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A Methodology for Developing a Nursing Education Minimum Dataset

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A Methodology for Developing a
Nursing Education Minimum Dataset

by

Aziza A. Rajab

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
College of Nursing
University of South Florida

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nursing data element, nursing education, online survey, ontology,
taxonomy, unified nursing language

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ABSTRACT

Globally, health care professionals, administrators, educators, researchers, and informatics experts have found that minimum dataset and taxonomies can solve the problem of data standardization required in building an information system to advance disciplines' body of knowledge. Disciplines continuously gather complex data, but data collected without an organizational context does not increase the knowledge-base. Therefore, a demand exists for developing minimum dataset, controlled vocabularies, taxonomies, and classification systems. To fulfill nursing's needs for standardized comparable data, two minimum dataset are used in nursing for organizing, classifying, processing, and managing information for decision-making and advancing clinical nursing knowledge.

No minimum dataset in nursing *education* currently exists. With common definitions and taxonomy of nomenclature related to nursing education, research findings on similar topics can aggregate data across studies and settings to observe overall patterns. Understanding patterns will allow educators, researchers, and administrators to interpret and compare findings, facilitate evidence-based changes, and draw significant conclusions about nursing education programs, schools, and educational experiences.

This study proposes a generic methodology for building a Nursing Education Minimum Dataset (NEMDS) by exploring experiences of developing various minimum dataset. This study adapted the systems model as the conceptual framework for building the taxonomy and classification system of nursing education essential data elements to guide the analysis of structure, process, and outcome in nursing education. The study suggested using focus groups, an online Delphi survey, and the statistical techniques of Multidimensional Scaling, and kappa. The study presented these steps: identifying educational concepts and data elements; defining data elements as nursing education terminologies; building the taxonomy; conducting an empirical and theoretical validation; disseminating and aggregating the data in national dataset.

The proposed methodology to build an NEMDS meets the criteria of having a nursing education dataset that is mutually exclusive, exhaustive, and consistent with the concepts that help nursing educators and researchers to describe, explain, and predict outcomes in the discipline of nursing education. It can help the transformation of simple information into a meaningful knowledge that can be used and compared by the school, state or country to advance nursing education research and practice nationally or internationally.

Chapter One: Introduction.

Background

Consensus is reached by healthcare professionals, administrators, educators, researchers and informatics experts around the world that the solution to the problem of data standardization required in building an information system to advance the body of knowledge and science in any discipline, relies on the availability of structured, standardized, and computerized data. (AACN, 1997; Gassert, 1998; IMIA, 1999; Pew, 1998; Stagger, Gassert & Curran, 2002). More importantly, we need methods and tools to allow data to be collected nationally and/or internationally in a comparable way across various populations, settings, regions, and perhaps across some disciplines. (Werely, Lang 1988; PITAC, 2004; Stevanovic, et al 2005).

In recent decades, with the revolutions of electronic technology, there is a strong movement towards the development of classical taxonomies, common vocabularies, and minimum dataset (MDS) to solve the problem of organizing, collecting, storing, retrieving, and aggregating data (Goossen, et al., 1998; Colling, 2000; wheeler, 2004; PITAC 2004).

These informatics researchers have found that taxonomies and MDS can solve the following problems: existence of huge amount of unstructured data in enterprises computer networks: wasted time re-creating overlapping information; and the lack of tools equivalent to data mining, data categorization , and data visualization (Patience and Chalmers, 2002) They emphasized the need for tools to organize information and avoid overloads, especially with ambiguous words, the need for more complex search engines

with extreme recall, metadata search, link ranking, taxonomies, and MDS that can help find information both for known items and for discovery of topics, and where interactive and iterative browsing of subject categories arrangements can trigger associations and relationships.(Edols, 2001; Rapoza, 2002; Lehman, 2003;). Information technology managers confirm that people spend more than 2 hours/day searching for information. One Delphi study findings showed that for 73 % of the people finding information was difficult, 28% said that the main impediments were “Bad Tools,” and 35% said that data changes constantly (Delphi study group report, 2002).

In the information-intensive health care industry there is a growing movement toward the use of electronic records in health care services; education, administration and research to collect and handle data. However, data collected without a theoretical context for organizing the data does not add to the knowledge-base. (Brailer, 2004; Moody, Slocumb, Jackson & Berg, 2004).

