situations. 3. Students are able to expand their knowledge creatively for creation of mechanical innovation. 4. Students are able to show leadership and followership, teamwork with other people who hold different education, qualification, and experience backgrounds in order to achieve the desired goals. 5. Students acquire English language skills or other foreign languages for communication and presentation creatively.

The curriculum objectives were designed based on needs analysis about desirable characteristics of the graduates from the Innovative Technology Machinery Program which defined the graduate desirable characteristics as follows.

1. Equipped with morality, ethics, code of conduct, public mind and awareness of the common good.
2. Able to develop and apply machines by integrating knowledge and skills for creation in real-life situations.
3. Innovators competent in devising mechanical works.
4. Responsible, determined, holding leadership and followership, team working, possessing adequate life skills, and living happily in the organization and society.
5. Skilled in applying mathematical knowledge, science and information technology for creative communication and presentation.

The course structure, in overall, demonstrates lower number of credits than the original curriculum due to the fact that content knowledge courses do not exist only in the university classes, but students will acquire knowledge and practical experience in the workplace from Year 3 and Year 4 in which the study plan is sectioned into modules as shown Table 2.

Table 2 Study plan of Bachelor of Science in Innovative Technology Machinery Based on WIL Model

Year	Semester 1	credit	Semester 2	credit	Summer semester (if have)	credit
1	General Education Course 1	3(2-2-5)	General Education Course 3	3(2-2-5)	Pre-course experience	-
	General Education Course 2	3(2-2-5)	General Education Course 4	3(2-2-5)		
	Basic Chemistry	3(3-0-6)	General Education Course 5	3(2-2-5)		
	Basic Chemistry Laboratory	1(0-2-1)	Innovation and Technology	3(2-2-5)		
	Fundamental Physics	3(3-0-6)	Basic Electrical and Electronics	3(2-2-5)		
	Fundamental Physics Laboratory	1(0-2-1)	Mathematics for Machinery 2	3(2-2-5)		
			Technical English for Machinery 2	3(2-2-5)		
	Mathematics for Machinery 1	3(2-2-5)				
	Technical English for Machinery 1	3(2-2-5)				
	Basic Machinery	3(2-2-5)				
	Total	23	Total	21		
2	General Education Course 6	3(2-2-5)	General Education Course 9	3(2-2-5)		
	General Education Course 7	3(2-2-5)	General Education Course 10	3(2-2-5)		
	General Education Course 8	3(2-2-5)	Power for Machinery	3(2-2-5)		
	Mechanics of Machinery	3(2-2-5)	Hydraulic and Pneumatic System	3(2-2-5)		
	Selected Major Course 1	3(2-2-5)	Machinery and Elements	3(2-2-5)		
	Selected Major Course 2	3(2-2-5)	Selected Major Course 3	3(2-2-5)		
	Free Elective Course 1	3(x-x-x)	Free Elective Course 2	3(x-x-x)		
	Total	21	Total	21		

Year	Semester 1	credit	Semester 2	credit	Summer semester (if have)	credit
3	Module (Basic mechanical work and mechanical drawing)		Module (Mechanical design practice)		Field Experience (WIL)	3(0-40-0)
	Principles of Mechanics (WIL)	3(0-6-3)	Machinery Design (WIL)	3(0-6-3)		
	Machinery Drawing (WIL)	3(0-6-3)	Machinery Laboratory 2 (WIL)	3(0-6-3)		
	Machinery Laboratory 1 (WIL)	3(0-6-3)				
	Practicum / Work-based learning		Practicum / Problem-based learning		Practicum	
	Total	9	Total	6	Total	3
4	Module (Operation of maintenance and environmental management of machinery)		Module (Machinery innovation operation)			
	Machinery Maintenance (WIL)	3(0-6-3)	Industrial Management (WIL)	3(0-6-3)		
	Environmental Management (WIL)	3(0-6-3)	Project in Machinery (WIL)	3(0-9-0)		
	Machinery Laboratory 3 (WIL)	3(0-6-3)	Machinery Laboratory 4 (WIL)	3(0-6-3)		
	Practicum / Problem-based learning		Practicum / Problem-based learning			
	Total	9	Total	9		

