Curriculum Evaluation of Bachelor's Degree in Network Engineering at Sichuan University of Science & Engineering

NanYang Xiang,
Rossarin Jermtaisong and Puripun Lert-o-pas
Rajamangala University of Technology Thanyaburi, Thailand
Corresponding Author, E-mail: rossarin_j@rmutt.ac.th

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Abstracts

The objectives of this research were to evaluate the curriculum of a bachelor's degree in Network Engineering at Sichuan University of Science & Engineering. The curriculum was evaluated by implementing the CIPP model emphasizing context, inputs, processes, and outcomes on Stufflebeam's decision-making approach. The research sample consisted of 353 people, selected by purposive random sampling, and divided into 5 groups: 19 administrators, 24 instructors, 230 students, 40 undergraduates, and 40 employers. The instrument was a questionnaire. Mean, standard deviation, and percentage were used for data analysis. The findings were as follows: 1) The opinions of administrators, instructors, students, graduate students, and employers toward a bachelor's degree in Network Engineering at Sichuan University of Science & Engineering were at a high level in all aspects and sorted in descending order as follows: process ($\overline{x}$ =4.12), input ($\overline{x}$ =4.02), product ($\overline{x}$ =4.01) and context ($\overline{x}$ =3.97). 2) Considering over aspects, it was found that: 2.1) All contexts were at a high level and ranked from the highest mean respectively: subject content, curriculum composition, curriculum construction, and curriculum objective. 2.2) All inputs were at a high level and ranked from the highest mean respectively: budget and facility, administrator, learning materials, instructor, and curriculum objective. 2.3) All processes were at a high level and ranked from the highest mean respectively: measurement, evaluation, and learning management. 2.4) All products were at a high level and ranked from the highest mean respectively: knowledge, emotions, attitudes, values, and skill.

Keywords: Curriculum Evaluation; Bachelor's Degree; Network Engineering

Introduction

Network technology emerged in the 1960s. After decades of rapid development, it has penetrated the methodology of human life and become the key technology connecting every corner of the world, driving the progress of the information age and leading the direction of future development. Network engineering is one of the most important engineering majors developed by the new generation of information technology. The major of network engineering integrates network design, planning, construction, and application. It is a major with good technical depth and wide application prospects. In 2012, the major of network engineering appeared in the Catalogue of Undergraduate Majors of Colleges and Universities issued by the Ministry of Education, China (2012 : onlne).

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In the year 2018, as a guideline for the college to integrate closely with the national strategy in dealing with new technological revolutions and industrial revolutions, new opportunities, and accelerating new engineering constructions, the Ministry of Education, Ministry of Industry and Information Technology, Chinese Academy of Engineering jointly issued "Accelerating the Creation and Development of New Engineering Application Feedback Studies" to promote the development of higher quality engineering education and cultivate outstanding Engineering Plan 2.0.

In 2020, the Sichuan Provincial Department of Education (2020 : online) and the Department of Economy and Information Technology decided to implement the Sichuan Provincial Excellent Engineer Education and Training Program 2.0. The university will take the construction of new engineering as an important starting point, arrange the training of talents in strategic fields necessary for the future, accelerate the training of high-quality engineering talents with strong innovation ability, and meet the needs of economic and social development, and promote higher engineering education. To promote the high-quality development of higher engineering education, the university will provide strong intellectual and talent support for the development of China's industry, the rise of the nation, and the development of Sichuan to a new level. Sichuan Provincial Education Department implemented an excellent engineering education training program for computer science and network technology by deploying the Fundamental Network Engineering Theory, Basic Skills in Network Communication Systems, Planning and Design in Network Engineering, Network Security, Network Programming, Network Communication Technology, Research and Development, Network System Integration, Commissioning, Maintenance, Management and Application, Network Application Development, and Preliminary of Engineering Capabilities into Sichuan Institute of Light Industry and Chemistry. Then, Network Engineering was also launched. Due to the process of information construction will also be faster and faster, computer network engineering is combined closely with computer technology and communication technology to form emerging technologies, especially in today's rapid development of the internet. As the network is under the circumstances of booming development, Network Engineering Technology has become one of the hot technologies in Information Technology. It is widely used in the rapid development of the information society. It also has a comprehensive discipline. By 2021, more than 400 colleges and universities in China have launched the field of Network Engineering, with nearly 50,000 students enrolled. Many outstanding professionals
in the country have been trained in the Network Engineering Course of Sichuan Institute of Light Chemical Technology.