Therefore there is a demand for the development and use of MDS, controlled vocabularies, taxonomies and classification systems. They are essential dimensions of an integrated and coordinated health care service and education systems for organizing, classifying, processing and managing information for decision-making purposes (Saba, 1992; Brailer, 2004; Moody, Slocumb, Jackson & Berg, 2004; PITAC, 2004,)

The National Dataset Development Program at the National Health Services (NHS) is continuously working to transform various national data from information to knowledge using various tools and statistical methods, one of which is establishing guidelines for developing MDS (White, 2005). The underlying assumption of any MDS according to NHS is that it answers a clear information need; enables reliable

comparative analysis of individuals, services, or organizations; enables collecting and measuring of performance and outcomes; and permits sharing and aggregating consistent information within and across domains.(White, 2005)

Healthcare systems and universities are being transformed by information technology systems (Chaffin & Maddux, 2004; PITAC, 2004). The arrival of information technology in health care settings in the late 1980s altered traditional nursing education that focused primarily on patient care, to incorporate computer skills (Chaffin, & Maddux, 2004). The term “nursing informatics” evolved in 1990s; it integrated nursing science with computer science and included the vast databases available to nurses. Computers, the internet, software and online journals became the new vocabularies for nurses to know and to learn from. Information technology is now the vital source of education and communication for nurses beginning with accessing online information on degree programs, knowing national nursing organization web sites, demonstrating high standards advanced nursing skills, to the growing number of online web based courses and distance education programs that are taught and evaluated from homes or offices (Carlton, Rayan & Siltzberg, 1998; Chaffin 2001; Stagger, Gassert, Curran, 2002).

Information technology brought useful innovations to health care in general and to nursing as a professional discipline in particular. Nurses are using computers for assessing and monitoring patients, administering medications, providing nursing procedures, documenting information, and communicating with patients and hospital staff. (Halstead & Coudret, 2000). But because information technology is one of the 21 competencies required for all health professionals as affirmed by the Pew Health Professions Commission (Pew, 1998) there is a growing need for nurses to have

informatics knowledge and skills, and to be involved in the technology for designing and accepting a standardized nursing language (Sullivan, 1997; Moorehead, Head, Johanson, Maas, 1998; Stagger, Gassert, Curran, 2202; PITAC, 2004).

Harriet Werley started the initiative of developing MDS in nursing in the early 1980s (Werley,1986) and her work was the first effort to fulfill the need for systematic data collection, organization, storage, and retrieval of standardized nursing data that are essential to quality in all structure, process, and outcome components of nursing care. It was not until 1998 when the American Nurses Association (ANA) steering committee on databases to support clinical nursing practice pioneered the development of nursing data set taxonomies, classification systems, coding and nomenclatures for creating a unified nursing language system (Cohen, Manion, & Morrison, 2000). The ANA also promoted the inclusion of nursing-related data in large health-related databases (Averill et al., 1998) facilitating the collection and analysis of massive amounts of data via large national computer networks. The committee recognized the need for nurses to participate in the development of national health care data sets by developing and disseminating standardized vocabularies suitable for inclusion in computer based systems (Zielstorff et al., 1995). The purpose of a standardized computerized essential nursing data set is to develop an organized information system that facilitates assessment of nursing services and determines nursing's contribution to general health outcomes (Coenen & Schoneman, 1995; PITAC, 2004). Standardized vocabularies are essential for computer decision-support tools using sharable protocols that reduce error rate, lower costs, and improve quality of health care (PITAC, 2004). According to ANA, without a commonly

accepted NMDS, there will be gaps in nursing data at any or all levels of the systems, making it impossible to assess the effects of nursing care on healthcare outcomes.

