CHAPTER III

METHODOLOGY

The study framework was based on the concept of complete needs assessment. There were 3 phases which were 1) competency needs identification, by identifying the expected pharmacy competency and the actual pharmacy competency levels, as well as identifying the pharmacy competency needs of the graduates 2) competency needs analysis, to study the factor of curriculum contents that affected the competency needs and 3) competency needs solution, to identify the pharmacy curriculum contents that respond to the required pharmacy competency of the graduates. The procedure for the first phase was a survey by using questionnaire and for the second phase was the comparison needs identification with literature review. The last phase was competency needs solution which was pharmacy curriculum design using QFD.

Phase I Competency Needs Identification

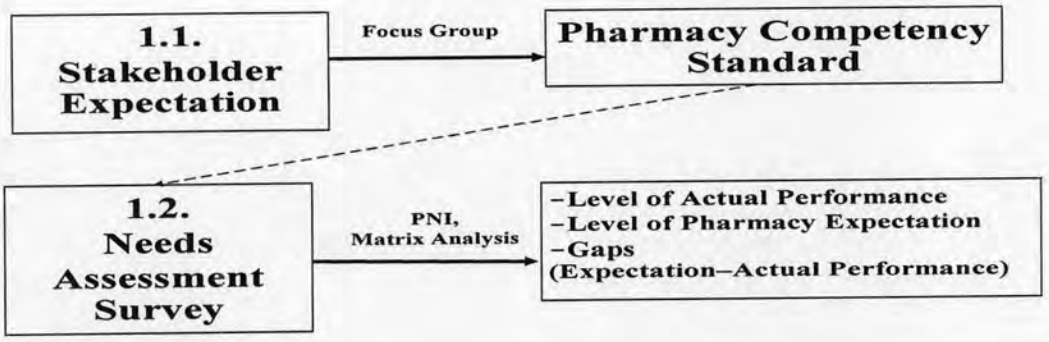

Figure 3.1 Competency needs identification process

1. **Identification of the Pharmacy Competency Expectation**

In order to design the pharmacy curriculum, the expectation of pharmacy undergraduate competencies should be determined. In this study, the CU pharmacy competency standard was used as the indicator for assessing the pharmacy student competency. The CU pharmacy standard was developed from the Pharmacy Practice

Activity Classification (PPAC), professionalism concepts and general pharmacy abilities by the Faculty of Pharmaceutical Sciences, Chulalongkorn University staff.

This CU pharmacy competency standard was fine-tuned by the view points of pharmacy practitioners in order to get the appropriate pharmacy competency for this study. The focus group technique was used for adjusting the new pharmacy competency standard. Three focus groups were conducted for validating the draft of new pharmacy competency standard at the Faculty of Pharmaceutical Science, at Chulalongkorn University. The first focus group consisted of ten participants from pharmaceutical companies and pharmacy faculty members. The discussion topic in the first group was concentrated on pharmaceutical technology competency. There were ten participants from hospital pharmacists, community pharmacists, and faculty members in the second focus group session. The discussion about clinical pharmacy competency was conducted in this second focus group. The last focus group session aimed at discussing about the social and administrative pharmacy competency. The members of the last focus group consisted of ten participants who are the faculty's members specialized in social and administrative pharmacy and pharmacists working in the Thai FDA.

In the process of focus group discussion, the moderators leaded the discussions using the CU pharmacy competency standard created by the faculty members. The discussions were audio-recorded and transcribed by the note takers. The CU pharmacy competency standard was evaluated and adjusted to be the new CU pharmacy competency standard for using in this study to develop pharmacy curriculum.

As for the new CU Pharmacy Competency Standard developed by the staff of faculties as aforementioned, the data was used as the input for the next step such as

1. In needs assessment survey: the pharmacy competency standards were adopted to develop the dual-response format questionnaire. There were 2 groups, which were pharmacy preceptors and clinical pharmacy students, whom answered questionnaires for assessing the pharmacy competency.

2. In needs analysis: pharmacy competency standards were the data led to the area 1.1 in HOQ matrix where it represented the needs of stakeholders towards the

curriculum. The pharmacy competency standard was adopted to design the contents by using QFD where Phase 3 was further mentioned in detail.

2. Needs Assessment Survey

Needs Assessment Survey aims to assess the pharmacy competency level of the pharmacy graduates at the actual competency level and expected competency level including the competency needs of pharmacy graduates to develop the pharmacy competency according to all pharmacy competency domains as specified in step 1.1 of Phase 1

The competency needs were determined by a survey method using a self-administered questionnaire. There were 2 needs assessments in the first phase of this study. The first survey was conducted to assess pharmacy student competency by pharmacy preceptors who were hospital pharmacists. The second survey was self-assessment by the fifth year pharmacy students. The assessment of expected competency and actual performance using the new pharmacy competency standard as the indicator were in the questionnaire. Then, the competency needs were calculated by comparing the expected competency and the actual performance. The data from these competency needs assessment surveys were used for supporting in pharmacy curriculum design in the next phase.

2.1 Population of Needs Assessment Survey

There were 2 study population in the needs assessment survey which were the fifth year pharmacy student from the clinical pharmacy track in the academic year 2007, Faculty of Pharmaceutical Sciences, Chulalongkorn University and pharmacy preceptors who had trained these clinical pharmacy students.

2.2 Needs Assessment Variables

Pharmacy competency was defined as the pharmacy graduates' skill or abilities to perform professional function. Pharmacy competency standard developed in the phase I was used to create items in questionnaire to find competency needs of pharmacy graduates. Main study variables in needs assessment survey were expectation competency, and actual performance.

1) Expectation competency

Expectation competency was the perception of pharmacists about what skills or abilities a pharmacy undergraduate ***should be able*** to perform at work.

2) Actual Performance

Actual Performance was the perception of pharmacists about what skills or abilities a pharmacy undergraduate ***can perform*** at work.

3) Competency needs of pharmacy graduates

It is defined as the discrepancy between expected pharmacy competency and his or her actual performance. The gaps of competencies used to identify prioritized competency problems.

4) Individual background characteristics

Individual background characteristics referred to the general information of the respondent such as gender, age, education level, the number of years after graduation, current profession field or field interested, and work position.

2.3 Questionnaire Development

The self-administered questionnaire was developed based on all activities across in the new CU pharmacy competency standard. It was developed in order to identify the expectation level and the actual performance of undergraduate pharmacy student competency. One questionnaire was sent to students. Students were asked to rate their actual performance and expectation of pharmacy undergraduate competencies. Another questionnaire was sent to pharmacy preceptors who the students practicing with. They were asked to rate students' actual performance and expectation of pharmacy undergraduate competencies. Both expectation and actual performance rating score were ranged from 1 (the lowest level) to 5 (the highest level). A pilot test of questionnaire was completed by 5 pharmacy preceptors and 5 pharmacy students. The clarity of wording and content of the questionnaire was assessed from the pilot test. The first session of questionnaire was the dual response which means the respondent have to do both parts of the pharmacy competency expectation and the actual performance which the pharmacy graduates were having. The second session was an opened-end question. The respondents were asked to rank the importance level of each pharmacy competency domains and to express any additional opinions about the strength and weakness of pharmacy curriculum.

<u>The example of the questionnaire sent to student</u>

Please specify the level of expected competencies and the level of the actual performance of yourselves. The competency level was measured with "1" representing "the lowest level", "2" representing "the low level", "3" representing

"the medium level", "4" representing "the high level", and "5" representing "the highest level".

Pharmacy Activities	Actual Performance					Expected competencies				
	5	4	3	2	1	5	4	3	2	1
Ability to interview the patient or patient's representative										
Ability to read the patients' medication history.										
Ability to communicate with the patient and the care givers.										

2.4 Data collection

The researcher collected data from 2 populations. The first questionnaire was distributed to the pharmacy preceptors who had trained the clinical pharmacy students. A questionnaire with a cover letter and stamped return envelope was mailed to pharmacy preceptors on 2 February, 2008. The last copy of questionnaire was received on 10 March, 2008. The second questionnaire was distributed to students to complete the questionnaire in the classroom on 12 September, 2008.

2.5 Data analysis

All statistical analyses were conducted using SPSS for Windows and Excel program. Data were analyzed by the three methods which were descriptive analysis, priority needs index (PNI), and matrix analysis.

