CHAPTER II

LITERATURE REVIEW

To be more understand of needs assessment and quality function deployment that apply to curriculum design, many of published journals, books, reports, empirical studies and others were critically reviewed. The review presented in five sections, which were; situation of pharmacy curriculum in Thailand, curriculum and competency, needs assessment (NA) technique, quality function deployment (QFD), and the study framework.

Part I Situation of Pharmacy Curriculum in Thailand

In Thailand, there were five major pharmacy curriculum revisions. (Pothiyanon, 1998). The first curriculum was used in 1914. Students who completed the secondary school were able to enroll in a 3-year program of a Diploma in medicinal preparation. The curriculum consisted of basic sciences (chemistry, physics, and botany), basic profession (Latin, English), medical sciences (bacteriology), and professional courses (material medica, pharmaceutical techniques). The educational outcomes mostly concentrated on drug preparation, dispensing, and herbal medicine. The second curriculum was revised and had been used during 1936 to 1940. Several courses were added to the previous curriculum including physiology, pathology, analytical chemistry, drug preparation, pharmacognosy and pharmaceutical industry. The students received a Diploma in Pharmacy after graduation. The graduates were able to work not only in a hospital as previous, but also in a drug store, pharmaceutical industry, and a medical science center.

The third curriculum was launched in 1939. The program had been expanded into a 4-year program. Students who enrolled in curriculum would study a 2-year pre-pharmacy program and then later a 2-year pharmacy program. After graduation, they would received a bachelor degree in pharmacy. Many courses were included in the curriculum including economics, psychology, accounting, public health, biochemistry, food chemistry, toxicology, pharmacy administration, and research methodology. From this time, pharmacists' roles had broadly expanded included additional

responsibilities that pharmacists had to perform. The fourth curriculum was established in 1957. The curriculum was revised to a 5-year program. Several courses were added and were extensively studied, especially subjects that supported pharmacists works in other settings, not only in hospitals. All students were required to complete 300 hours of pharmacy practices before graduation. The final revision was established since 2008. The bachelor degree of Doctor of Pharmacy Curriculum required a minimum of 230 credits through 6 years of studying. Furthermore, they were also required to complete 2,000 hours of pharmacy practices before taking the licensure examination (Faculty of Pharmaceutical Sciences, Chulalongkorn University, 2008).

Part II Curriculum and Competency

1. Curriculum

1.1 Definition of Curriculum.

Webster defines curriculum as "the courses offered by an educational institution or one of its branches" or "a set of courses constituting an area of specialization."

The Report of the Focus Group on Liberalization of the Professional Curriculum appointed by AACP defined curriculum as "an educational plan which is designed to assure that each student achieves well-defined performance-based abilities (Chalmers, et.al, 1992)." Curriculum development should be an ongoing process that is responsive to changes in pharmacy practice and society and that incorporates new scientific discovery.

1.2 Curriculum Design

1.2.1 Definition of Curriculum Design and Curriculum Elements

Curriculum Design refers to the arrangement of the elements of a curriculum into a substantive entity (Ornstein, Hunkins, 2004). The parts, or elements, that are arranged in a curriculum design are (1) aims, goals, and objectives; (2) subject-matter; (3) learning experiences; and (4) evaluation approaches.

The design's four components suggest to the curriculum maker four questions; What is to be done? What subject matter is to be included? What instruction strategies, resources, and activities will be employed? And what methods and instructionals will be used to appropriate the results of the curriculum.

1.2.2 Type of Curriculum Design

Curriculum components can be organized in numerous ways. However, there were three basic designs: a. subject-centered designs, b. learner-centered designs, c. Problem-centered designs (Utranun, 1989; Pupan, 2003; Ornstein, Hunkins, 2004). Each category comprises several examples. Subject-centered designs include subject designs, discipline designs, broad field designs, correlation designs, and process designs. Learner-centered designs are those identified as child-centered designs, experience-centered designs, romantic/radical designs, and humanistic designs. Problem-centered designs consider life situations, core designs, and social problem/ reconstructionist design.

a. Subject-centered designs are by far the most popular and widely used curriculum designs. This is because knowledge and content are well accepted as integral parts of the curriculum. Schools have a strong history of academic rationalism; furthermore, the materials available for school use also reflect content organization. Subject-centered designs included subject design, discipline designs, broad field designs, correlation designs, and process designs.

1) Subject-centered designs. The subject-centered design is both the oldest school design and the best known-to both teacher and laypeople. It is so well known because teachers and laypersons are usually educated and/or trained in school employing it. It is also popular because it corresponded to textbook treatment and how teachers are trained as subject specialists. It also receives current emphasis because of the continued stress on school standards and school accountability. This design is based on belief that what makes human unique and distinctive is their intellect; the searching for and attainment of knowledge are the natural fulfillment of their intellect.

2) Discipline Design.

This discipline design that appeared in the post-World War II era evolved from the separate-subject design. This new design grew rapidly in popularity during the 1950s and reached its zenith during the mid-1960s. Like the separate subject design, the discipline design's basis is the inherent organization of content. However, whereas the subject design does not make clear the foundational basis on

which it is organized or established, the discipline design's orientation does specify its focus on the academic disciplines.

3) Broad Fields Design.

The broad fields design, which may also go by the name of interdisciplinary design, is another variation of the subject-centered design. It appeared as an effort to correct what many educators considered the fragmentation and compartmentalization caused by the subject design. The effort strove to assist students in developing a sweeping understanding of all content areas. It was an attempt to integrate content that appeared to fit together logically. Thus the separate social sciences of geography, economics, political sciences, anthropology, sociology, and history were fused into social studies. Linguistics, grammar, literature, composition, and spelling were collapsed into language arts. Biology, chemistry, and physics were integrated into general science. Because of this fusion of subjects, educators sometime assign the fused subjects design to this organization. Others say that the fused subject design is a design unto itself.

4) Correlation Design.

Correlation is a design employed by those who do not wish to go as far as creating a broad fields design, but who realized that there are times when separate subjects require some linkage in order to reduce fragmentation of curricula content. Existing as a midpoint between separate subjects and total integration of content, it attempts to identify ways in which subjects can be related to one another while still maintaining their identity as subjects.

5) Process Design

The process designs emphasize those procedures and dispositions to act that enable students to analyze their realities and create frameworks by which the knowledge derived can be arranged. Often the organizational frameworks differ from the way the world appears to the casual observer. There is much dialogue about involving students in their learning and empowering them to be the central players in the classroom.

b. Learner-Centered Design

All curricularists are concerned with creating curricula that valuable to students. In response to those educational planners who valued subject matter,

educators early in the twentieth century asserted that students are the center or focus of the program.

1) Child-centered designs. Advocates of the child-centered or student-centered design believed that if we are to optimized learning then the student must be achieve in his or her environment. Learning should not be separated from the ongoing lives of students, as is often the case with the subject-centered design, it should be based on students'lives, their needs and interests.

2) Experienced-centered designs. Experienced curriculum designs closely resembled the child-centered designs in that they used the concerns of children as the basis for organizing the children school world. However, they differed from child-centered designs in their view that the interests and needs of children cannot be anticipated and, therefore, a curriculum framework can not be planned for all children.