The curriculum is a core component of talent training and the consequences of any education and teaching reform and it should eventually be used in the course. Otherwise, it will not produce significant results since the quality of course creation determines the level of professional creation and ultimately determines the quality of talent training (Li, X, 2021 : online). Taylor, a well-known American educationalist and curriculum theorist, is renowned as the "father of curriculum evaluation." He claims that assessing a curriculum entails determining how effectively a lesson plan and curriculum correspond with educational objectives. On the other hand, Bach argued that the purpose of curriculum evaluation is to gather data and utilize it to guide judgments about instructional strategies or curriculum designs. To lay the groundwork for curriculum reform or innovation, the execution of curriculum evaluation must highlight the benefits and drawbacks of curriculum programs or

plans. The field of education both theory and practice have given evaluation a lot of attention. A full educational process comprises educational objectives, educational activities, and educational evaluation.

The CIPP Model is an evaluation model that aims to assess specific programs to enhance the programs, especially the programs offered in education and human resources. (Nikijuluw, R. C, 2020 : 116-123). The CIPP evaluation model was developed by Stufflebeam, D. L. (1971 : 19-25). This model explains that the primary purpose of the evaluation is to obtain valuable information for decision-making. The second purpose is to enable an understanding of the program's strategy. The approach of the model is based on two main assumptions. The first assumption is that evaluation plays a significant role in stimulating and planning changes, while the second assumption is a complementary element to general institutions' programs (James, W., 1993 : 1). So the CIPP model takes adjustment and improvement for evaluation purposes. The ultimate goal of the model is to improve the teaching quality of the curriculum to promote the common development of the curriculum, along with teachers, and students. This study evaluates the curriculum of a bachelor's degree in Network Engineering at Sichuan University of Science & Engineering using the CIPP model.

Research Objectives

To evaluate the curriculum of the bachelor's degree in Network Engineering at Sichuan University of Science & Engineering using the CIPP model focusing on aspects of context, input, process, and product.

Research Methodology

The curriculum evaluation of the bachelor's degree in Network Engineering at Sichuan University of Science & Engineering using the CIPP model focuses on the following: 1) Context evaluation (C): The context evaluation is the evaluation of the objective or the aims of the curriculum that are consistent with the policy, curriculum philosophy, faculty, university, and the needs of society towards the curriculum. 2) Input evaluation (I): Input evaluation is the evaluation of factors leading to the teaching and learning process in which it looks like including the appropriateness of the teaching and learning process. 3) Process evaluation (P): Process evaluation is the evaluation of the instructional process, teaching materials, measurement, and the implementation of the set plan. 4) Product evaluation (P): Product evaluation is the evaluation of curriculum outcomes involved in effectiveness and instructional problems. The details of the research methodology are as follows:

1. Population and Sample: The population in this study were 5 groups of 699 people involved in bachelor's degree in Network Engineering at Sichuan University of Science & Engineering namely: 20 administrators, 30 instructors, 533 students, 46 undergraduates, and 46 employers. The sample was selected by purposive sampling consisting of 5 groups, 353 people, involved in bachelor's degree in Network Engineering at Sichuan University of Science & Engineering namely: 19 administrators, 24 instructors, 230 students, 40 undergraduates, and 40 employers.

2. Instrument: The research instruments were classified into various types of questionnaires used for curriculum evaluation of a bachelor's degree in Network Engineering at Sichuan University of Science & Engineering with details as follows:

1) Questionnaire for administrators, instructors, students, and undergraduates in the curriculum of bachelor's degree in Network Engineering at Sichuan University of Science & Engineering using the CIPP model focusing on aspects of context, input, process, and product. The questionnaire in parts 1-5 is a rating scale divided into five grades from the lowest to the highest with open-ended questions for suggestions. This questionnaire is divided into 5 parts: art 1: The general personal information, Part 2: IContext information Part 3: Information on inputs, Part 4 Information on the process, and Part 5: Information on the product. IOC (Index of Item Objective Congruence) of the questionnaire for administrators was equal to 1.00 and Cronbach's alpha coefficient showed the questionnaire reliability for administrators was 0.975, for instructors was 0.978, for students was 0.994, and for undergraduates was 0.973.