1) Descriptive analysis

Descriptive statistics was performed to determine the general characteristics of the two groups of the samples. Means, standard deviation and distribution were calculated for the characteristics of the variables. Mean of expected competency and mean of actual performance were calculated. The competency level was measured by 5 point Likert's scale with "1" representing the lowest level of expectation or performance, "2" representing the low level of expectation or performance, "3" representing the medium level of expectation or performance, "4" representing the high level of expectation or performance, and "5" representing the highest level of expectation or performance.

2) Priority Needs Index (PNI)

In order to determine the competency needs of graduate students, Priority Needs Index (PNI) was calculated (Wongwanich, 2005). PNI is the method to measure the order of how important of needs are by using the statistic value in the form of index to state the maximum and minimum value.

The PNI formula was:

$$PNI = (I - D) \times I$$

Where; I = Importance (The expectation level of each pharmacy activity)

D = Degree of success (The current level of each pharmacy activity)

Priority Needs Index, were ranked from high score to low score. The activities that had the high PNI score meant low competency and they should be improved. For this study, the researcher set the cut-off scores at the average score of the PNI of pharmacy competency activity for each pharmacy competency domain. The higher PNI score, the lower ability level. Thus competency activities with the PNI above the average score, the curriculum related to those activities need to be improved. For example, if we found that the average score of PNI of the competency activity in Domain 1 was 1.38, curriculum related to any activities with the PNI above 1.38 needed to be reorganized.

3) Matrix Analysis

Another useful method for the further curriculum development is matrix analysis. The figure of matrix analysis divided into four quadrants as shown in Figure 3.2 (Wongwanich, 2005; Gonzalez, Quesada, Gourdin, et al, 2008).

Quadrant A: The upper left quadrant indicated low level of expectation and high performance.

Quadrant B: The upper right quadrant indicated high level of expectation with over-determined performance.

Quadrant C: The lower right quadrant indicated low level of expectation with under-determined performance.

Quadrant D: The lower left quadrant indicated low level of expectation and low performance.

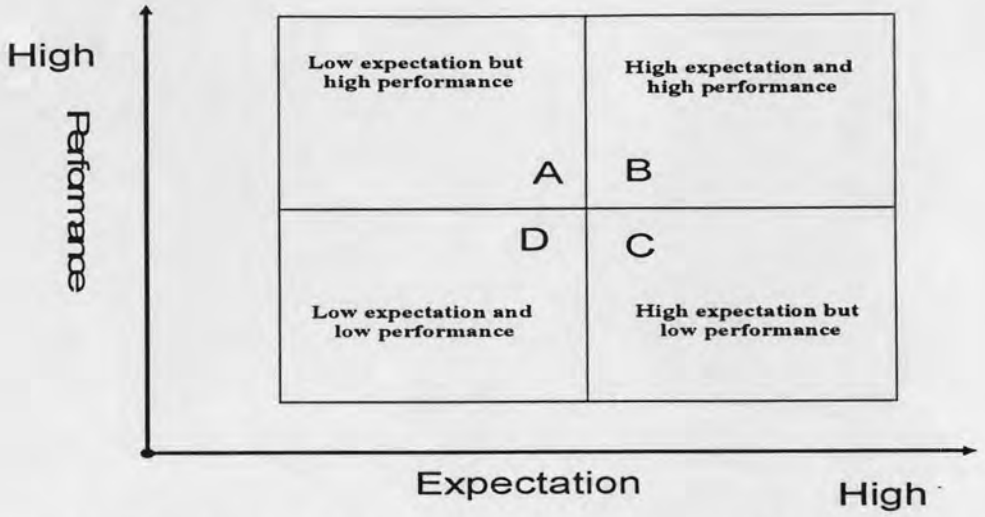

Figure 3.2 Matrix analysis of the pharmacy expectation and the actual performance of pharmacy competency

The method to build the Matrix Analysis was by dividing the table into 4 cells to represent the relation between the expected and the actual status. The cut-off point could be the average value between the indicated high-low scores or the standard the assessor deems appropriate to be the cut-off score. In this study the researcher specified the cut-off point at score 3 because the questionnaire used the 5-point Likert's scale to assess the actual and the expected competency score as addressed above. The score higher than 3 was translated as high pharmacy competency which was the standard of the faculty. The underlying reasons that researcher chose to use two ordering methods – Priority Needs Index (PNI) and the Matrix Analysis were as follows:

1. The researcher studied the means and the standard deviations resulted from the assessment of the undergraduate pharmacy competency by the pharmacy preceptor and found that the average score of the pharmacy preceptor's expectation level differs greatly, this meant the pharmacy preceptor had different expectation for the undergraduate's competency. As such, the researcher decided to use the Priority Needs Index (PNI) to rank the importance of the needs by presenting as an index that is able to locate the highest and lowest problems. This PNI method emphasizes on the determined expectation level to balance with the needs. Thus, it should be a proper method to analyze such greatly variation among data.

2. The advantage of using Matrix Analysis was that the matrix analysis presents the strength and weakness of the matter being considered, herein the pharmacy competency. The translation was also simple because the data was categorized according to the characteristic of the data. The strategy or plan recommendation to improve the competency, done by the Matrix Analysis, was straightforward.

3. In addition the Matrix Analysis was included because the researcher also emphasizes on the actual performance of the undergraduates, i.e. by specifying the cut-off score at 3. In the case the student has certain low pharmacy competency and also having low expectation, that pharmacy competency fell in quadrant D, in another word, the student has low competency in certain area and the stakeholder does not regard it important. If considering only the PNI, the translation of the data in this part may loss, given that the PNI is the index and if the actual and the expected level are low, the PNI may translate that such competency has no need for improvement. The fact that the stakeholder also did not expect for this competency is however lack. Nevertheless, using only the Matrix Analysis will give up the detailed figure information as PNI has, as well as it will be difficult to read the data when dealing with a large amount of data. As a result, based from the aforementioned advantages and disadvantages, the researcher deemed that using both methods provided a complete result and the information obtained could be further used to develop the strategy for the curriculum development in Phase 2.

The results obtained from the Matrix Analysis illustrate the strength and weakness of the graduate's pharmacy competency as a result of the current curriculum. This information was enabled the staff of faculties to develop proper approaches in improving the relevant contents in the model curriculum.

From needs assessment study in the development of the undergraduate's pharmacy competency, by employing the needs identification from both the PNI and the matrix analysis, the data obtained could be divided into 3 parts which were;

- The actual level of the undergraduate's pharmacy competency indicated the current curriculum assessment
- The expected level of the stakeholders toward the undergraduate's pharmacy competency were filled in the quality planning matrix in the blank "pharmacy preceptor" of the HOQ as mention later.

- Needs which refers to the gaps between the expected and actual pharmacy competency were informed the faculty members about the problematic pharmacy competency and related contents in order to further set the proper curriculum policy and plan.
- Needs Assessment survey from clinical pharmacy' students
- The actual level of the undergraduate's pharmacy competency indicated the current curriculum assessment and filled in the quality planning matrix.
- The needs assessment data obtained from the pharmacy students were used as the current data informing the staff of faculties of the pharmacy competency level both the actual and expected competency level of their students. Such data were enabled the staff of faculties to adopt as a guideline to develop or improve the curriculum to suit the needs of the students.

Phase II. Competency Needs Analysis

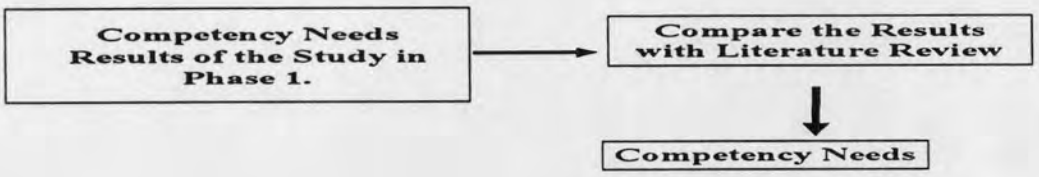

Figure 3.3 Competency needs analysis

The aim of this phase was to identify pharmacy competency needs by confirmation with the other studies. The assumption was stated that the cause of competency needs was the lack of curriculum contents related to those competencies. Therefore, the curriculum was the one factor that associated to competency needs. The competency needs results of the study in Phase 1 were confirmed with the competency results of other study by the researcher.

Phase III Competency Needs Solution

The complete need assessment study was provided the alternative solution for the proper use after needs analysis, and prioritization of needs. There are several techniques to be applied in needs solution, but in this study, the researcher chose to use QFD approach which is the new technique in the process of need solution in needs assessment.