3) Romantic (Radical) Design. An underlying assumption of the radicals appears to be that the current society is corrupt, repressive, and unable to cure itself. Schools have used their curricula to control and to indoctrinate individuals into a particular curricula view rather than to educate and emancipate them. Radical curricularists believe that individuals must learn those ways of engaging in a critique of knowledge. Learning is reflective; it is not externally imposed by a person in power. Education leads to freedom and emancipation. In the radical curriculum design, knowledge is not a finished product that sits in a unit plan or course syllabus. Such a document is a curriculum that indoctrinates. Learning is something that results from the interaction between and among people. It comes by challenging content and performing different views about the content, as well as from critiquing the purposes of the information presented in the curriculum.

4) Humanistic Design.

Humanistic design gained prominence in the 1960s and 1970s, partly in response to the excessive emphasis on the disciplines during the 1950s and the early 1960s. it was this perceived imbalance regarding attention to subject matter that caused humanistic education to appear in the 1920s and 1930s as part of the progressive philosophy and the whole-child movement in psychology, After World War II, humanistic designs connected to existentialism in educational philosophy.

c. Problem-Centered Designs

The third major type of curriculum design, which is problem centered, focused on the problems of living-on the perceived realities of institutional and group life.-both for the individual and for society in general. Problem-centered curriculum designs are organized to reinforce cultural traditions and also to address those community and societal needs that are currently unmet. They address individual's problem as well. Problem-centered designs consider life situations, core designs, and social problem/reconstructionist designs.

1) Life-Situation Design

Fundamental to the design are three assumptions. The first is that persistent life situations are crucial to a society's successful functioning and that it makes educational sense to organize a curriculum around them. The second assumption is that students will see direct relevance to what they are studying if the content is organized around aspects of community life. Finally, by having students study social or life situations, they will be directly involved in such improvement.

2) Core Design

This particular curriculum design, sometimes called "social functions" core, is carefully planned. It centers on general education and is based on problems arising out of common human activities. There are several variations of core designs. Subject matter core designs, for example, would be classified as subject-centered designs. Area-of living core designs are rooted in the progressive education tradition. Indeed, Dewey argued that learning is part of living and, therefore, the experience of living should serve as the focus for the curriculum. An authentic curriculum is life reflected on intensity.

After reviewing the literatures, discipline of subjects had been highly deemed on with respect to used for designing pharmacy curriculum. This was because this study focused only curriculum contents design that best fit the stakeholders' expectations. Main components that primarily supposed to design were courses, credit hours, course sequences. Then, the next section explained the principle of content sequences.

1.3 Content Sequences

The approach of content sequences is developed by Smith, Stanley, and Shores. They presented four principles which are (Utranun, 1989; Pupan, 2003; Ornstein, Hunkins, 2004).

1) Simple to complex learning approach. It indicates that content is optimally organized in a sequence going from simple subordinate components or elements to complex components depicting interrelationships among components.

2) Prerequisite learning approach. It works on the assumption that the curriculum be arranged so that the content or the experience is presented first in an overview (abstract) fashion to furnish students with a general idea of the information

3) Whole to part learning approach. It receives support from cognitive psychologists. They urged that the curriculum be arranged so that the content or the experience is presented first in an overview fashion to furnish students with a general idea of the information or situation.

4) Chronological learning approach. Frequently, history, political science, and world events are organized in this manner. Curricularist refers to this type and organization as world-related.

The pharmacy profession is a specialized field having its own knowledge and skills, the curriculum design thus was emphasized as the competency-based curriculum which appropriated to the pharmaceutical profession. Then, the next part of literature reviewed had explained concepts of pharmacy competency as follows:

2. Competency

Competency is the behaviors or skills that employers must have, develop or acquire to achieve a specified level of performance (McGuire, R., 2005). McConnell (2001) defined competency as a student's or practitioner's ability to perform actions in a real setting (McConnell, 2001). Hill, et al (2006) defined competency as the set of knowledge, skills, capabilities, judgment, attitudes, and values that entry-level practitioners are expected to possess and demonstrate (Hill, et al, 2006).

In the view point of this study, pharmacy competency is defined as a pharmacy graduate's ability to perform professional functions.

2.1 Competency Standard in Thailand

In Thailand, the competency standard guideline was established in 2002 by the Thai Pharmacy Council. The standards were developed by a group of pharmacy experts during the meetings. The standards, which included eight domains, are as follows (Thai Pharmacy Council, 2002):

1) Knowledge in pharmaceutical manufacturing process and quality assurance.

2) Conduct a health problem and community drug need assessment, drug selection and procurement of pharmaceutical products to serve patients appropriately.

3) Prepare an appropriate pharmaceutical product for extemporaneous preparation.

4) Conduct a basic health evaluation for appropriate counseling to patients including referring in necessary case.

5) Make rational drug use planning for each patient and provision of drug usage by focusing on patient participation.

6) Follow up, prevent, solve drug related problem in a patient and a community, and systemic report to related person.

7) Provide up-to-date and reliable pharmaceutical and health product information to patients, communities, and health practitioners.

8) Knowledge in pharmaceutical related laws.

2.2 Competency Standards in United States

Pharmacy Competency Standard is an input data for this study, obtained from the Pharmacy Practice Activity Classification (PPAC) which is a set of specific activities and/or behaviors across all practice settings based on pharmacists' knowledge and clinical judgment. The PPAC was developed by the American Pharmacists Association to create a single document which broadly captures the activities of all pharmacists irrespective of practice setting. The PPAC consists of 4 competency domains whereas this practice classification is a hierarchical categorization of pharmacist activities, clustering "similar" sets of behaviors. The highest level is the Domain or field of activity. Four major domains of pharmacist activities have been identified. Within each domain are more specific Classes of activities. Within each class are the Activities or Interventions -- labels for sets of specific behaviors that, based on their professional knowledge and clinical judgment, pharmacists engage in as a part of their professional practice to enhance patient care and outcomes (American Pharmacists Association, 1998):

Table 2.1 The Pharmacy Practice Activity Classification (PPAC)

DOMAIN	CLASS
A. Ensuring Appropriate Therapy and Outcomes	A.1. Ensuring appropriate pharmacotherapy A.2 Ensuring patients understanding/adherence to his of her treatment plan A.3. Monitoring and reporting outcomes
B. Dispensing Medications and Devices	B.1. Processing the prescription or drug order B.2. Preparing the pharmaceutical product B.3. Delivering the medication or device
C. Health Promotion and Disease Prevention	C.1. Delivering clinical preventive services C.2. Surveillance and reporting of public health issues C.3. Promoting safe medication use in society
D. Health Systems Management	D.1. Managing the practice D.2. Managing medications throughout the health system. D.3. Managing the use of medications within the health system D.4. Participating in research activities D.5. Engaging in interdisciplinary collaboration

This study targeted to design pharmacy curriculum for the faculty of Pharmaceutical Sciences, Chulalongkorn University using two main concepts which were needs assessment and, quality function deployment

Part III Needs Assessment Technique (NA)

1. Definitions of Needs and Needs Assessment

Needs was defined as a measurable discrepancy between the current and the desired status for an entity (Altschuld and Witkin, 2000). Kaufman. (1972) defined needs as a discrepancy or gap between some desired or acceptable condition or state of affairs and the actual or observed or perceive condition or state of affairs (Witkin, 1984).

Also departing from discrepancy definition, Stufflebeam viewed needs as "something that can be shown to be necessary or useful for the fulfillment of some defensible purpose." He identified three view points: the democratic, the diagnostic, and the analytic. In the democratic view, a need is a change desired by the majority of some reference group. The diagnostic view considers a need as something whose absence or deficiency proves harmful, while in the analytic view, a need is the direction in which improvement can be predicted to occur, given information about current status (Witkin, 1984).