To reduce the present gap in nursing data, there have been various initiatives to develop several MDS in nursing globally (Goossen, et al, 1998). The development of a Nursing Minimum Dataset (NMDS) used widely in clinical nursing practice, and the development of Nursing Management Database (NMMD) used in nursing administration services fulfilled the need for systematic collection, storage, and retrieval of standardized nursing data. Both these data sets in nursing are considered to be an essential component to the analysis of the systems- approach to the study of inputs, process, and outcomes in nursing and healthcare. They are an essential element in classifying and advancing clinical nursing knowledge (Werley, Devine, & Zorn, 1991, Junger 2004). While the vocabularies used in clinical nursing dataset are not universally accepted; there is a growing movement toward adoption of a unified nursing language and an international classification of nursing practice (ICNP) (Hardiker, 2004; Moody, 2004; PITAC, 2004). The main reason for having commonly accepted NMDS systems is to produce comparable data for defining nursing's contribution to patient care specifically and to healthcare outcomes generally, and for advancing both nursing practice knowledge and professional growth (Anderson & Hannah, 1993, Coenen et al., 2001, Mass & Delaney, 2004; PITAC, 2004). It is evident, based on several studies (Hardiker, 2003; Burgun, 2001; Goossen, 1998; Baernholdt, 2003; deClercq, 2000) that the process of developing any valid and reliable MDS has been shown to be complex and dynamic, and requires several stages and iterations. Building a Conceptual Ontology and designing a Taxonomy of Terms and specific data elements of common vocabularies and standard language is

the primary step in building any MDS in any field or discipline (Goossen, 1998; Burgun, 2001; Hardiker, 2003; Moody, 2004).

To standardize the language, vocabularies must be recorded in standard ways so their meaning can be shared between health professionals in a manner that is interoperable and computable (i.e., able to manipulate and combine with other data by a computer). The language must be coded in a standard manner, even if the concepts are referred to by different local names, displayed in different local languages, or depicted in different local alphabets, they will mean and refer to the same variables each time. The availability of a core set of standard terms that can be incorporated into the system at every level to describe concepts is crucial to the process of MDS building (Goossen, 1998; Burgun, 2001; Hardiker, 2003; Moody, 2004)

The traditional classification systems used to code medical diagnosis, procedural interventions and outcomes are not adequate (PITAC, 2004), because in clinical settings, providers historically recorded all clinical encounters in detailed textual descriptions, then summarized and coded the information manually by selecting entries from existing classifications such as ICD-9-CM, Nursing Intervention Classification (NIC), and Nursing Outcome Classification (NOC). These selections of coding are frequently influenced by reimbursement implications rather than detailed clinical implications, which may conflict with the underlying clinical construct itself. Therefore with the advent of information technology, computer solutions can ease the challenge of recording standard codes for detailed clinical concepts. Table1 shows examples of some existing MDS in different healthcare specialties. The common first step in developing all these dataset and many others was to gain consensus on the specific data elements and data

variables that best described the field by identifying what relevant information can be produced by the data elements that has meaning to the users and adds to their knowledge. Next these data elements are designed in a classification system (Taxonomies), the data elements are defined with specific terminology and coded to build a MDS. The Delphi Method is widely known as a method for forecasting the future and reaching consensus on undecided, uncertain, or unclear issues. Therefore the Delphi Method is used commonly to reach consensus on relevant essential data elements to build ontologies, taxonomies and minimum dataset that allow disciplines to organize and manage knowledge electronically. Similarly developing a Nursing Education Minimum Dataset (NEMDS) can serve as an infrastructure to organize the knowledge base of nursing education and research.

Table 1 displays examples of some existing minimum dataset in different health care specialties.

Table 1

List of Datasets in Nursing and Health Care

Type of Dataset	Abbreviation
Systematized Nomenclature of Medicine, Clinical Terms	SNOMED-CT
Emergency Medicine Minimum Dataset	EMMD
Long-Term Health care Minimum Dataset	LTHCMDS
Ambulatory Medical Care Minimum Dataset	AMCMDS
Financial Uniform Minimum Dataset	UB92
Health Care Facilities Minimum Dataset	HCFGMDS
Health Professional Minimum Dataset	HPMDS
Nursing Minimum Dataset	NMDS
Nursing Management Minimum Database	NMMD
Uniform Clinical Dataset For Home Care and Hospice	UDHCH
Uniform Clinical Dataset	UCDS
Uniform Hospital Discharge Dataset	UHDDS
Mental Health Dataset	MHDS
Older People Dataset	
Diabetes Dataset	
Chronic Heart Diseases Dataset	
Cancer Dataset	
Data Element for Emergency Department	DEED
Patient Care Dataset	
Preoperative Nursing Dataset	