The work in this process was to design the curriculum contents in response to the need of stakeholders, which was the pharmacy competency needs in this study. In this regard, the faculty member team designed the content from the pharmacy competency. The information came from the needs assessment on the pharmacy competency from pharmacy preceptor and clinical students. The information enabled the faculty member team to create the new idea for improving and updating the contents grounded on the pharmacy competency. The data from this section also was used as the input in the quality planning matrix (Area 5) of HOQ.

Theoretically, designing curriculum consisted of (1) objectives, (2) courses, (3) learning experiences, and (4) evaluation approaches. This study focused only on these two components which were curriculum objectives and courses. QFD is a tool for designing products and services. QFD was used for designing pharmacy curriculum in this study. House of quality was also used to design pharmacy curriculum.

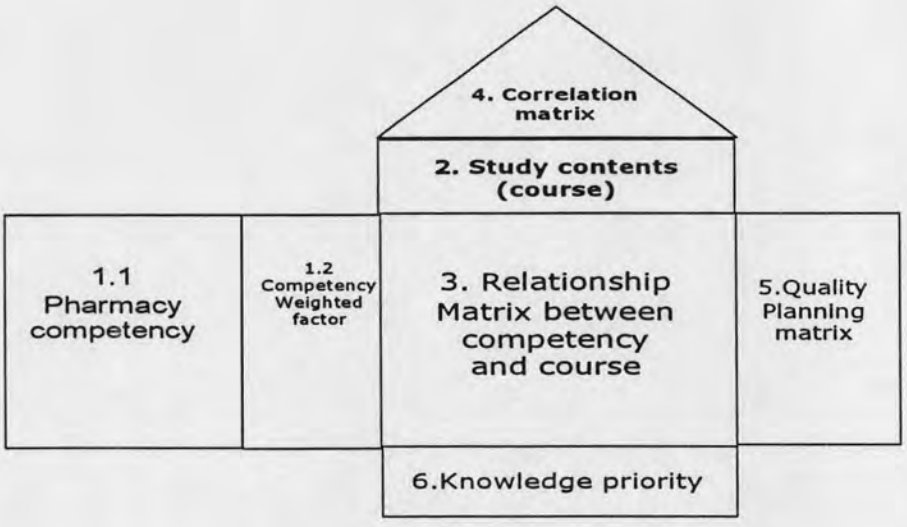

Figure3.4 House of Quality in designing pharmacy curriculum

Table 3.1 The components of curriculum using academic version of QFD.

Curriculum components	Academic version of QFD	Methodology
1. Objective	QFD plan for curriculum design	Focus group from the faculty' members (Step 0. QFD plan)
2. Competency	Pharmacy competency standard (Area 1.1)	Literature review and focus group from pharmacy practitioners and the faculty's members from the phase 1 of this study
	The competency weight factors (Area 1.2)	AHP by the faculty's members
3. Courses	The study contents (Courses) (Area 2)	Focus group from the faculty's members for information for content design - Pharmacy competency standard - The competency needs results from phase 1 - Literature review
	The relationship factor (r) (Area 3)	Evaluation form of objective-and-activity by the faculty's members
4. Credit hours	The importance of courses (Area 6)	- The calculation of the relationship factor and The competency weight factors
5. Course sequence	Correlation matrix (Area 4)	Focus group of the faculty members
6. The absolute weight (for course assessment)	Quality planning matrix (Area 5)	- The calculation of target quality, emphasis and improvement rate.

There were 7 steps in designing pharmacy curriculum using QFD. These seven steps were step 0: QFD plan for pharmacy curriculum design to get curriculum philosophy and objectives; step 1: Pharmacy competency structure in curriculum design and competency important rating using AHP; step 2: Identifying study contents (How's); step 3: Establishing correlations between pharmacy competency and study contents which used to calculate the importance of each course and absolute value in quality planning matrix; step 4: Identification of the pre-requisite contents using the correlation matrix for course sequences; step 5: Competency assessment in quality planning matrix using the needs of faculty's members, preceptor, and pharmacy students to calculate absolute weight or relative absolute weight; and step 6: Identify the importance priority of knowledge requirement to get the importance of course. After finishing all steps, the analysis of the house of quality (curriculum planning matrix) were conducted and proposed the new Pharm.D. curriculum.

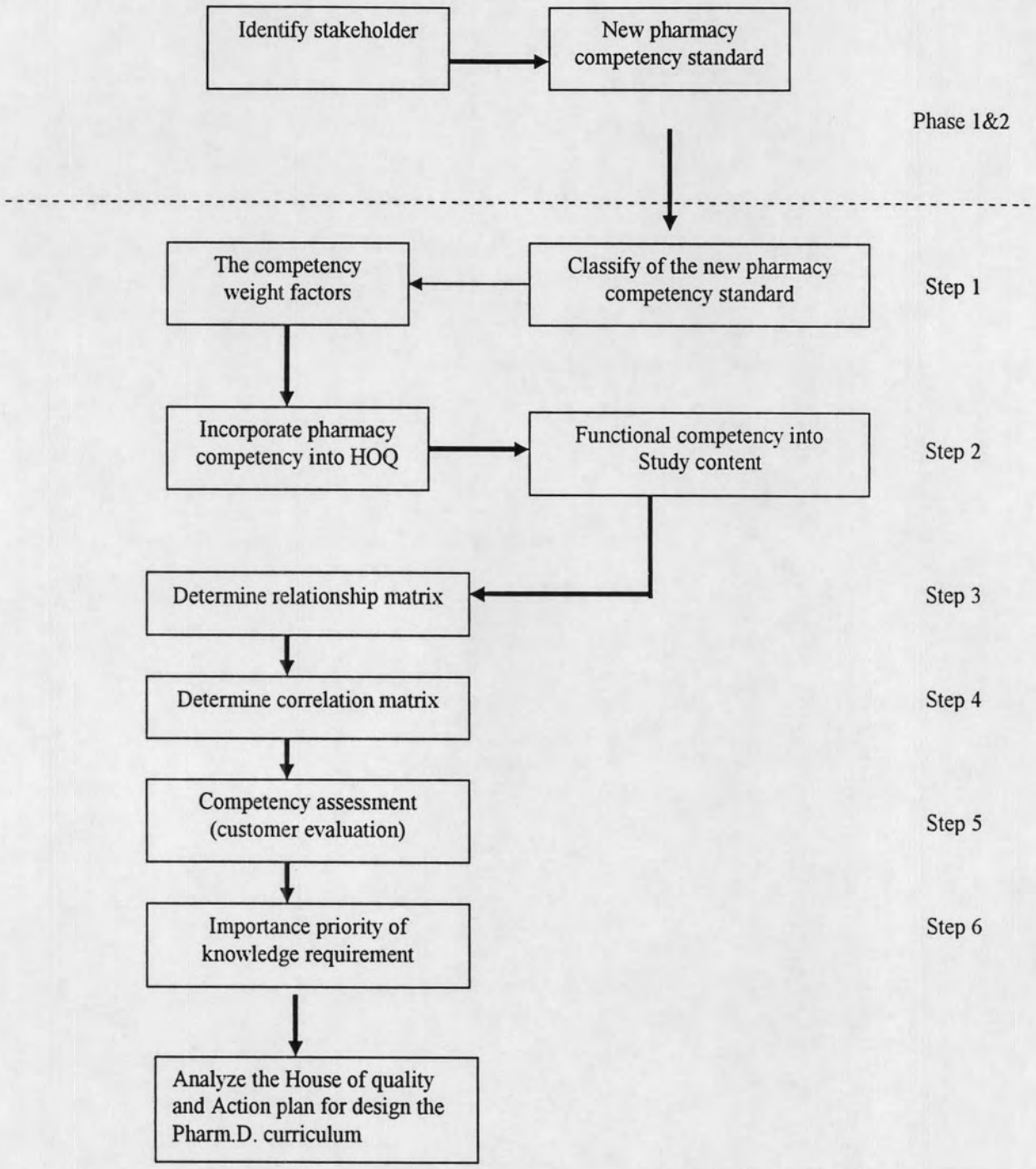

Figure 3.5 Flowchart depicting the steps in the academic QFD Model

Step 0 QFD Plan for Pharmacy Curriculum

Before the pharmacy curriculum was designed using quality function deployment (QFD) approach, the planning step was conducted first. Planning step was aimed to define "mission statements" and selected the "QFD working frame" for new pharmacy curriculum design. Mission statements were the product description. In this study, it referred to the qualification of pharmacy undergraduates. QFD team consisted of seven professors who have expertise in each pharmaceutical field, which are 1)pharmacology and physiology, 2)biochemistry and microbiology, 3)pharmaceutical technology, 4)pharmaceutical chemistry, 5)clinical Pharmacy, 6)social and administrative pharmacy. One professor was selected from each expertise field with the following criteria: 1) a member in academic committee, 2) a senior lecturer (with the title of assistant professor or associate professor).