Kaufman (1982) defined needs assessment as a formal analysis that shows and documents the gaps between current results and desired results (ideally concerned with gaps in OUTCOMES), arranges the gaps (NEEDS) in priority order, selects the NEEDS to be resolved" (Witkin, 1984). He emphasized that the needs assessment may identify gaps in results that show either too little or too much of something. Kaufman also views needs assessment as a tool that requires the consensus of partners in planning and setting priorities on needs (Kaufman and English, 1981). Needs assessment is defined as the process of determining, analyzing, and prioritizing needs and, in turn, identifying and implementing solution strategies to resolve high-priority needs (Altschuld and Witkin, 2000).

2. Three Levels of Need and Target Groups

There are three level of need, with different target groups associated with each (Altschuld and Witkin, 2000). The levels are as follows:

Level 1 (the primary level) consists of those individuals who would be the direct recipients of receivers of services. The services would be a result of a program developed to resolve a high-priority need. Examples of these target groups would be students, clients, patients, customers, and so on

Level 2 (the secondary level) is composed of individuals or groups who deliver services to Level 1 (and sometimes level 2 is used to refer to a treatment

provided to Level 1 target groups). Examples would be teachers, social workers, counselors, health care professionals, librarians, policy makers, administrators, and others.

Level 3 (the tertiary level), which is substantially different from Levels 1 and 2, focuses on resources and inputs into solutions. Examples of this level of need are buildings, facilities, classroom, transportation systems, salaries and benefits, program delivery systems, and the like.

3. Needs Assessment Process

Complete Needs Assessment composed of three steps; first, needs identification; second, needs analysis; third, needs solution (Wongwanich, 2005).

3.1. To begin with, needs identification, this step is the identification and prioritization of the needs. In addition, WNI, Priority needs index, matrix analysis, and others methods were able to applied for needs prioritization, in which PNI and matrix analysis were used in this presenting study. Details of these two methods were;

3.1.1 Priority Needs Index (PNI)

Priority Needs Index (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 is created by Lane, Crofton, and Hall by developing the order ranking of needs from the difference of the average of expectation and the current value by weighing the difference of the average between Importance (I) and Degree of Success (D) with the importance (I).

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

I = Importance

D = Degree of Success

Priority Needs Index was ranked from high score to low score. The needs that had the high PNI score meant low degree of success and they should be improved.

3.1.2 Matrix Analysis

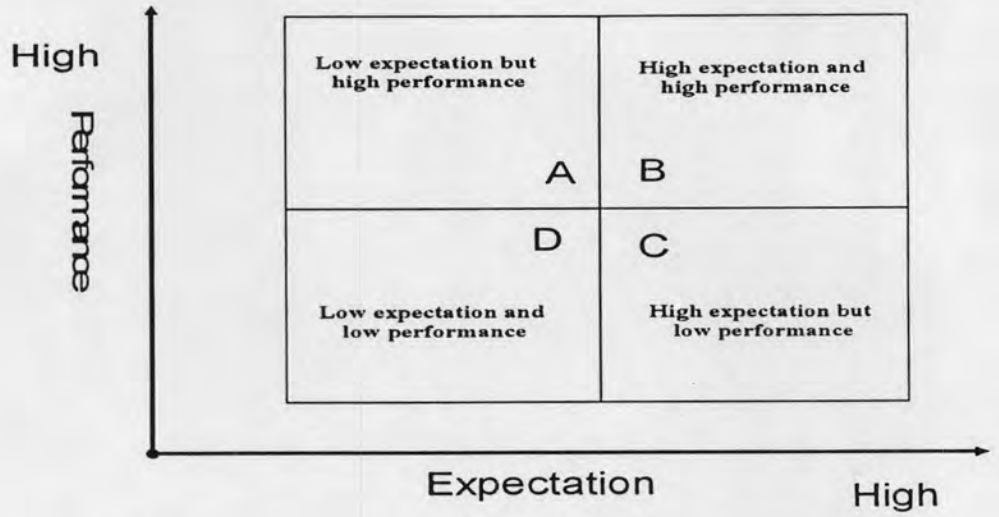
Another useful method for the further curriculum development is matrix analysis. Matrix analysis is the method of performance analysis to present the strength and weakness of each activity competency. The figure of matrix analysis divided into four quadrants showing the relation between the expectation and the current performance as shown in Figure 2.1(Wongwanich, 2005; Gonzalez, et al, 2008.).

Quadrant A: The upper left quadrant indicated low level of expectation and high performance. Any activities falling in this quadrant meant that the performance got over-determined result. Actual performances of these activities were rated higher. If there was a limited resource, action should be taken to other activities. If the quality characteristic placed here is eliminated or reduced, perhaps the customer will not notice it.

Quadrant B: The upper right quadrant indicated high level of expectation with over-determined performance. It meant the activity performance got satisfied level. This was the most desired quadrant. Universities must improve and monitor all quality activity competencies placed here.

Quadrant C: The lower right quadrant indicated low level of expectation with under-determined performance. It meant the activity performance got dissatisfied level and required for improvement. This is the critical quadrant. Universities must set up an action plan to move the critical activity competencies to quadrant B as soon as possible.

Quadrant D: The lower left quadrant indicated low level of expectation and low performance. It meant the activity performance got dissatisfied but not much concerned by the academic's customer. Universities should not take any action unless there are changes in the market, or customer expectation.



Note:

1) The competency results in the quadrant A & B mean the strength of the undergraduate pharmacy competency.

2) The competency results in the quadrant C & D mean the weakness of the undergraduate pharmacy competency.

Figure 2.1 Matrix analysis of the pharmacy expectation and the actual performance of pharmacy competency

3.2 Needs analysis was the subsequent phase of needs assessment. This step was to analyze causes of discrepancies and to establish priorities. Fishboning Technique, Fault Tree Analysis, and LISREL Analysis were used as study methods.

3.3 Needs solution was the third step of needs assessment. The aim of this step was to select solution strategies for high-priority needs and to develop action plans for the implementation of the best solution or strategies. The methods that can be applied for needs solution were such as Multi-Attribute Utility Theory (MAUT), Analytic Hierarchy Process (AHP), Cross-Impact Analysis and Quality function Deployment (QFD), a relative recent arrival on the Needs Assessment scene (Altschuld and Witkin, 2000; Wongwanich, 2005)

In this study, the complete needs assessment was conducted. The process of the assessment were; first, needs identification which is the competency needs identification; second, needs analysis which is the analysis of competency

needs with curricula contents; and the last, needs solution which is the application of QFD to design pharmacy curriculum. QFD technique was applied in order to design curriculum contents, and would be explained in the next parts of literature reviews.

Part IV Quality Function Deployment (QFD)

This part presented a comprehensive investigation of Quality Function Deployment (QFD), a design tool. It was divided into five sections. The first part mentioned a details and description of the QFD and the house of quality (HOQ). The main benefits and problems of QFD then followed including the other techniques that used in QFD were presented. After that, the related researches of QFD were reviewed and sum up with how QFD used in creating curriculum.

1. QFD and the House of Quality (HOQ)

The concept of QFD was created in Japan in the late 1960s. According to Akao (1988) after World War II, Japanese companies used to copy and imitate product development; nevertheless, they decided to move their approach to one based on originality. QFD was introduced, in that environment, as a concept for new product development.