Total credits 122 credits

Discussion

The analysis on current conditions, consulting and meeting with stakeholders revealed that businesses adopt policy to support the Innovative Technology Machinery Program due to the fact that businesses viewed that Rajabhat Maha Sarakham University is equipped with key mechanisms in the development of Work Integrated Learning (WIL) program with the industries. The university focuses on building networks under in the 12th National Economic and Social Development Plan (2017-2021) that promotes cooperation in all sectors which is also in line with the country's education policy to drive innovation with Thailand 4.0 scheme in order to uplift Thailand from

the current position to high-income country driven by the economic growth. This movements underscore changing the future product formats and industrial technology to function as key mechanisms for driving the country's economy. There are 4 industries participating in WIL with the Innovative Technology Machinery Program i.e. 1), Partnership - manufacturing mechanical parts business 2) Jinjiang Group Co., Ltd. - production of alternative energy from waste materials business 3) Sarach Marketing Co., Ltd. - tamarind snacks business and 4) STS Concrete Center Ltd, Partnership - construction and environmental-related business.

The TQF 2 design involved different working stages, that is, a small group meeting in the program, faculty meeting, academic seminar, and curriculum critique. It was found that the course arrangement should start from simple courses or basic courses to more complex courses or courses relevant to the profession. The courses offered to students in each semester should be related or supportive to each other for the benefits in the job as well as concurrent with the type of WIL Model continuously throughout the course which conform to learning for working and working for learning. From Table 2 , students will be enrolled in General Education Courses and Fundamental Courses in Year 1, but Summer Semester is reserved for WIL program based on Pre-course experience model in order to build motivation in learning and understanding the working conditions in the future upon graduation. Year 2 is a continuation of General Education Courses and Foundation Courses along with the chosen Major Courses that interest the students. Year 3-4 enter into WIL program by modules that correspond with the enrolled courses in each semester i.e. 1) Basic mechanics and mechanical drawing 2) Mechanical design 3) Maintenance and mechanical environment management 4) Innovative machinery.

Conclusion

The Work Integrated Learning in Innovative Technology Machinery Program is designed to meet with the needs of the society by integrating the curriculum design with 4 industries. The curriculum is aimed to produce graduates who are ready to work in the job market. The WIL program nurtures the students with skills and experiences for knowledge application, utilizing job skills and specific skills relevant to the

profession, and getting to know the real working life before graduation. This kind of collaboration benefits the development of learning resources in real conditions and this curriculum development answers the country's policy in accelerating the development of resources in the country to keep up with future social changes. There are 4 industries participating in WIL with the Innovative Technology Machinery Program i.e. 1) Jinjiang Group Co., Ltd., 2) Sarach Marketing Co., Ltd., 3), Partnership and 4) STS Concrete Center Ltd, Partnership

The curriculum development based on WIL Approach must begin from determination of learning outcomes that need to implant into the students. After, learning assessment and learning plans are designed by selecting the right integration with work appropriate for the learning outcomes and evaluation guidelines by means of modules that are consistent with the courses in each semester as follows: 1) Basic mechanics and mechanical drawing 2) Mechanical design 3) Maintenance and mechanical environment management 4) Innovative machinery.

The learning outcomes conform to the learning outcomes that need to develop students in real conditions. The learning outcomes of the Innovative Technology Machinery comprise 5 areas: 1) Morality, Ethics 2) Knowledge 3) Cognitive Skills 4) Interpersonal Skills and Responsibilities and 5) Numerical Analysis, Communication and Information Technology Skills.

Recommendations

1. Recommendations for Application

1.1. The WIL curriculum focuses on the student's learning outcomes rather than the process. The learning process focuses on individual differences of students with an emphasis on learning outcomes of learners that directly meet the needs of graduate users. The WIL concentrate on producing different learning outcomes in the same group of students rather than production of ideal graduates which is unable to actually meet the needs of labor market.

1. 2. The WIL curriculum does not conform to fixed instructional model. Therefore, teaching and learning can be adjusted at any time in order to keep up with changes in the global society and technological progress. The setup of criteria or requirements to control or determine others to follow may deter the country development and obstruct the competitive advantage of Thailand against other countries.

2. Recommendations for Further Study

The future study should focus on a research on the follow-up of WIL program evaluation in overview.

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