This step, theoretically, was composed of the identification of product description or product vision statement, key business goal, target market, assumption and constraints, and the stakeholders.

1) Product description or product vision statement was defined as the performances or terminal competencies of pharmacy undergraduates that are best fit to the requirements of their stakeholders.
2) Key business goal was defined as the objectives in developing pharmacy undergraduates.
3) Target market was defined as pharmacy setting which pharmacists work such as hospital, drug store, etc.
4) Assumption and constraints was defined as the factors that should be considered before developing pharmacy curriculum.
5) The stakeholders.

According to the heart of QFD concept, the customer identification is the most important process. In higher education, the clear definitions of customers are very difficult because the various groups of customers are involved in the education.

This study, therefore, used Dr. Akao's concept as a way to map out the stakeholders of the faculty of Pharmaceutical Sciences. Dr. Akao defined the customers of higher education into two groups; first, the internal customers such as students, instructors, administrators; second, the external customers such as the employers and communities (Mazer, 1996; Chan, et.al., 2006).

Step 1 Pharmacy Competency Standard

The data collection of the stakeholder's expectations was a vital step in this research because the collected data was primarily used in the curriculum design, and to set the direction when creating curriculum. In this study the researcher has substituted the stakeholder's expectations with the graduate's pharmacy competency developed by the needs assessment technique in phase 1. This is due to the fact that if we use the normal approach when finding the stakeholder's expectations for curriculum development, such as market research, sales data, customer complaint, retailers, focus groups, toll-free lines, opinion surveys, in-depth interview, etc, the problems arise could be that the data is loose, vague from the qualitative statements of the customer's own words, as well as taking long time to collect and expensive. Thus, the researcher has readjusted the finding of stakeholder's expectations by first studying from the PPAC which explains the practice activities of the graduate. Later is writing the draft of the pharmacy competency standard and fine-tuning with the pharmacy practitioners and faculty's members, then summarizing into the pharmacy competency standard to further input in the house of quality in Area 1.

The data about the stakeholder's expectations were acted as an input data in the HOQ in Area 1 as shown in Figure 3.4 which composed of 2 sub areas – area 1.1 Pharmacy competency standard (voice of customer) and area 1.2 the competency weight factor.

Area 1.1 Pharmacy competency (Voice of customer); is a data regarding the stakeholders expectation of the curriculum, herein means the pharmacy competency. The characteristic of the area 1.1 input data was the structured pharmacy competency, a structure list of the competency requirements regarding the pharmacy graduates as the stakeholder expect them. Due to the design of pharmacy competency in this research was obtained from the modification of the PPAC concept and the PPAC pharmacy competency is structured into 3 levels which are 1) domain or field of activity, 2) class of activities, and 3) activities or interventions. Accordingly, the newly created pharmacy competency in this research will be structured into 3 levels as in the PPAC.

Area 1.2 The competency weight factor; The competency weight factor referred to the importance of pharmacy competency domains. The researcher used the data from the pharmacy competency standard level 1, i.e. the domain or field of

activity, composing of 4 domains to calculate for the pharmacy competency's weighted factor using AHP. The detail of each stage was further described as follows.

1.1 A structure list of pharmacy competency

The pharmacy competency of the program's graduates was listed in the area 1.1. These represented desirable outcomes for the stakeholders that resulted from using the product. In this study, the product was a graduate of the Pharm.D curriculum, and the stakeholders was the pharmacy practitioners, faculty members, and including a graduate of this curriculum as described in the QFD plan for pharmacy curriculum. The new CU pharmacy competency standard, which was developed from this study in phase 1, was used to identify the desired capabilities of Pharm.D. graduates. New CU Pharmacy competency standard could be grouped into 2 types: functional competency, which is pharmacy competency domain 1 to 4; and core competency which was pharmacy competency domain 5 to 6. The pharmacy competency standard could be divided into 3 levels.

1. First level: A competency domain or field of activity, which is the required qualification of entry level, generalist pharmacists. Functional competency composed of 4 domains which were ensuring appropriate therapy and outcomes; selection and dispensing medications and devices; health promotion and disease prevention; and health systems management. Core competency composed of 2 domains which were professionalism and general ability.

2. Second level: A competency level or classes of activities, which is a sub-class of competency domain level. These classes of activities were divided by knowledge, skills, or attitudes in each different category. Functional competency had 15 classes of activities. Core competency had 9 classes of activities.

3. Third level: Activities or Interventions, which is a sub-class of competency level. Activities refer to specific behaviors that pharmacists engage in as a part of their professional practice to enhance patient care and outcomes, based on their professional knowledge and clinical judgment, Functional competency consisted of 102 activities. Core competency consisted of 16 activities.

The data from each level of the pharmacy competency was an input data to the HOQ and since the required types of input data was different; the pharmacy

competency data used in designing the pharmacy contents was also different. For example, at the translation of the pharmacy competency into the pharmacy contents, it had to be translated from the competency level 3, Activities or Interventions, because the pharmacy competency at the competency domain level was unable to be translated directly into the contents. The data of pharmacy competency level to be input in the HOQ was summarized as follows:

Level	Data Usage
Level 1 (competency domain or field of activity) (4 items)	- First level (competency domain) was used to find the weighted factor of each competency domain employing AHP approach.
Level 2 (a competency level or classes of activities) (15 items)	- Second level (a competency level) was shown in the HOQ and the weighted factor of each competency domain will be distributed to each item of the competency level, totaling 15 items. - Second level (a competency level) was led to the relationship with the content group in the HOQ table.
Level 3 (Activities or Interventions) (105 items)	- Third level (Activities) was used in the transformation of the pharmacy contents.

Therefore, the second level (class of activities) was used as a data input in the area 1.1 in the house of quality addressed above. The researcher placed this area with the secondary level or a class of activities of pharmacy competency standard which have 15 classes of activities for curriculum design. Only domain 1 to 4 of pharmacy competency was translated into the design of curriculum content.

1.2 The Competency Weight Factors (WFs) using AHP (Area 1.2)

The competency weight factors (WFs) of the program's graduates was listed in Area 1.2. In this study, analytic hierarchy process (AHP) was used as a method to determine the competency weight factors. The AHP is a method to help people make better decisions in complex situations involving trade-offs between the advantages and disadvantages. The method is based on assigning numerical values to subjective judgments on the relative importance of each competency domain; and synthesizing the judgments to determine which competency domain has the highest priority (Saaty,

1994 Cited in Badri and Abdulla, 2004). WTs provided importance level of each pharmacy competency and helped faculty's members to emphasize contents relevant to those pharmacy competency.

According to the process of QFD in this study, the researcher used Visio QFD Program (Yoshida, Masami, 2008) to create house of quality for Pharm.D. curriculum. This program required a set of numeric pair-wise comparison for each competency domain to put in the program. The researcher got these numbers using AHP questionnaire as presented in the Table 3.3. The processes of obtaining this set of numeric input for the program were as follows:

AHP Process

1. The functional pharmacy competency consisted of four competency domains as presented in Figure 3.6.

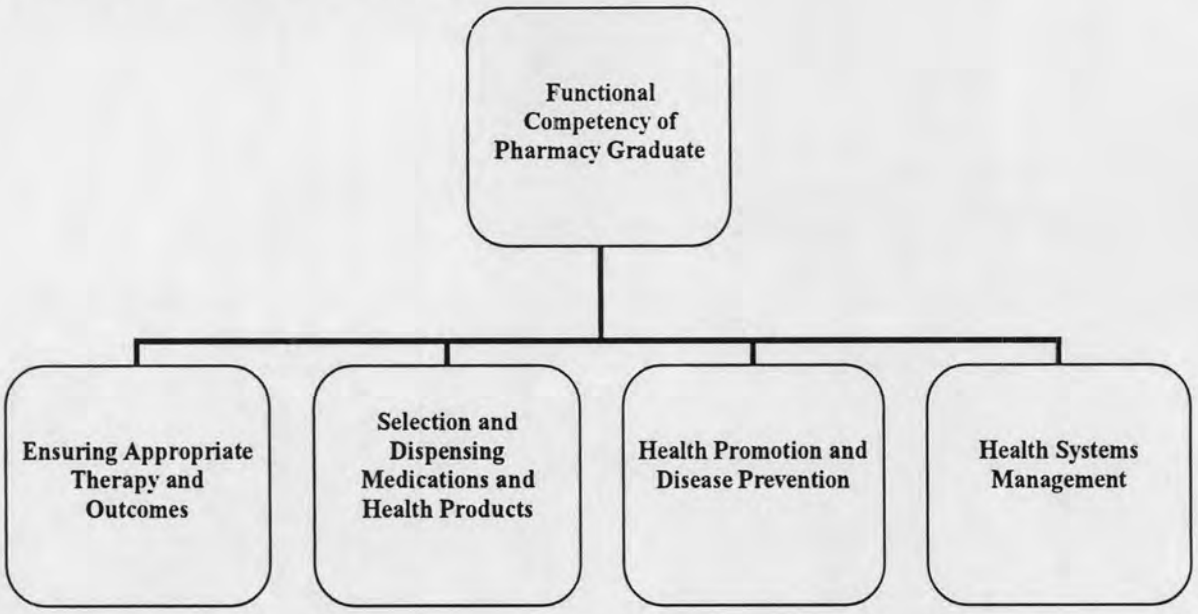

Figure 3.6 The functional competency of pharmacy graduates.