1.1 Definition of Quality function deployment

The philosophy of QFD is "the voice of customer will drive everything an organization does throughout the process of developing and delivering products and services". QFD has been defined in many different ways. Akao (1988) defined Quality function deployment (QFD) as a system for designing products or services based on customer demands and involving all members of the producer or supplier organization (Akao, 1988). Cohen (1995) defined QFD as "a method for structured product planning and development that enables a development team to specify clearly the customer's wants and needs, and then to evaluate each proposed product or service capabilities systematically terms of its impact on meeting those needs (Cohen, 1995)". Altschuld and Witkin (2000) defined it as "a procedure primarily employed in business and industry for developing products that satisfy the needs of consumers or customers (Altschuld and Witkin, 2000)".

For this study, QFD is a systematic ways that provides a means of translating customer requirements into the appropriate technical requirements for each stage of product development.

1.2 QFD and the House of Quality (HOQ)

The QFD process involves mapping customer requirements onto specific design features and manufacturing processes through these four matrices. QFD can be employed at two levels:

- To translate requirements of one functional group into the supporting requirements of a downstream functional group
- As a planning and control tool for product development.

The first level typically involves the first of these matrices (Figure 2.2). This matrix has the most general structure and is often called the "house of quality" (HOQ). Typically applications of QFD are limited to the HOQ, however QFD can play a greater role as a linking mechanism throughout product development through the use of subsequent matrices.

The four phases of QFD help communicate product requirements from the customers to the design team to the production operators. Throughout the phases, all participants are able to assess how solutions would help to satisfy customer requirements. All decisions are based on the highest level of customer satisfaction. The four phases provide a guide through the product development cycle from product design to production.

Each phase has a vertical column of *Whats* and a horizontal column of *Hows*. *Whats* are customer requirements and *Hows* are ways of achieving these requirements. *Hows* that are most important, require new technology, or involve high risk are carried forward to the next phase.

In the *Design Phase*, the customer helps to define the product requirements. The *Hows* carried over from the Design phase become the *Whats* for the *Details Phase* and design specifications are converted into individual part details. In the *Process Phase*, the processes required to produce the product are developed. The

Hows from the Details phase become the *Whats* for the Process Phase. The *Hows* from the Process phase become the *Whats* for the *Production Phase* and the production requirements for the product are developed.

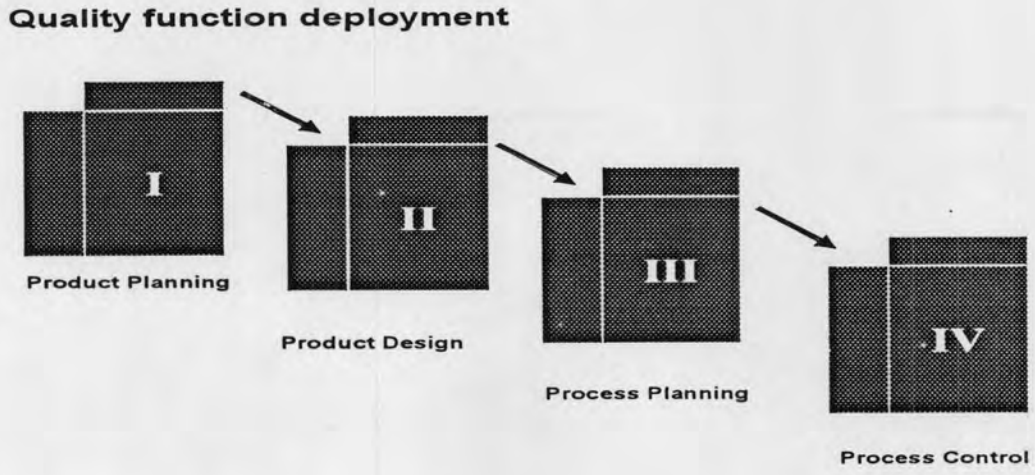


Figure 2.2 The four phases of the traditional House of Quality.

The house of quality (HOQ) can be developed in many shapes and forms. The general objectives of the QFD model include the components address in Figure 2.3 (Akao, 1988; Cohen, 1995, Hauser and Clausing, 1988 cited in Denton, Kleist, and Surendra, 2005; Han, et.al., 2001; Chan and Wu, 20002).

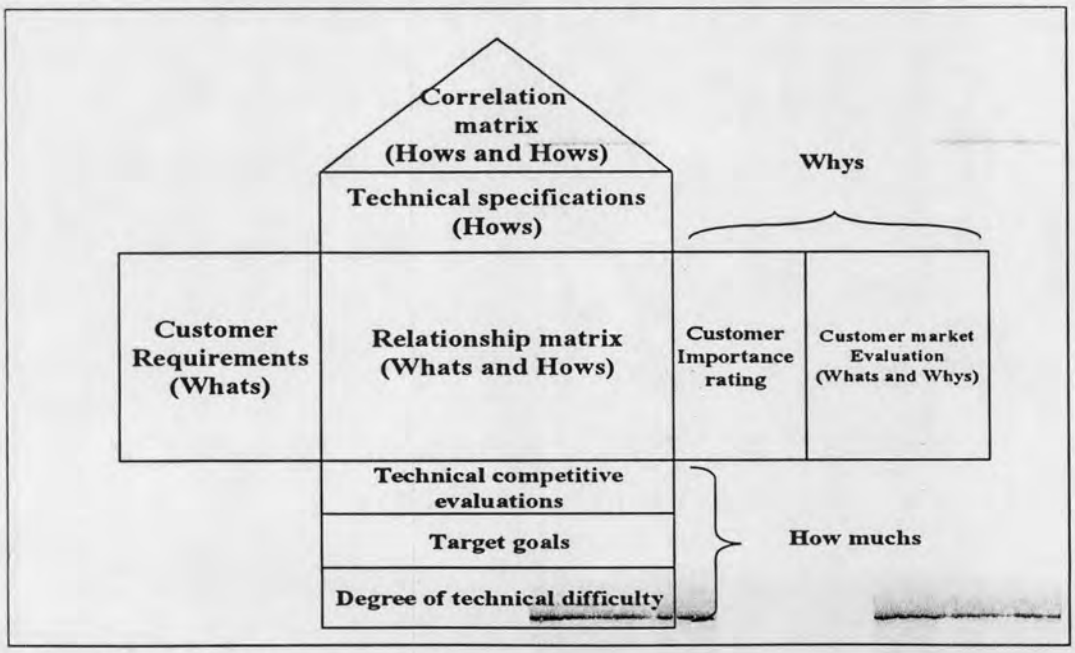


Figure 2.3 House of Quality

Customer requirements (CR) – Also known as "Voice of Customer" or VoC, they are the "whats" the customers want from the product to be developed. Customer requirements are the basic inputs required to initiate a QFD project. Customer requirements could be in regard to the use of a product, aspects of products that consumers find undesirable, or why consumers are not purchasing a company's products or services. The data are obtained from surveys, focus group interviews, individual interview, and observation. The QFD process also includes determining the priority of needs.

Customer importance ratings - Once these "whats" are in place, the customer needs to provide numerical ratings to these "whats" items in terms of their importance to the customer. A numerical rating of 1 to 5 is often used, in which the number 5 represents the most important and 1 the least.

Customer market competitive evaluations - In this block, a comparison is made between a company's product/service and similar competitive products/services on the market by the customer. The comparison results will help the developer position the product on the market as well as find out how the customer is satisfied now. For each product, the customer gives 1 to 5 ratings against each CR, 5 being best satisfied and 1 the worst.

Technical requirement - They are the technical specifications that are to be built into a product with the intention to satisfy the CR. They are sometimes referred as "hows" because they are the answers to CR: how can the requirements be addressed or satisfied. They are the engineers'understanding in technical terms what customers really want. The technical specifications must be quantifiable or measurable so that they can be used for design.