2) Questionnaire for employers involved in the curriculum of bachelor's degree in Network Engineering at Sichuan University of Science & Engineering using the CIPP model focusing on aspects of context, input, process, and product. The questionnaire parts 1-2 is a rating scale divided into five grades from the lowest to the highest with open-ended questions for suggestions. This questionnaire is divided into 2 parts as follows: Part 1: The general personal information, Part 2: Information about the product. IOC (Index of Item Objective Congruence) of a questionnaire for administrators was 1.00 and Cronbach's alpha coefficient showed the reliability of the questionnaire was 0.968.

4. Data Collection: This research data is used to evaluate the professional curriculum of preschool educators. The researchers have done the following:

1) Contact the graduate office of the Faculty of Technical Education, Rajamangala University of Technology Thanyaburi, to write a letter of request for data collection permission.

2) Contact the Dean, Head Department, and Head of the bachelor's degree in Network Engineering at Sichuan University of Science & Engineering, for assistance and cooperation to collect data from the sample.

3) After determining the time, the researcher collected questionnaires from the sample group.

4) Data analysis and summary.

5. Data analysis

1) Quality analysis of the Item Objective Congruence (IOC) is used to analyze the effectiveness of curriculum evaluation. A questionnaire and structured interview were used. Cronbach Alpha Coefficient was deployed for the reliability of the questionnaire and the structured interview.

2) Analysis of hypothesis testing:

2.1) Criteria estimation assessment scale of a questionnaire. The assessment criteria are as follows: 5 means having the highest level of opinion, 4 means having a high level of opinion, 3 means having a moderate level of opinion, 2 means having a low level of opinion,1 means having the lowest level of opinion.

2.2) Interpretation of the results is considered over the average score of the midpoint as follows: An average score of 4.21 – 5.00 means that the opinion is at the highest level,An average score of 3.41 – 4.20 means that there is a high level of opinion,An average score of 2.61 - 3.40 means that the opinions are at a moderate level, An average score of 1.81 – 2.60 means that there is a low level of opinion, An average score of 1.00 – 1.80 means that the opinion is at the lowest level.

Research Conceptual Framework

The framework below shows the researcher's guide of the study:

The curriculum evaluation of t bachelor's degree in Network Engineering at Sichuan University of Science & Engineering using the CIPP model			
Context evaluation (C)	**Input evaluation (I)**	**Process evaluation (P)**	**Product evaluation (P)**
- curriculum component - curriculum objectives - curriculum structure - course content	- qualifications of administrators - qualifications of instructors - qualifications of student - learning materials - building and budget	- curriculum management - learning management - measurement and evaluation	- knowledge - skills - emotional attitudinal value aspects

Figure 1 Conceptual Research Framework

Research Results

1. The curriculum analysis results in an overall evaluation of the bachelor's degree in Network Engineering focusing on aspects of context, input, process, and product.

The curriculum analysis results in an overall evaluation of the bachelor's degree in network engineering, focusing on aspects of context, input, process, and product as classified by administrations, instructors, students, graduate students, and employers. Also presented in Table 1 and Figure 2.

Table 1 Mean and level of overall curriculum evaluation focusing on aspects of context, input, process, and product.

CIPP model	Context		Input		Process		Product	
	Mean	**Level**	**Mean**	**Level**	**Mean**	**Level**	**Mean**	**Level**
Administrations	3.92	highly agree	4.01	highly agree	4.01	highly agree	3.96	high agree
Instructor	4.04	highly agree	4.03	highly agree	4.01	highly agree	4.03	high agree
Students	3.95	highly agree	4.08	highly agree	4.03	highly agree	4.06	high agree
Undergraduates	3.99	highly agree	3.98	highly agree	4.00	highly agree	3.99	high agree
Employer	-	-	-	-	-	-	4.03	highly agree

Total	**3.97**	**highly agree**	**4.02**	**highly agree**	**4.12**	**highly agree**	**4.01**	**highly agree**