2. Collecting input data by pair-wise comparison of decision elements. The data collection was based on the concept of pair-wise comparison

In this study, a set of pair-wise comparison for each competency domain was constructed. Forty-five faculty's members were participated in the pair-wise comparison by judging that how importance between each pair of domain. The pair-wise comparison is made using the scale shown in Table 3.2. The questionnaire for AHP is presented in Table 3.3.

Table 3.2 The definition of the nine-point scales

Absolute scale	Definition	Explanation
1	Equal importance	Two competency domains are equally.
3	Moderate importance of one over another	Experience and judgment slightly rate one competency domain over another.
5	Essential or strong importance	Experience and judgment strongly rate one competency domain over another
7	Very strong importance	The competency domain is strongly rated.
9	Extreme importance	The evidence rating one competency domain over another is of the highest possible order of affirmation.
2,4,6,8	Intermediate values between the two adjacent judgments.	When compromised is needed.

Table 3.3 AHP questionnaire for rating the importance between each pair of domain

No. Pair	The first choice	The second choice	The first choice is less important than the second choice								Equal	The first choice is more important than the second choice							
1	Domain 1	Domain2	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
2	Domain 1	Domain 3	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
3	Domain 1	Domain 4	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
4	Domain 2	Domain 3	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
5	Domain 2	Domain 4	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9
6	Domain 3	Domain 4	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9

3. Generally, after the pair-wise comparison process was completed by faculty members, the software package "Expert Choice" was used to compute the eigenvalue for each pharmacy competency domain. The eigenvalues indicated the relative of each pharmacy competency domain. These values were named as "the competency weight factor". Due to the usage of Visio QFD in creating the house of quality in this study, the AHP step of Visio QFD required only one set of numeric input in order to compare the pair-wise of pharmacy competency domain according to the AHP questionnaire above (Table 3.3: AHP Questionnaire). Visio QFD Program calculated the weight factors. Therefore, from the AHP questionnaire of the evaluation on 4-dimension of pharmacy competency, the researcher calculated mean, median and mode and consider these results in order to select one set of numeric input for Visio QFD program.

Step 2 Identifying study contents of the pharmacy body-of-knowledge (study content) (Area 2; How's).

Pharmacy competency was translated to contents in this step. Then, these contents were grouped into courses. Area 2 contained elements of the pharmacy body-of-knowledge for Pharm.D. curriculum. The researcher translated functional competency in activity-level (called "What's" in QFD language) into pharmacy study contents (called "How's" in QFD language). These study contents are placed at the top of the HOQ.

In designing pharmacy body-of-knowledge, the content creating process was divided into the following procedures: 1) the study framework for the pharmacy body-of-knowledge, 2) source of pharmacy content design, and 3) process of translation of pharmacy competency in activity-level into study contents. These procedures were elaborated as follows.

1 The study framework of the pharmacy body-of- knowledge

The pharmacy body-of-knowledge designed is based on the pharmaceutical knowledge according to regulations of pharmacy council (Pharmacy council, 2008). The pharmacy body-of-knowledge can be divided into four types of sciences which are; first, the basic biomedical sciences; second, pharmaceutics sciences; third, clinical science, and fourth, social and administrative pharmacy sciences. The details were as followed.

1. Basic Biomedical Sciences consists of fundamental of professional sciences including physical sciences, health sciences, anatomy and physiology, causes and mechanism of disease, pathology and laboratory examination.

2. Pharmaceutics Sciences means pharmaceutical knowledge relating to chemical products, distilled herbals, and bio-substance to produce medicines, drug production and invention, bioequivalence, quality assurance, medicine storage process and distribution, research and development of medicine industry. The Thai Pharmacy Council stipulated that these should not be less than 35 credit hours or 25 percentages of total credit hours in the present curriculum.

3. Clinical Sciences means pharmaceutical knowledge with the contents relating to the medicine dose, drug's efficacy and danger, appropriate use of medicine, undesired symptom relating to medicine, including the reporting system, Pharmacokinetics, The Thai Pharmacy Council stipulated that these should not be less than 42 credit hours or 30 percentages of total credit hours in the present curriculum.

4. Social and Administrative Sciences means knowledge with contents in relation to related behavior to medicine and health policy, national health development plan, drug system development, pharmacy professions, drug system management, consumer protection, public health, health support, pharmaceutical economics and epidemiology, law, and professional ethics. The Thai Pharmacy Council stipulated that these should not be less than 14 credit hours or 10 percentages of total credit hours in the present curriculum.

After considering the contents of knowledge that needed to be designed, the design occurred at the study content (level 4) which is a component of courses (level 3). In the same way, the course was designed under each pharmacy content fields in level 2 as presented in Figure 3.7.

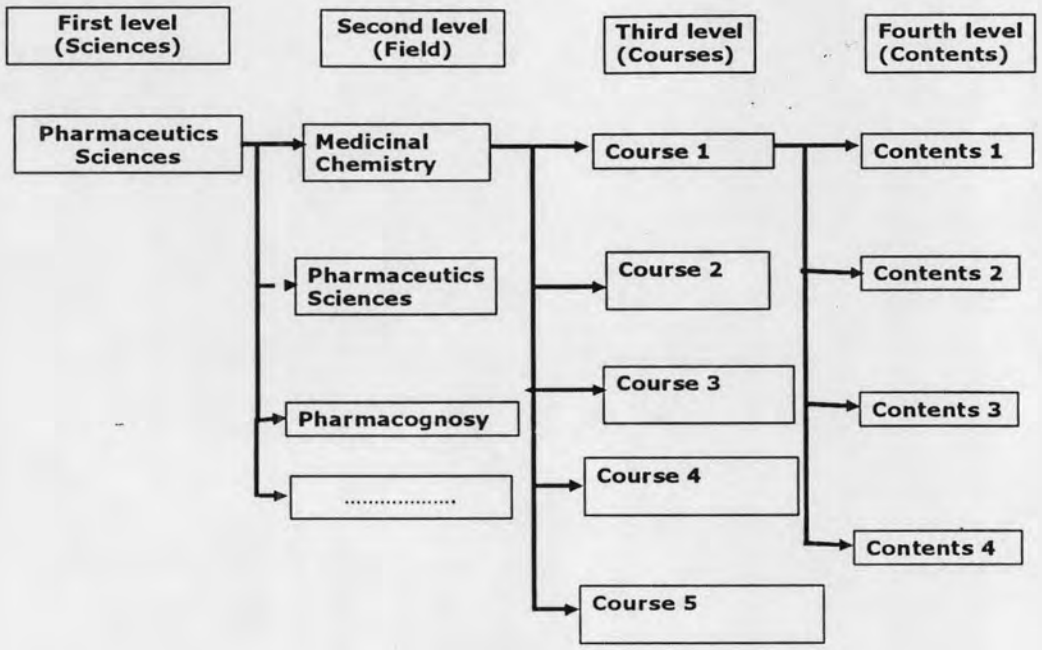

Figure 3.7 The example of the structure of the pharmacy body-of- knowledge

2 Information sources of pharmacy content design

Information used in content design acquired from various sources according to characteristics of required information divided into 3 sources accordingly:

1. Regulations to frame the content designs were
   - New Developed CU Competency Standard from the Faculty of Pharmaceutical Sciences at Chulalongkorn University.
   - Thai Pharmacy Competency Standard from Thai Pharmacy Council2. Regulations of the country originating the Pharm.D. curriculum and used as a reference in curriculum building, which are:
   - Accreditation Standards and Guidelines for the Professional Program in Pharmacy Leading to the Doctor of Pharmacy Degree, 2007 from the Accreditation Council on Pharmaceutical Education (ACPE) (ACPE, 2006)
   - Educational Outcomes, 2004 from American Association of Colleges of Pharmacy (AACP) (AACP, 2004)
   - The NAPLEX Competency Statements (NAPLEX, 2008)

2. Pharm.D. Curriculum from leading university aboard in order to be used as guideline, which were:

- College of Pharmacy, University of Michigan
- College of Pharmacy, University of Florida
- School of pharmacy, Temple University

3. Source of Reference book and Guiding for grouping the pharmacy contents – a source containing lists of textbooks in pharmacy knowledge referred in this study when naming the knowledge group created.