Relationship matrix - Relationship matrix is used to maintain the relationship between CR and design requirements. In other words, the matrix corresponds to the "whats" vs. "hows". It is the center part of HOQ and must be completed by technical team. A weight of 1-3-9 or 1-3-5 is often used for internal

representation of relationship, 1 being the weak and the biggest number being the strong relationship.

Correlation matrix - It is the triangular part in the HOQ (the "roof"). The correlation matrix is used to identify which "hows" items support one another and which are in conflict. Positive correlation help identify "hows" items that are closely related and avoid duplication of efforts. Negative correlation represents conditions that will probably require trade-offs. The positive and negative ratings are usually quantified using 2, 1, -1, and -2 ratings, with 2 being the two "hows" items are strongly supportive to each other and -2 being the conflicting. Sometimes only 1 and -1 are used.

Target goals - Completed by technical team, these are the "how muchs" of the technical "hows" items. They provide designers with specific technical guidance for what have to be achieved as well as objectively measuring the progress. The goals have to be quantified in order to be specific and measurable.

Technical difficulty assessment - Technical team conducts the assessment. It helps to establish the feasibility and reliability of each "hows" item. A 1 to 5 ratings are used to quantify technical difficulty with 5 being the most difficult and 1 being the easiest.

Technical competitive evaluation - It is used for comparing the new product with competitor's products to find out if these technical requirements are better or worse than competitors. Again, 1 to 5 ratings are used with 5 being the fully realized each particular "hows" item and 1 being the worst realized.

Overall importance ratings - This is the final step of finishing HOQ for phase 1. For each column, sum all the row numbers each of which is equal to the production of relationship rating and customer's important rating. The results help identify critical product requirements and assist in the trade-off decision making process.

2. Benefits and Problems of QFD

2.1 Benefit of QFD

There are many benefits of QFD, as follows (Cohen, 1995; Han, 2000; Martins and Aspinwall, 2001; Govers, 2001; Bouchereau and Rowlands, 2000).

1) Major reduction in development time and costs, shorter design cycles and changes. Significantly reduced start up problems, times, and costs.

2) Leads to truly satisfied and delighted customers.

3) Improved communication within the organization. Brings together multifunctional teams, and encourages teamwork and participation.

4) The quality and productivity of service will become more precise in a continual improvement process, and the company can reach world class.

5) QFD clarifies customer priorities for competitive advantage. Marketing advantage through increased market acceptability –leading to increased market share and better reaction to marketing opportunities.

6) Enables one to focus proactively on Customer relationship early in the design stage. Critical items identified for parameter design, and product planning is much easier to carry out. Also, ensure consistency between the planning and the production process

7) Brings together large amount of verbal data, organizes data in a logical way, and producing better data for refining the design of future products and services.

8) The house of quality is a useful framework for gathering, communicating, and evaluating the customers' requirements.

2.2 Problems and Mistakes during the Use of QFD

Although QFD has attracted great attention, its popularity has not always translated into successful practice. When inappropriately applied, it may increase work without producing any benefits (Akao, 1990). As Gover (2001) indicated that "QFD is not just a tool but has to become a way of management". The major problems of QFD, which are (Cohen, 1995; Han, et.al., 2000; Martins and Aspinwall, 2001; Govers, 2001; Bouchereau and Rowlands, 2000; Altschuld and Witkin, 2000):

1) If all relational matrixes combined into a single deployment, the size of each of the combined relational matrixes would be very large. Completing QFD late, does not let the changes be implemented. It takes a long time to develop a QFD chart fully.

2) QFD is a qualitative method. Due to the ambiguity in the voice of the customer, many of the answers that customers give are difficult to categorize as demands.

3) Conflicting requirements could arise among different customers who have different expectation.

4) It can be difficult to determine the connection between customer demands and technical properties. Organizations do not extend the use of QFD past the product planning stage.

5) QFD is not appropriate for all applications. QFD was adapted from manufacturing contexts and may not fit some other needs assessment situations well.

3. Other Techniques That Used in QFD; AHP

The Analytic Hierarchy Process (AHP) was used for prioritize data. The Analytic Hierarchy Process (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 variable; and synthesizing the judgments to determine which variables have the highest priority (Badri and Abdulla, 2004). The AHP is built on three principles: the principle of constructing hierarchies, the principle of establishing priorities, and the principle of logical consistency.

The task of setting priorities requires that the criteria and sub-criteria be layered in the hierarchy so that the elements of each level are comparable among themselves in relation to the elements in the next higher level. A weighting process is used to obtain overall priorities. This is done by moving down the hierarchical structure of information and weighting the priorities measured in a hierarchy level with respect to criterion. For the weighting process, the AHP uses pair-wise comparison to create derived scale for each set of criteria in the hierarchy. The pair wise comparison asks the individual to specify levels of intensity or preference.

The inconsistency ratio is calculated for each set of judgments. It is important to emphasize that the objective is to make "good" decisions, not to minimize the inconsistency ratio. Good decisions are most often based on consistent judgments, but the reverse is not necessarily true. It is easy to make perfectly consistent judgments that are nonsensical and result in terrible decisions. When the inconsistency ratio is zero we have complete consistency; when it is greater than zero there is some inconsistency. If it is 0.10 or less the inconsistency is generally considered tolerable. The degree of inconsistency that indicates a "significant" problem depends, of course, on the specific situation where the model is applied. The number 0.10 is given as a general guideline.

For solving a decision-making problem, the AHP normally has four steps as follows (Saaty, 1994; Lam and Zhao, 1998):

Step 1: Setting up the decision hierarchy by breaking down the decision problem into a hierarchy of interrelated decision elements.

The design of hierarchies requires experience and knowledge of the problem area. At the top of the hierarchy is the managerial objective of making the decision. The intermediate level normally contains decision criteria that contribute to the quality of the decision. The lowest level normally is a list of decision alternatives.

Step 2: Collecting input data by pair-wise comparisons of decision elements.

The data collection is based on the concept of pair-wise comparisons. The elements in within the same level of a hierarchy are compared in relative terms as to the importance of their contribution to a given criterion that occupies the level immediately above the elements being compared. A set of pair-wise comparison matrices is constructed for each of the lower levels, one matrix for each element in the level immediately above.

Step 3: Using the "eigenvalue" method to estimate the relative weight of decision elements.

Using the above pair-wise comparison scores as the input, "eigenvalues" can be found for each matrix using matrix algebra. The eigenvalues indicate the relative importance (weight) of decision elements with respect to the objective at the immediate higher level.

Step 4: Aggregating the relative weights of decision elements in stage three to arrive at a set of ratings for the decision alternatives.

The final or global weights of the elements at the bottom level of the hierarchy are obtained by adding all the contributions of the elements in one level with respect to all the elements in the level above. This is known as the principle of hierarchic composition. In the case of group decisions, the group judgments can be aggregated through the deterministic approach. One may argue that it is possible to assign weights directly to elements of a level. However, such direct assignment of weights is too abstract for the evaluator and results in inaccuracies. Pair-wise comparisons, on the other hand, give the evaluator a basis on which to reveal his or her preference by comparing two elements simultaneously.