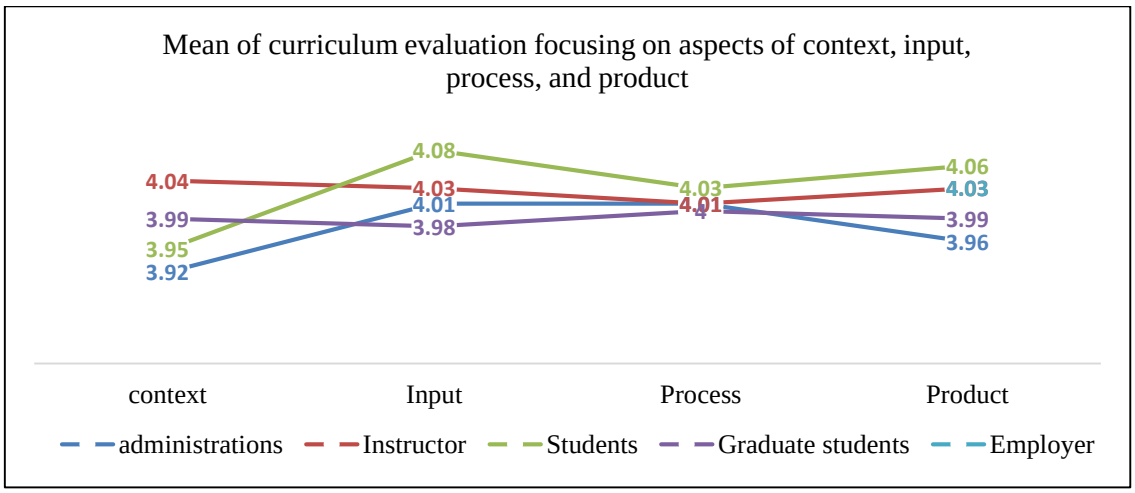

Figure 2 Mean of overall curriculum evaluation focusing on aspects of context, input, process, and product.

From Table 1 and Figure 2, it was found that the opinions of instructors, administrations, students, undergraduates, and employers toward the bachelor's degree in Network Engineering were at a high level sorted from the highest mean in order as follows: process($\bar{x}$ =4.12), input ($\bar{x}$ =4.02), product ($\bar{x}$ =4.01) and context ($\bar{x}$ =3.97).

2. The analysis results evaluate the curriculum of the bachelor's degree in network engineering, focusing, on aspects of context.

The analysis results of the bachelor's degree curriculum in Network Engineering focused on aspects of context (curriculum component, curriculum objectives, curriculum structure, and course content) as classified by administrations, instructors, students, and undergraduates. These results are also presented in Table 3.

Table 3 Mean and level of curriculum evaluation focusing on aspects of context.

Context	**Curriculum Component**			**Curriculum objectives**			**Curriculum structure**			**Course content**		
	Mean	**Level**	**No**	**Mean**	**Level**	**No**	**Mean**	**Level**	**No**	**Mean**	**Level**	**No**
Administrations	3.95	highly agree	2	3.82	highly agree	3	3.78	highly agree	4	4.11	highly agree	1
Instructor	3.97	highly agree	3	4.00	highly agree	2	4.10	highly agree	1	4.10	highly agree	1
Students	3.90	highly agree	3	3.90	highly agree	3	3.97	highly agree	2	4.00	highly agree	1
Under graduates	4.03	highly agree	1	3.97	highly agree	3	4.00	highly agree	2	4.00	highly agree	2
Total	3.96	highly agree	2	3.92	highly agree	3	3.96	highly agree	2	4.05	highly agree	1

From Table 3, it was found that the opinions of administrations, instructors, students, and graduate students toward the bachelor's degree in Network Engineering curriculum in the overall context were at a high level, sorted from the highest mean in order as follows: course content (= 4.05), component curriculum (= 3.96), curriculum structure (= 3.96), and curriculum objectives (= 3.92).

3. The analysis results evaluate the curriculum of the bachelor's degree in network engineering, focusing on aspects of input.

The analysis results evaluate the curriculum of the bachelor's degree in Network Engineering focusing on aspects of input (instructors, administrators, students, learning materials, budget, and building) classified by administrations, instructors, students, and undergraduates. Also presents Table 4.

Table 4 Mean and level of curriculum evaluation focusing on aspects of input.

Input	Qualifications of Instructors			Qualifications of Administrators			Qualifications of Students			Learning Materials			Budget and Building		
	Mean	**Level**	**No**	**Mean**	**Level**	**No**	**Mean**	**Level**	**No**	**Mean**	**Level**	**No**	**Mean**	**Level**	**No**
administrations	4.01	highly agree	3	4.04	highly agree	2	3.96	highly agree	4	3.96	highly agree	4	4.08	highly agree	1
Instructor	3.96	highly agree	5	4.06	highly agree	3	4.08	highly agree	2	4.03	highly agree	4	4.11	highly agree	1
Students	4.07	highly agree	3	4.01	highly agree	4	3.96	highly agree	5	4.13	highly agree	2	4.15	highly agree	1
Undergraduates	3.92	highly agree	5	4.08	highly agree	1	3.95	highly agree	4	4.04	highly agree	2	4.05	highly agree	3
Total	**3.99**	**highly agree**	**3**	**4.04**	**highly agree**	**2**	**3.98**	**highly agree**	**4**	**4.04**	**highly agree**	**2**	**4.09**	**highly agree**	**1**