- Subject Classification of the Basic Resources for Pharmacy Education Version 2008

3. Process of Course Design

The Design of pharmacy content could be obtained from several group discussion attended by the faculty and off-site seminar. The procedure was divided into two stages as presented in Figure 3.8, which were;

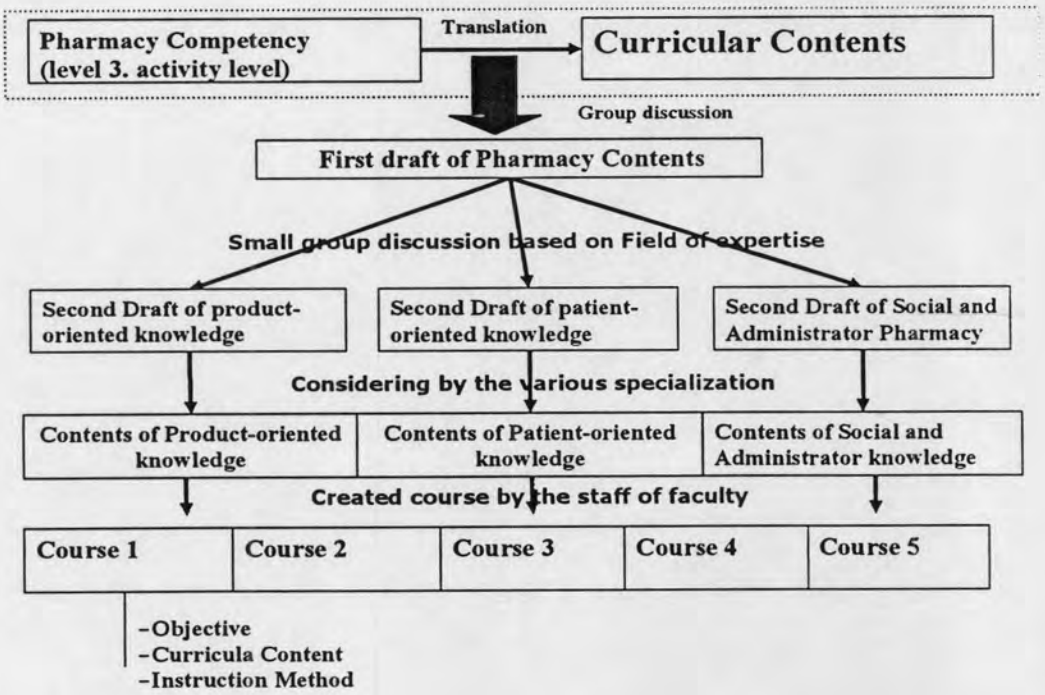

Figure3.8 The process of course design

Stages 1 : Drafting the contents

The process of the group discussion in this step was:

1. The researcher clarified and created the same understanding of pharmacy competency among the faculty's members. Furthermore, correction, adding or deleting some points in the new pharmacy competency standard were conducted.

2. The faculty's members discussed and translated the activity-level competency into the pharmacy study contents.

3. After that, the faculty's member examined between the drafted of pharmacy contents and Thai pharmacy competency. The new written pharmacy contents was met the existing Thai pharmacy competency standard or not.

The information obtained were became a draft of contents entering to process in step 2. In this process, the content revision and classify of pharmacy contents were conducted. The working procedures of the second stages were:

Stage 2 : Content revision

The objective of the meeting in stage 2 was to get the faculty's members to understand the application of QFD in pharmacy curriculum design. Furthermore, the revision of the draft of pharmacy content was conducted. The researcher collected data with the following work process:

The researcher conducted a small group discussion to review the content revision obtained from the studies in Stage 1 above. The grouping criteria of attendants are based on their fields of expertise. This small group discussion's attendants can be divided into six different groups, which were: 1) pharmacology and physiology, 2) biochemistry and microbiology, 3) pharmaceutical technology, 4) pharmaceutical chemistry, 5) clinical pharmacy, and 6) social and administrative pharmacy.

Process of group discussion

1. The facilitator greeted and introduced him/herself and declared the group discussion objectives as well as elaborate guidelines in group discussion.

2. The facilitator then discussed about the contents necessary to produce the graduate with pharmacy competency as required by the faculty. The faculty member needs to consider the draft of contents together, and further correct and improved it.

3. Once obtaining the revised content from the 6 expert groups, all the data were summarized and the appropriate content were selected and then classified into each related subject. These subjects were then named to be in accordance with the classification for pharmacy education version 2008 or rename accordingly to the faculty consideration. Adding pharmacy study content could be done by additional research in references on the list of Basic Resources for Pharmacy. After obtaining the pharmacy contents, it was presented to the faculty of various specializations for their further consideration.

After obtaining the content revision, the faculty's members of each field took the subjects in their specialized areas to conduct further research from textbooks and documents, including analyzed from other curriculum of Pharmaceutical Sciences institutions, both domestic and abroad. These obtained contents were used to create undergraduate contents and could also be linked to further create graduate contents. The results of the content design were:

- Behavioral objectives
- Study content in details
- Tentative instructional method

Step 3 Establishing correlations between pharmacy competency and study contents (Area 3; Relationship matrix).

Area 3 of the HOQ, the relationship matrix, links the pharmacy competency of undergraduates in Area 1 to the pharmacy body-of-knowledge components of a pharmaceutical academic in Area 2. The relationship matrix performed the critical function of exploring the intersection between the pharmacy competency required by the pharmacy practitioners and the contents elements of body-of-knowledge that the undergraduate pharmacy were expected to have.

In this study, the identification of the relationship between the pharmacy competency and study contents were conducted. The relationship between the

pharmacy competency and study contents was represented by r symbol and named as "the relationship factor". In this step, the researcher explained how to get the relationship factor in details. The step of getting the relationship factor was divided into: 3.1) Concept to determine the relationship factor (r) (Kelley, et.al,, 2008), 3.2) Collecting information of the relationship factor (r), and 3.3) Creating the code

1 Relationship factor (r)

Table 3.4 Example of the connectivity between competency activity, behavioral objective and contents

Competency Level or Class of Activity	Ability to develop the pharmaceutical care process based on the patient records and any other evidences	**Contents**
Competency Activity	1. Ability to determine the difference of each medication for patient treatment	
	2. Ability to select the appropriate medicine by formula and the quality to suit the disease and the state of the patient	
Behavioral Objective	1. Understand the mechanism of action of all medication therapy for GERD (Pharmacology lecture)	Pharmacology
	2. Discuss the dose, adverse drug reactions, drug interactions, clinical efficacy for the available drug therapy for GERD.	Therapeutics
	3. Understand the structure activity relationships and physiochemical properties relating to agents used in the treatment of GERD, and will be able to identify these agents	Medicinal Chemistry

According to Table 3.4, competency level or class of activity level in pharmacy competency concerning "Ability to develop the pharmaceutical care process based on the patient records and any other evidences". Accomplishment of

this competency came from two pharmacy activity competencies, which were "ability to determine the difference of each medication for patient treatment" and "ability to select the appropriate medicine by formula and the quality to suit the disease and the state of the patient". In order to conduct these activity competencies, the relationship of behavioral objective and three courses, which were Pharmacology, Pharmacotherapeutics and Medicinal Chemistry courses, was consistent. When obtaining course content with relationship toward competency in activity level, the next step was to find relationship factor, which referred as a correlation value demonstrating the level of relationship between content and competency. It meant that one course's content contributed one competency in certain level. Example of course content having relationship with competency "Ability to develop the pharmaceutical care process based on the patient records and any other evidence" which was the content of the following courses: Pharmacology, Therapeutics, and Medicinal Chemistry. The correlation score of pharmacy competency and course equaled to the relationship factor (r) which were showed in Table 3.5.