4. Related Research of QFD

4.1 Application of QFD in Curriculum Design

There have been a number of quality function deployment (QFD) applications in higher education. The examples of the application of QFD in curriculum and course development are reported as follows:

Bier and Cornesky (2001) used Quality Function Deployment (QFD) techniques to construct a master's degree in acupuncture and oriental medicine (MS in AOM) at RainStar University. The advantage of this study is the necessary competencies incorporated into the curriculum by focus on group of expert panels which include people in academic and private practice. As a result, QFD leads to the graduates who match up directly with the job requirements they will face after graduation. They concluded that QFD matrices are able to, not only help design the curriculum, but also keep an entire academic unit focused on the importance of each course in the final product: the graduate (Bier and Cornesky, 2001).

Hwarng and Teo (2001) demonstrated how an institution in higher education can apply Quality Function Deployment (QFD) methodology to translate the voices of customers (VsOC) in stages into operations requirements. They conducted in Business school at the National University of Singapore (NUS). They concluded that the adapted three-phased, service-based QFD methodology proved to be an effective tool for translating the VsOC into "what to carry out" (Hwarng and Teo, 2001).

Peters, Kethley and Bullington (2005) applied the House of Quality to facilitate the design of a required operation management course in an MBA program. The benefits of this tool are the House of Quality was a useful framework for gathering, communicating, and evaluating the customers' requirements. It also provided a basis informed discussion about the course with the faculty members (Peters, Kethley and Bullington, 2005).

Denton, Kleist, and Surendra (2005) proposed that the technique of Quality Function Deployment (QFD) may be useful for curriculum and course design. They applied these principles and techniques to business curriculum and course design in the academic domain of Management Information Systems. The benefit of using this technique is the overcoming resource constraints and delivering rich and deep courses within a well-designed curriculum (Denton, Kleist, and Surendra, 2005).

Gonzalez, et al. (2008) used quality function deployment (QFD), Benchmarking analyses and other innovative quality tools to develop a new customer-centered undergraduate curriculum in supply chain management (SCM). They used potential employers as the source for data collection. Furthermore, they used QFD and benchmarking to develop a Voice of Customer matrix. Using information from the matrix, a new customer-oriented SCM undergraduate program was designed. They outline a practical solution to the problem of designing academic program which satisfy the main expectations of potential employers (customers).

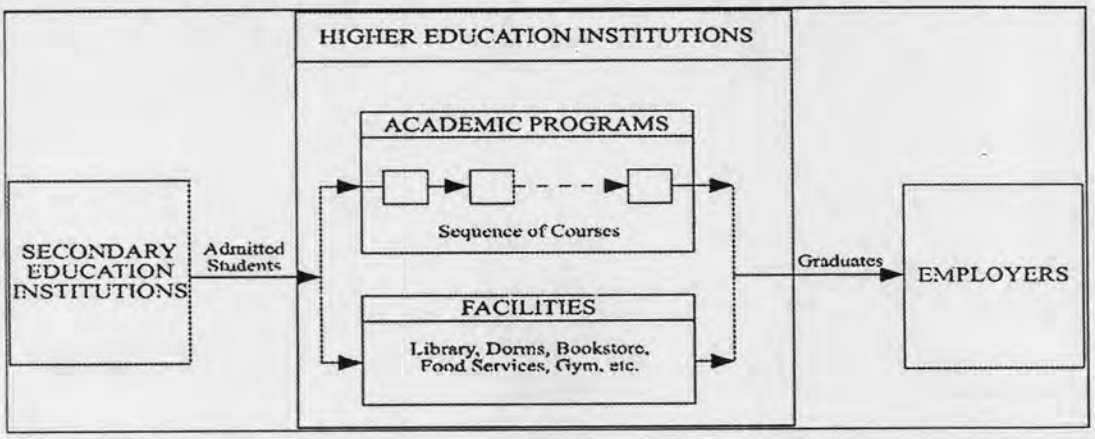
However, there are two main processes that are very important in QFD; first, customer identification; second, the QFD matrix design.

4.2 Related Research of Customer Identification in QFD

Among the essential steps of quality function deployment steps, customer focus is the most important. In higher education, the clear definitions of customers are very difficult because the various groups of customers are involved in the education. From literature review, many researchers have been defined this term in different ways as follows;

According to Sirvanci (2004), the model of the student flow in higher education was proposed. Figure 2.4 depicts the flow of students through a higher education institution. Once admitted, students move through the various courses required for a degree as raw material flows through the successive stages of the

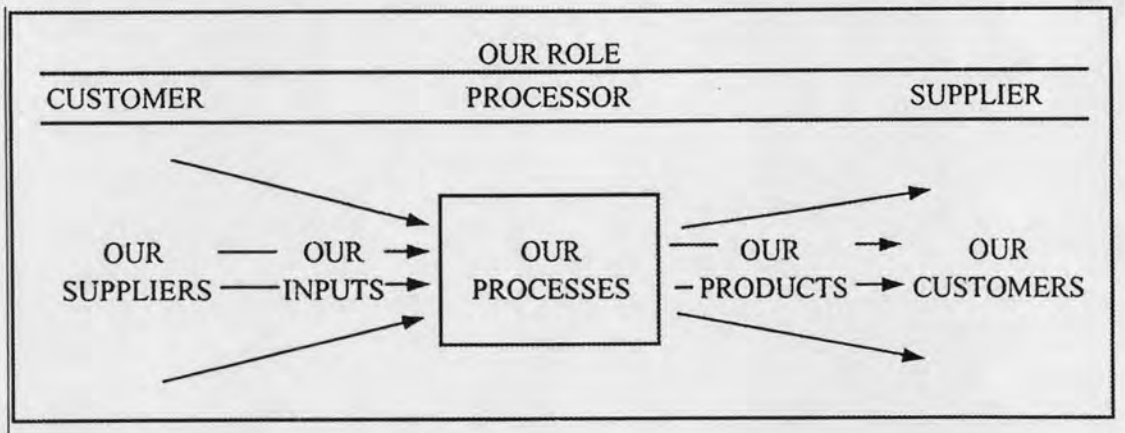
manufacturing process. As the finished product carries the brand name and label of the manufacturer, graduating students are issued with diplomas certifying that all the requirements for their degree have been completed. University graduates compete for their jobs just like brands and products compete for customers in the market place. In this model, Sirvanci (2004) suggested that graduated students may be interpreted as the finished product, and that employers are the customers of higher education institutions (Sirvanci, 2004).



Source: Sirvanci (2004)

Figure 2.4 Student flow in higher education

Hwang and Teo (2001) conducted "Translating customers'voices into operation requirements QFD application in higher education" at the University of Leeds, Singapore. In the customer identification step, they use Juran's Triple Role concept (TRIPROL) as a way to map out the customers of higher education. The concept is readily illustrated by the TRIPROL2 diagram as depicted in Figure 2.5. TRIPROL does not only facilitate the identification of the various customers in a higher education context, but also help explain the roles played by the different stakeholder groups. It adequately and neatly represents the various roles of the stakeholder groups. The customer represents the stakeholder group acquiring various kind of input in order to produce its products. Therefore, it is a customer of those who provide the input. The processor represents the stakeholder group processing those inputs in order to produce its products. Therefore, it is the processor of the products. The supplier represents the stakeholder group supplying its products to its customers. Therefore, it is a supplier to its customer (Hwang and Teo, 2001).



Source: Juran (1982)

Figure 2.5 The TRIPOL ™ diagram

Dr. Akao of Asahi University and one of the founders of the QFD methodology explained the concept of QFD evaluators to university education. He 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).

In this research, Dr. Akao's concept was applied to the customer identification step.