From Table 4, it was found that the opinions of administrations, instructors, students, and graduate students toward the bachelor's degree in Network Engineering at Sichuan University of Science & Engineering curriculum overall on context were at a high level sorted from the highest mean in order as follows: Budget and Building ($\bar{x}$ =4.09), Qualifications of Administrators ($\bar{x}$ =4.04), Learning Materials ($\bar{x}$ =4.04), Qualifications of Instructors ($\bar{x}$ =3.99), and Qualifications of Students ($\bar{x}$ =3.98).

4. The analysis results evaluate the curriculum of the bachelor's degree in Network Engineering focusing on aspects of the process.

The analysis results evaluate the curriculum of the bachelor's degree in network engineering, focusing, on aspects of the process (curriculum management, learning management, and measurement and evaluation. Also presents Table 5.

Table 5 Mean and level of curriculum evaluation focusing on aspects of the process.

Process	Curriculum Management			Learning Management			Measurement and Evaluation		
	Mean	Level	No	Mean	Level	No	Mean	Level	No
Administrations	4.00	highly agree	2	4.00	highly agree	2	4.05	highly agree	1
Instructor	4.02	highly agree	2	4.03	highly agree	1	3.98	highly agree	3
Students	4.09	highly agree	3	4.13	highly agree	2	4.25	highly agree	1
Undergraduates	3.97	highly agree	2	3.97	highly agree	2	4.05	highly agree	1
Total	**3.99**	**highly agree**	**3**	**4.03**	**highly agree**	**2**	**4.08**	**highly agree**	**1**

From Table 5, it was found that the opinions of administrations, instructors, students, and graduate students toward the bachelor's degree in Network Engineering at Sichuan University of Science and Engineering curriculum overall were at a high level, sorted from the highest mean in order as follows: measurement and evaluation ($\bar{x}$=4.08, S.D. =0.89), learning management ($\bar{x}$=4.03, S.D. =0.61), and curriculum management ($\bar{x}$=3.99, S.D. =0.68).

5. The analysis results evaluate the curriculum of the bachelor's degree in Network Engineering focusing on aspects of the product.

The analysis results evaluate the curriculum of the bachelor's degree in network engineering, focusing, on aspects of the product (knowledge, skills, and emotional attitudinal value aspects) classified by administrations, instructors, students, graduate students, and employers. Also presents Table 6.

Table 6 Mean and curriculum evaluation level focusing on product aspects.

Product	Knowledge			Skills			Emotional, Attitudinal, and Value Aspects		
	Mean	**Level**	**No**	**Mean**	**Level**	**No**	**Mean**	**Level**	**No**
Administrations	4.00	highly agree	1	3.86	highly agree	3	3.98	highly agree	2
Instructors	4.02	highly agree	2	3.94	highly agree	3	4.09	highly agree	1
Students	4.08	highly agree	1	3.96	highly agree	3	4.05	highly agree	2
Undergraduates	4.01	highly agree	1	3.99	highly agree	2	3.96	highly agree	3
Employers	4.15	highly agree	1	4.07	highly agree	2	3.94	highly agree	3
Total	**4.05**	**highly agree**	**1**	**3.96**	**highly agree**	**3**	**4.00**	**highly agree**	**2**

From Table 6, it was found that the opinions of administrations, instructors, students, and undergraduates toward the bachelor's degree in Network Engineering at Sichuan University of Science and Engineering curriculum overall were at a high level, sorted from the highest mean in order as follows: knowledge ($\bar{x}$=4.05), emotional, attitudinal, and value aspects ($\bar{x}$=4.00), and skills ($\bar{x}$=3.96).