Table 3.5 Example of the competency and courses relationship

0 = No relationship **1 = Weak relationship** **2 = Moderate relationship** **4 = Strong relationship**	**Courses**		
Competency	**Pharmaco-therapeutics**	**Pharmacology**	**Medicinal Chemistry**
Ability to develop the pharmaceutical care process based on the patient records and any other evidence	4	2	1

The Example Table 3.5 was a result from consideration of necessary content for pharmacy competency. The researcher rated score to relationship factor value as stated in Table 3.5. It described the content in the subject of Pharmacotherapeutics could contributed the *Ability to develop the pharmaceutical care process based on the patient records and any other evidence* in high level (r = 4) and the content from the

course of Pharmacology had competency relationship in medium level (r = 2). In addition, the content from the course of Medicinal Chemistry had competency relationship in low level (r = 1).

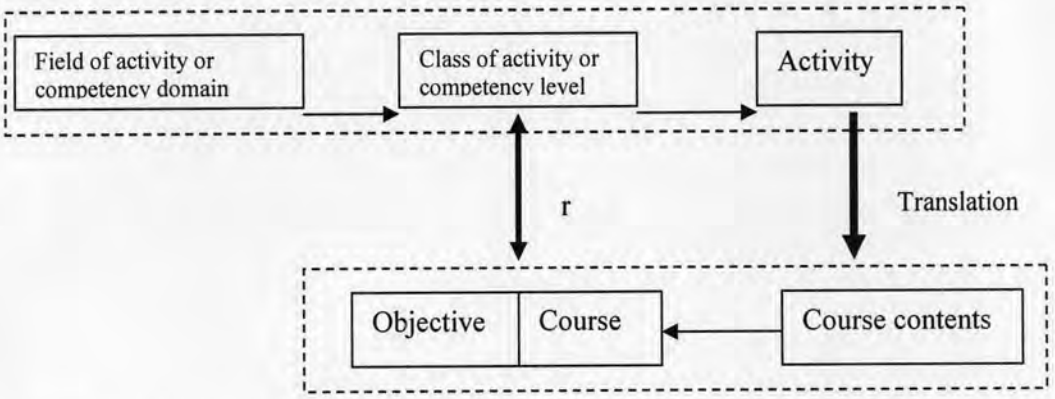

Figure 3.9 The relationship between the course and class of activity

From Figure 3.9 the course contents were designed based on its importance toward pharmacy competency, which must show the explicit details of the pharmaceutical work process. For example, skills in documenting care for patients with diabetes, asthma, hypertension, and otitis media represent. Therefore, in this study the content creation responding to pharmacy competency must be at activity level, which is a sub-class of competency showing the pharmaceutical work process in details. After that, the course contents were grouped into a course, with its objectives. The relationship between the course objectives and the pharmacy competency level or the class of activity was then rated, represented by the "r" value.

2 Data collecting for "r" value

2.1. Tools used in the research

There were two sets of evaluation form that used in calculating the relationship between pharmacy content and competency.

1) Evaluation form of objective-and-contents refers to a form that used by the staff of teacher in identifying the relationship between the behavioral objective of the course and its content (Appendix C: Evaluation form of objective-contents).

2) Evaluation form of objective-and-activity was a form that used by the instructors in identifying the relationship between the behavioral objective of the

course and the competency activity (Appendix D: Evaluation form of activity-objective).

2.2. Data collection process

The researcher collected data using the following work process:

1) The researcher asked for corporation from the faculty coordinating each subject in the Faculty of Pharmaceutical Sciences, Chulalongkorn University. The data collection came from two sets of evaluation form per one course. The two sets of evaluation form were: 1) evaluation form of objective-and-contents and 2) evaluation form of objective-and-activity. After receiving both evaluation forms back, the researcher had to examine the accuracy of returned evaluation form and grouped the subjects with the same activity competency together in order to set up a group discussion later on.

2) In this additional group discussion, the researcher requested the course coordinator to form a meeting for the courses that have relevant contents and activity competency. The objective of a group discussion was to identify competency gained after completing each course and reconsider whether the content of certain courses is duplicated with other courses or not. The content of each course must be revisited to identify if there was any repetitive, over or less. Also, the scope of content must be considered to achieve the competency level that was a goal of each course. In summary, the additional group discussions were:

- Patient related subject group including subject group of pharmacotherapy and pharmacy practice and fundamental subject group of clinical sciences knowledge which was pharmacology, medicinal chemistry, anatomy and physiology, microbiology, biochemistry
- Product related subject group which is pharmaceutical calculation, physical pharmacy, pharmaceutical dosage forms and drug delivery system I&II, and laboratory good practices for the preparation of pharmaceutical dosage form, biopharmaceutics and pharmacokinetics.
- Subject group of research and drug information system such as pharmacology III, research methodology in pharmaceutical care, drug information services in pharmaceutical care

- Subject group of pharmacokinetics, which are pharmacology I, biopharmaceutics and pharmacokinetics, application of pharmacokinetics in clinical practice I,II.

3) After the additional group discussion activity, the researcher collected the result from the evaluation form and calculated the score in each course as well as calculated the score from the activity-objective set. The score from the objective-content set used to confirm the accuracy of activity-objective evaluation form. The score of each course from the activity-objective evaluation set were compared to be "r" value (relationship factor), which were the data input into HOQ later on. The process of comparing the score was mentioned in the part of creating the code.

2.3. Creating the code

This study, the step of curriculum creation followed the step of QFD process. This step involved determining relationship factor (r) value. During this process, the researcher asked the faculty coordinators to evaluate the content in each course through course objective whether it related to any competency. After finish work on the form of activity-objective, the researcher took the evaluation form to calculate the score to find relationship factor (r) value. From the frequency of each score in each competency, the competency score of each competency were converted into code referring to each appointed criteria. The researcher determined the criteria in appointing code value by using VISIO QFD program. The program required the number input instead of relationship factor (r) value: "0" means no relationship, "1" means weak relationship; "2" means moderate relationship; and "4" means strong relationship. The researcher applied the concept of correlation and described interaction as a fractional value between ±1. Using the (4, 2, and 1) rating scale, the positive relationship scores could be defined (Paul, Ricks, and Shockcor, 1999):

- Strong relationship is scored as 4/(4+2+1) = 4/7 = 0.57
- Moderate relationship is scored as 2/(4+2+1) = 2/7 = 0.29
- Slight relationship is scored as 1/(4+2+1) = 1/7 = 0.14

In aforementioned calculation, the result from scoring criteria was as follow:

Table 3.6 The criteria set of each score level (code)

Code	Score	Definition
0	Less than 0.14	No relationship
1	0.14 to 0.29	Weak relationship
2	0.29 to 0.57	Moderate relationship
4	More than 0.57	Strong relationship

The following section showed an example of calculating score in evaluation form to set up the criteria. According to the evaluation of activity-objective form in the subject of *Pharmaceutical Dosage Forms and Drug Delivery System* I, it showed the example of score calculation of the frequency value in activity level as follows.

Table 3.7 The example of calculating the frequency value of competency activity.

N0.	Objective / Activity competency	1. To know principle of pharmaceutical dosage form development and dosage form design	2. To know types and select appropriate pharmaceutical recipient	3. To know types and select the appropriate pharmaceutical container suitable for dosage form	4. To explain and identify the importance characteristics of each dosage form	5. To explain advantage of pharmaceutical dosage form	6. To know composition and specific preparation technique of dosage form	7.To know dosage form evaluation and examine the physical stability	8. To select the pharmaceutical container and drug labels which appropriate for that dosage form?
	2.3. Competency to dispense medication 2.3.1 Ability to compound pharmaceutical products with the details on the standard formulation								
2.3.1.1	Ability to demostrate accurate handling techniques for dosage form preparation		1		1	1	1	1	1
2.3.1.2	Ability to select ingredients (form and strength) and equipment (bottles, syringes) that match the description on the drug formulation		1	1	1	1	1	1	1
2.3.1.3	Ability to select equipment accurately for product		1	1	1	1	1	1	1

N0.	Objective / Activity competency	1. To know principle of pharmaceutical dosage form development and dosage form design	2. To know types and select appropriate pharmaceutical recipient	3. To know types and select the appropriate pharmaceutical container suitable for dosage form	4. To explain and identify the importance characteristics of each dosage form	5. To explain advantage of pharmaceutical dosage form	6. To know composition and specific preparation technique of dosage form	7.To know dosage form evaluation and examine the physical stability	8. To select the pharmaceutical container and drug labels which appropriate for that dosage form?
	preparation								
2.3.1.4	Ability to understand the final storage containers that may compromise product efficacy)		1	1	1	1	1	1	1
2.3.1.5	Ability to apply labeling to the product to optimize its stability and correct storage and use		1	1	1	1	1	1	1
2.3.1.6	Ability to identify beyond use date		1	1	1	1	1	1	1

From the above table, it showed that in activity statement number 2.3.1 consists of 6 activity competencies. There were 41 pairs of competency-objective in the frequency out of the frequency of the possible competency-objective pairs. The proportion of the competency-objective pair equal to 41/48 or 0.85 score. When the score was converted to code, it yielded value 4. It meant that the subject of Pharmaceutical Dosage Forms had a relationship toward competency 2.3.1 in high level. This transferred code was put as data in QFD process.