4.3 Related Research of the QFD matrix design

In the application of QFD in curriculum and course design, the house of quality (HOQ) matrix can be designed freely upon the input and outcome on which the researchers needs or want. The examples of design of QFD matrices are: In the study of Mazur (1996), he designed the QFD matrices by identifying the relationships between the customer (industry) requirements and the skills and capabilities of graduate students. After that, the skills and capabilities of graduate students were mapped into subject matter, activities, and reports in proportion to the curriculum percentages in the quality table (Mazur, 1996).

Bier and Cornesky used QFD to construct a higher education curriculum at RainStar University. They designed the QFD matrices by identifying the relationships between the terminal competencies of the graduate students and the courses. RainStar believes QFD matrices can, not only help design the curriculum,

but also keep an entire academic unit focused on the importance of each course in the final product: the graduate (Bier and Cornesky, 2001).

Duffuaa, et.al.(2003) apply QFD to design a basic statistics course. They defined organizations as the external customers and the students as the internal customers. The customer requirement obtained from companies is collected through survey. The technical requirements are obtained from faculty members as follows: syllabus, prerequisites, student preparation, faculty, teaching methods, and class size. QFD process planning matrices are used for developing several alternative course design concepts. They identified the design concept that closely meets customer requirements base on a simple decision criterion. The result of analysis is a balanced basic statistics course (Duffuaa, et.al, 2003).

In the study of Noble (1998), he applied QFD to capstone design courses. His input data for QFD matrices are the objectives of these courses that determine from the learning concepts. He designed the house of quality matrix by identifying the relationships between the objectives and the topics that should be learned (Noble, 1998).

Normally, many studies have the similar of QFD matrices design. Input data of most studies are the customer requirements. The outcome of QFD matrices of curriculum design are teaching method or the pattern of activities (Mazur, 1996).

5. How QFD Approach Used in Creating Curriculum

General curriculum consists of 3 parts, which are 1) course consisting of content and instructional method, 2) education plan and 3) curriculum structure. This study was applied the QFD approach in designing Pharm.D. curriculum. Steps in curriculum design involved collecting data from the studies in phase 1, collecting additional data in each step of curriculum creating process, and then integrating them. These work processes required corporation from the faculty members in providing information by conducting small group meeting and brainstorming session. All the outcomes would then be processed and used in the curriculum design. The QFD approach had high flexibility and did not have fixed designation. It is generally be able to alter depending on the data characteristics received from the stakeholders and organization, including the desired outcome from curriculum design.

According to the curriculum development, steps in curriculum design consisted of three parts which were (Ornstein, Hunkins, 2004); first, the design of content and scope of content; second, the design of instructional method; third, the content connection. This therefore leads to the following considerations, as shown in Figure 2.6, of how to produce preferable graduate students as the faculty of pharmacy desired.

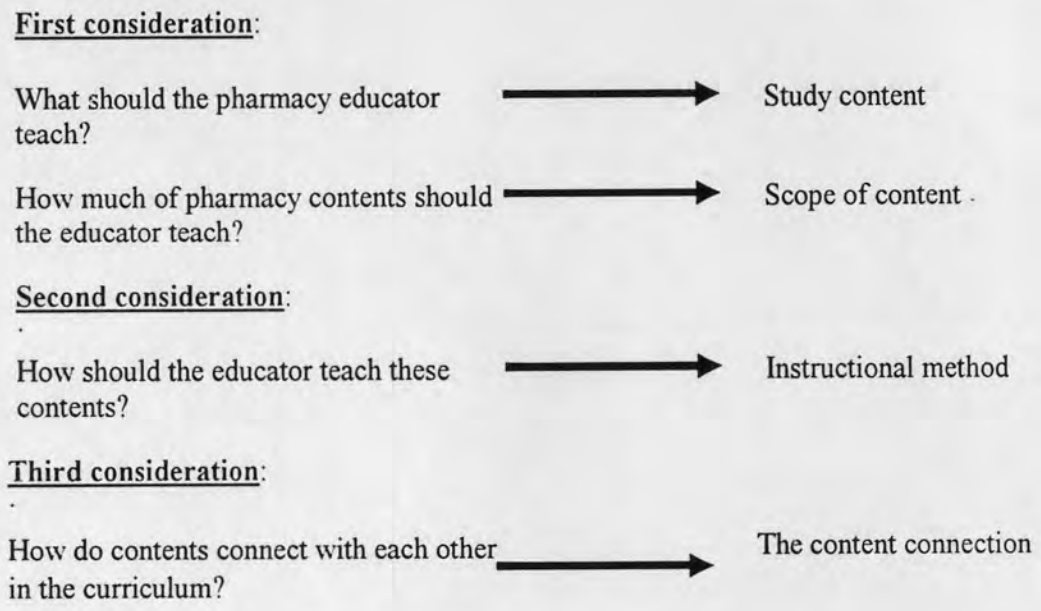


Figure 2.6 The consideration in curriculum design

According to 3 parts of curriculum design, the parts needed to be designed were; content and scope of content, instructional method; and content connection. .

The traditional four-matrix, industrial QFD methodology (Hauser and Clausing, 1988) needed some adaptations to be applied in curriculum design. This study had modified QFD methodology based on the recommendation from Denton, Kleist, Surendra, 2005 and three parts which stated above. For the academic version of the QFD model, a four-matrix method was transformed in a three-matrix method as shown in Figure 2.7. Furthermore, the traditional terminology also had to be modified to apply the QFD methodology to the design. These three-matrix included

(1) House of quality (curriculum planning matrix)