Discussion

1. The results of the curriculum evaluation found that the context aspects were appropriate at a high level, input factors were appropriate at a high level, processes were appropriate at a high level, and outputs were appropriate at a high level. Overall, four aspects were appropriate at a high level There is clear and appropriate curriculum planning with good and systematic curriculum management. Consequently, effective curriculum operations and the curriculum developed are able to fully respond to the needs of society, agencies, and educational personnel. These findings are consistent with the study by Duan, D. Y. (2017:42-59), which used the CIPP model to evaluate an all-English undergraduate program at University H. The model proved to be generally appropriate due to the clarity and appropriateness of the course management plan, which promoted effective learning outcomes and improved the quality of course management. Similarly, a study by Liu, M. D. and Zhang, Y. M. (2023:127-134) evaluated a Master of Education program and developed an evaluation system for a hybrid teaching model based on the CIPP evaluation model. A study by Wang, Q. and Liang, L. (2021: 25-32) also found high suitability of using the CIPP model for evaluating curriculum development. The study evaluated the implementation of a new curriculum for a university English course in China and found that the CIPP model provided a comprehensive and systematic evaluation of the curriculum, with all four dimensions - context, input, process, and product - being evaluated as highest level. It was found that the overall and individual product aspects are appropriate at the highest level.

2. The context is appropriate at a high level, probably due to the curriculum set. There is a process to develop and improve the curriculum according to standard criteria. The curriculum development process requires analyzing fundamental data in various fields to determine the various components of the curriculum to produce satisfactory results for users (Taba, H., 1962:53). As a result, the context assessment was appropriate at a high level. This is in line with the concept of (Tanner, D. and Tanner, L., 2018:9) who studied the consistency of the objectives, structure, and content of the curriculum and subjects is important for assessment. Consistent with the research of (Jiang, G.Y., 2007: 10-12) has conducted a study on the evaluation and development of the Doctor of Education curriculum. Department of Educational Research and Evaluation, Faculty of Education, Kasetsart University, found that the input factors were satisfied at a high level. The opinions of the instructors show that 1) the learning environment, supporting things such as buildings, equipment, and learning media, and 2) the instructors are adequate and appropriate.

3. The input aspect was appropriate at a high level since there were many qualified teachers responsible for the curriculum. In addition, buildings and budgets also supported educational management. As a result, the results of the assessment of input factors were appropriate at a high level. This is in line with the concept of Pirak, B. (2011:86-90), who found that input aspect are appropriate at a high level, and by the research of Saran, L. (2009: 65–66),

who found that learning media and teaching were appropriate at a high level, The teaching and learning materials were appropriate and consistent with the course objectives.

4. The process aspect is appropriate at a high level. The curriculum has curriculum administration according to the system and mechanisms for curriculum operations, as well as a variety of learning activities. This is in line with the curriculum implementation process, which is one of the curriculum development systems to achieve the specified curriculum goals and resulted in the process evaluation results appropriate at a high level. This is consistent with the research of Wilasinee, P., and Prasart, N. (2019: 411-422) who studied the evaluation master degreein Geo-Informatics (improvement version2017), Faculty of informatics, Mahasarakham University by employing CIPP mode. It was found that overall of processes wereshowed highlevel,curriculum advisory board,current students, graduates and employer express their percentage opinion at high level.

5. The product was appropriate at a high level, probably due to the students. According to the concept of Stufflebeam, D. and Shinkfield, A. (2007: 81- 94) that the evaluation of the production is to check if the results that occur to the learners are by how much you expect. According to the research of Srinonyang, P., et al**.,** (2020:182-194) who studied the evaluation for Bachelor of education program in teaching english (5years) (Revised curriculum B.E. 2556), Faculty of education, Mahamakut Buddhist University. It was found that the satisfaction of undergraduate users with TQF-based undergraduate quality was also found to be at a high level

In conclusion, the curriculum evaluation of a bachelor's degree in Network Engineering at Sichuan University of Science and Engineering showed its value and accountability by its objectives. A further implementation of the curriculum was recommended on the condition that some items should be improved.

Recommendations

1. **Recommendations for applying the research results**

1) The curriculum of the bachelor's degree in Network Engineering at Sichuan University of Science and Engineering should consider the results of the curriculum evaluation by adjusting the curriculum details in the next round and adding in the parts that are less average than other aspects.

2) Evaluation of the curriculum can be considered an essential step in its curriculum development and should be assessed periodically. This will help reduce problems that may arise when curriculum implementation.

3) Every 5 years of curriculum evaluation, it makes them comprehend the characteristics of the curriculum, not only strengths but also weaknesses which would be a guideline for curriculum improvement.

2. Recommendations for future research

For further research, the topic should focus on:

1) Curriculum evaluation using other assessment formats such as CIPPIEST, CIPPO, CIPPI.

2) Study curriculum evaluation using mixed methods.

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