Step 4: Ranking the study contents (pre-requisite course) (Area 4)

In the traditional HOQ, this step aims to identify trade-offs between pairs of engineering characteristics. In this study, the researcher used this step to identify the

sequence of pharmacy courses in order to ascertain that the students should have proper learning flow all the whole part of the curriculum. Therefore, this study applied the two approaches for identifying the pre-requisite contents which were;

- **Prerequisite learning approach**: Prioritization of content by this approach is conducted by first introducing the basic knowledge and later more advanced one. For example, anatomy and physiology course is arranged to be taught so that the student could bring knowledge gained from the course to enroll in other course such as pharmacology course. The content arrangement was conducted by the whole-to-part approach.
- **Whole to part learning approach**: Prioritization of content by this approach is conducted by first studying the overview of some courses in the curriculum and study the details of each part later on. For example introduction to pharmacognosy course is the subject to study the overview of pharmacognosy and the student will learn the subject additionally in herbal for treatment and health promotion course.

This part used a group meeting and discussion from the faculty's member from six specialized areas which were: 1) pharmacology and physiology, 2) biochemistry and microbiology, 3) pharmaceutical technology, 4) pharmaceutical chemistry, 5) clinical pharmacy, 6) social and administrative pharmacy. After the discussing about the prerequisite courses, the researcher marked "√"if those courses were connected; and leaved it blank if they were not connected in the "roof" of the HOQ.

Step 5: Competency assessments in planning matrix (Area 5)

In the traditional HOQ, this step is for competitive assessment. For academics, it is not practical or even appropriate to identify specific competitors as a curriculum is being designed. This study has applied the evaluation of competency from student perspective and pharmacy preceptor perspective in order to input data into planning matrix. Planning matrix gave out the data on weakness in graduate's competency and finds the competency which the faculty will give priority and improve to plan in curriculum design later on.

Table 3.8: The example of quality planning matrix.

Competency	1. competency weight factor	Quality planning						
		benchmarking		Planning			Weight	
		2. Student	Pharmacy Preceptor	3.Target Quality	4. Improvement rate	5. Emphasis	6. Absolute Weight Factor	7. Relative Weigh Factor
1.1gather and assess information for pharmaceutical care	0.18	3	3	4	1.33	1.5	0.351	0.20
1.2 provide pharmaceutical care								
1.3 manage the patient data								
2.1 evaluate medication and health product								
2.2 analyze the prescriptions								

1. Process of Quality planning matrix

There were 6 stages in designing Quality planning matrix for competency assessment as presented in Table 3.8.

1. Listing the competency weight factors in Area 1(the competency weight factor)

2. Listing the average scores of actual pharmacy performance from student self-assessment in Area 2 (student)

3. Listing the average scores of the expectation of pharmacy competency from pharmacy preceptors' assessment in Area 3 (Target quality). In this study, target quality is the expected value of competency by the faculty in producing pharmacy graduate. In general, the value has to be greater or equal to the graduate evaluation value.

4. Calculating the improvement rate (Area 4).

Formula;

$$\text{Improvement Rate} = \frac{\text{Target quality}}{\text{Graduate evaluation}}$$

In this study,

Improvement Rate = (Mean of the expectation of pharmacy competency from pharmacy preceptors) / (Mean of the actual performance from pharmacy student assessment)

The Improvement Rate value identified the list of competency that we can improve or need improvement.

If Improvement Rate level > 1, the improvement was needed

If Improvement Rate level ≤ 1, it was already a good competency.

5. Determine outstanding competency of graduate by requiring the score in emphasis field accordingly (Yoshida, Masami, 2008):

The most important (1.5 point)

Very important (1.2 point)

Important (1.0 point)

6. Absolute weight calculation (Area 6)

Absolute weight calculation method

Absolute weight= (target quality)× (Emphasis) × (Improvement rate)

Weight calculation or competency important calculation method

$$\text{Weight} = \frac{\text{Absolute weight}}{\text{Absolute weight summary}}$$

2 The interpretation of Absolute weight

From original formula, improvement rate was replaced with organization set goal divided by customer satisfaction. It yielded the level that the organization needed to improve in certain levels. The faculty of pharmacy had an aim according to the customer need, which was a pharmacy preceptor. It was divided by the competency that the graduate had evaluated themselves. This yielded the level needed to be improve, which was also the proportion of the competency level evaluated by pharmacist trainer versus the actual competency evaluated by a student him/herself.

Absolute weight in this research obtained from substitution of various values as following:

1. emphasis – determined the value by using the level of relationship of competency domain obtained from the faculty according to the relationship level of competency domain gained from AHP method

2. target quality – determined the value by using the mean of the expectation of pharmacy competency from pharmacy preceptors

3. Improvement rate is the ratio between the level of expected competency evaluated by trainer pharmacist and the actual competency evaluated by a student him/herself.

Therefore, the absolute weight value varied in response to the values of target quality, emphasis, improvement rate. If the value of absolute weight is high, it meant that importance had been highly given to one competency. If the absolute weight was low, it meant that the faculty did not give importance to this competency. This value was the result of the perspectives of the faculty of pharmacy and trainer pharmacist. Therefore, in consideration of target quality, within the resource constraint situation the faculty had a policy to set a desired competency to meet the expectation of the pharmacist's employers. Improvement rate was the ratio of the pharmacist's actual competency and the employer's expected competency. Emphasis was the pharmacy competency emphasized by the faculty in producing competitive graduate. This value was different from "needs" value because needs is from the customer perspective only.

Step 6 Identify the importance priority of knowledge requirement (Area 6)

In the traditional HOQ, the final step of QFD approach is a comparative between the technical assessment of the engineering characteristics and their competitors. It also indicates target values for design improvement. As stated by Denton et.al, 2005, they recommended that this area can be used in the academic HOQ to show the relative amount of time spent in each the body-of-knowledge and to indicate potential increases or decreases in emphasis for curtain body-of-knowledge areas. In this study, the results obtained from the area 6 of HOQ were the scores that indicated the importance of courses. These scores could be calculated into lecturing period for each course. The calculation of classroom period of each course can be

done by comparing against the overall period of time in the pharmacy curriculum by the Office of Higher Commission.

In this last process, after all data completed in the HOQ, the next process was calculation to find the importance of courses and calculate credit of each course which bounded with regulations by Office of Higher Commission. The calculation of method was as following

Table 3.9: the example of the importance score calculation

Competency Domain	Class of Activity	The competency weight factor	Pharmacotherapy	Anatomy and Physiology	Pharmacy Practice
1. Ensuring Appropriate Therapy and Outcomes	1.1 gather and assess the information for the pharmaceutical care purpose	0.18	4	1	1
	1.2 provide pharmaceutical care	0.18	4	1	1
	1.3 manage the patient data	0.18	2		2
	Importance of subject		1.8	0.36	0.72
	Credit of subject		4	1	2

The method of calculating the importance score and number of credit

1.1 From the House of quality, the calculation of the importance score of course was by multiplying the relationship factor with the competency weight factor and total the results together by column.

Importance score of pharmacy competency $= \sum$ (the competency weight factor $\times$ the relationship factor)

The importance score of Pharmaotherapy = (4)(0.18)+(4)(0.18)+2 (0.18)

The importance score of Pharmaotherapy = 1.8

After that, the researcher ranked the courses using the absolute score. The result of this step was the relative importance of pharmacy knowledge.

1.2. After obtained the importance of course, the researcher used the importance of course to calculate the number of appropriate credit in each course of overall curriculum by comparing to the scope of credits. The researcher analyzed and interpreted the result from HOQ to propose the Pharm.D. curriculum.