(2) Course planning matrix

(3) Education plan and the curriculum structure of Pharm.D. program

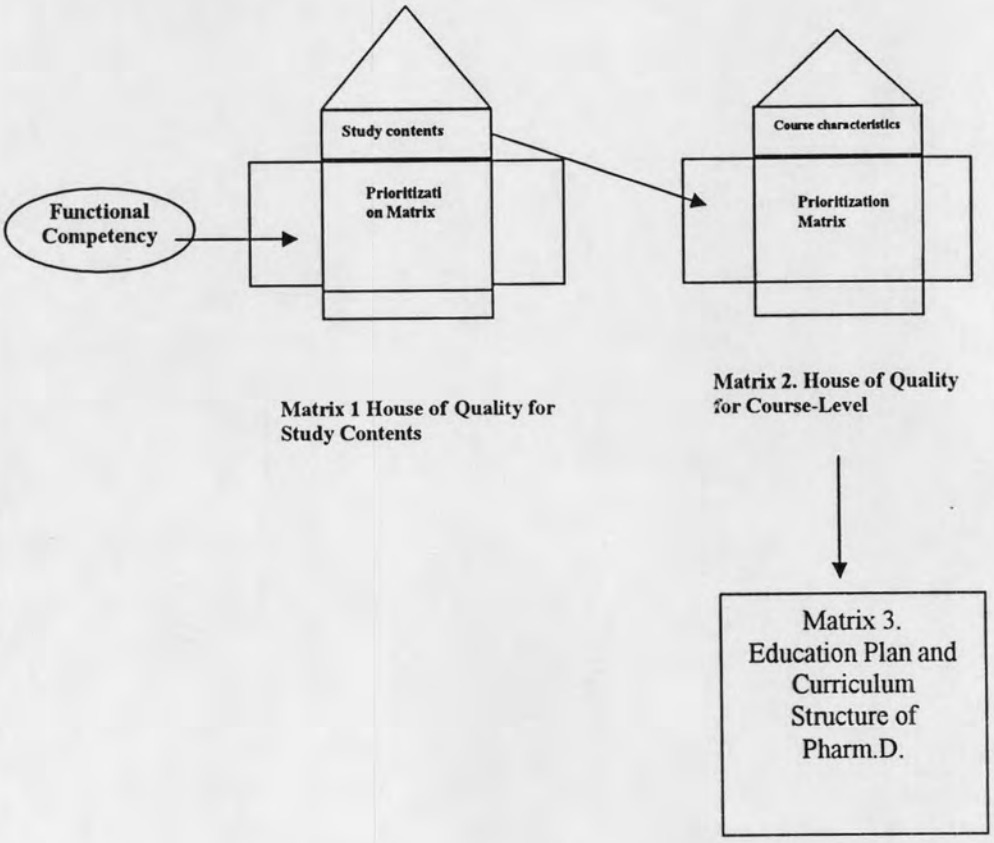


Figure 2.7 The three-phase of academic QFD model

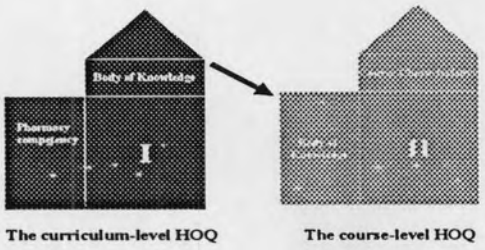
Matrix I: house of quality for study content (curriculum planning matrix).

This step was known as the "House of Quality". In this study, the academic version of the QFD model translated new pharmacy competency into study contents considering functional competency (competency domain number 1 to 4) and resulting in the matrix of HOQ for study contents.

In the competency domain number 5 (general ability) and 6 (professionalism) , they did not directly related to contents used in the instructional method, therefore would not be used in this pharmacy curriculum design.

Matrix II: (course planning matrix)

After completion of the curriculum-level house of quality, as referring to the house of quality for study contents, the "hows" of the curriculum-level house of quality became the "whats" of the course design as shown in Figure 2.8. Thus, each element identified as critical for achieving stakeholder satisfaction must be addressed in the design of courses that made up the curriculum. However, course planning process was not covered in this study.



The curriculum-level HOQ The course-level HOQ

36

Figure 2.8 Adaptation of the traditional QFD model to curriculum design and course design

Matrix III: (Education Plan and Structure of Pharmacy Curriculum)

Education plan and curriculum structure design were constructed by courses and the number of credits studied. The curriculum connection was taken into account in this education plan and curriculum structure design.

Part V The Study Framework

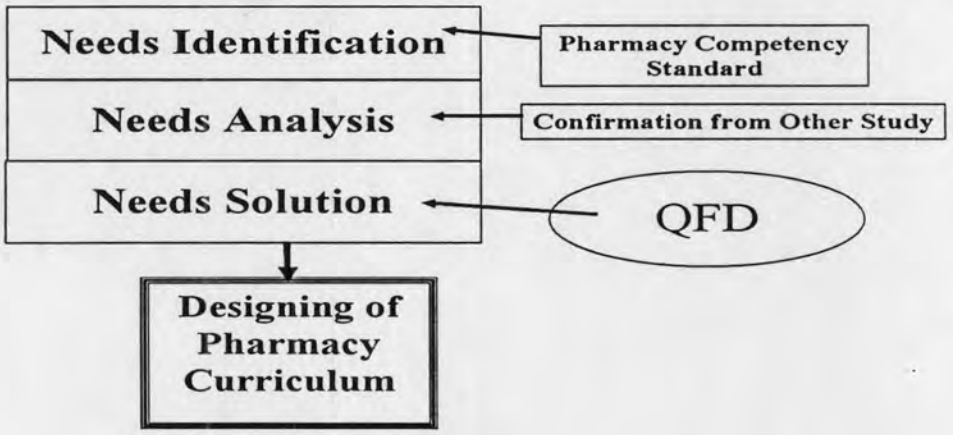


Figure 2.9 Study Framework

After reviewing relevant studies and literatures, the study conceptual framework had developed. It was proposed to design pharmacy curriculum by using complete needs assessment (Witkin and Altschuld, 2000 ; Wongwanich, 2005). The assessment was consisted of 3 main steps; (1) competency needs identification by using group discussion and survey, (2) competency needs analysis, which was substantiation method of associated causes underlining competency needs, by comparing results obtained from competency needs identification and other study results, (3) competency needs solution by applying QFD technique in order to figure out of contents in the pharmacy curriculum. Details were certainly specified as followed;

Phase I. competency needs identification This prior step of needs recognition was comprised of 2 sub-processes;

1. This process was to identify expectations of stakeholders to the curriculum. In this study, the expectations of pharmacy competency of those individuals were set as pharmacy competency standard. Besides, this pharmacy competency conceptual thinking was generally established based on Pharmacy Practice Activity Classification (PPAC) of the American Pharmacists Association (1998). It was able to measured

from (1) Ensuring Appropriate Pharmacotherapy and outcome: (2) Selection an Dispensing Medications and Health Products: (3) Health Promotion and Disease Prevention fourth: (4) Health Systems Management, and moreover, the investigator had included (5) Professionalism and (6) General Ability which be able to acquired from professors' view points. The developed pharmacy competency would be proficient to provide input information in order to further expand to needs assessment questionnaires, and information of designing contents in the curriculum in the needs solution process later on.

2. This process was to identify needs assessment survey. Definition of needs were firstly specified by referring to Kaufman and English, 1979; Witkin and Altschuld, 2000; Wongwanich, 2005. They described needs as gaps or discrepancy between existing pharmacy competencies and expected pharmacy competencies. At this step, the new developed competency would created a dual response questionnaire asking about perception of 2 assessment groups which were pharmacy preceptor and clinical pharmacy students. Furthermore, PNI and Matrix analysis had been used as competency needs priority setting.

Phase II. competency needs analysis

To identify foundation causes of competency needs, the assumption was thoroughly specified as competency needs in this presenting study had been resulted by inefficient of study contents. By this reason, competency needs were likely to base on the curriculum. Thus, study framework of cause-reason relationship determined only cause contents in relation to existing and expected pharmacy competency. Within Phase II, thus, the study process was mainly about specifying causes or factors emphasizing competency needs determining merely course contents within the curriculum. Results of pharmacy competency needs in Phase I would then be compared to results from other researchers.

Phase III. Competency Needs Solution

With respect to accomplishing the highest satisfaction of relevant stakeholders, the pharmacy curriculum was designed to support them by developing study framework based on conceptual thinking of QFD approach (Akao, 1988; Cohen, 1995; Witkin and Altschuld, 2000). Their explanation basically referred to QFD is to translate the VsOC (customer requirements) into the final product and/or service

quality. In this presenting study, QFD was defined as QFD in curriculum design which was quality tool that helps to translate the pharmacy competency into the new course contents that truly satisfy their stakeholder needs. By which house of quality, a matrix, was used as a study tool in order to assist in creating of the new curriculum. Input data was pharmacy competency and competency needs, obtained from Phase I. The research methodology for the curriculum design using QFD approach consists of 7 steps which were; step 0. QFD plan for pharmacy curriculum design; step 1: pharmacy competency in curriculum design; Step 2: identifying contents elements (study content) (How's); step 3: establishing correlations between pharmacy competency and study contents; step 4: identification of the pre-requisite contents using the correlation matrix; step 5: competency assessment in quality planning matrix; and step 6: identify the importance priority of knowledge requirement. Results from the design were philosophy, curriculum objectives, curriculum structure and educational plan.