Statement of the Problem

To date there is no minimum data set in the field of nursing education (NLN, 2004). The National League for Nursing (NLN) was the first to emphasize the importance of developing the Nursing Education Minimum Dataset (NEMDS) by creating the Task Force Group to begin the development of a NEMDS. With common definitions, taxonomy of terms, and nomenclature related to nursing education, research findings on similar educational issues and topics can be pooled together so that patterns can be observed across studies, and data can be aggregated across settings. Understanding these patterns will allow educators to make interpretations, compare findings, facilitate evidence-based changes in their educational programs, and draw significant conclusions regarding educational experiences (Goossen, et al, 1998; Jeppson, 2002; Baernholdt, 2003; Junger, 2004; Moody, 2004). The NEMDS can also serve as a benchmark and a guideline for nursing education researchers about the terms and elements used in nursing education research processes and outcomes (Junger 2004; Moody, et al, 2004; NLN, 2004; PITAC, 2004). NEMDS has great potential to enhance the quality of nursing education services and research synthesis.

Statement of the Purpose

The purpose of this study is to develop a deeper understanding of minimum dataset, and to create a generic methodology for building Nursing Education Minimum Dataset (NEMDS), by exploring previous experiences of developing various MDS in

different countries. This study will apply an adaptation of system theory to serve as the conceptual framework for building the taxonomy and classification system of nursing education essential data elements.

Specific Study Aims

Study Aim 1: Identify the essential domains, commonly used data elements and essential terms used by the nursing education community.

Study Aim 2: Adapt the system model to serve as a conceptual framework and taxonomic schema for organizing the essential data elements in nursing education.

Study Aim 3: Describe the steps and the methodological process of developing a nursing education minimum dataset (NEMDS).

Significance of the Study

The proposed generic methodology of building NEMDS is expected to address an important gap in the equality of nursing education practice and research synthesis. The NEMDS has the potential to enhance the evidence based teaching (EBT) in nursing education (Stevens, 1999).

Currently the implementation of EBT in nursing education is very limited due primarily to three factors: first, the weaknesses that exists in generating and using knowledge to guide nursing education practices through in-depth predictive research that focuses on teaching and learning experiences, environments, and educational programs. What we have at present is very few quantitative, descriptive studies confined to traditional formal courses and curriculums, with limited numbers of diverse samples and sample size, and infrequent publication of these studies (Yonge, 2005). Second, The

difficulties that exist in funding educational research nationally and internationally make it impossible to advance the knowledge related to nursing education; Third, and most relative to our study, is the absence of methodologies and databases to collect and share national and international data related to nursing education for advancing the knowledge building process and to promote an EBT in nursing education practices (Young, 2005). Therefore, establishing NEMDS can enable nursing educators to systematically collect, organize, store, retrieve, and analyze specific data elements and educational variables to generate a large body of knowledge through rigorous research that can guide and advance nursing education practice.(Junger, 2004; Moody, 2004; PITAC, 2004)

Based on studies and examples of building various minimum dataset in healthcare and nursing practice, (Huber, 1997; Goossen, 1998; Saba, 1992; Baernholdt, 2003; Fahrenkrug, 2003), a common and nationally accepted NEMDS will have the following potential implications:

- Assist nurse educators and researchers in analyzing selected variables across programs at any level of the system and to examine how selected input variables are related to the process and output variables in nursing education practices. (Junger, 2004).
- Serve as an assessment and planning tool to be used in administrative databases for research, funding, and policy making applications of nursing programs by systematically monitoring nursing education quality and outcome indicators (Fahrenkrug, 2003).
- Increase nursing educators opportunities to communicate and collaborate with educators from other disciplines to identify nursing educators' needs, describe

nursing educators' roles, and address quality of nursing education services, outline methodologies and guidelines for nursing education process and outcomes (NLN, 2004; PITAC, 2004).

- Enable comparison of common data elements and outcomes across academic programs at a state, regional, national or international levels, by producing key information and bench marking indicators for various types of evaluation parameters (Junger, 2004; Moody, 2004).

There have been no previously published efforts that have focused directly on describing the methodology for building a NEMDS specifically. Therefore the proposed generic methodology is an effort to identify the essential items and data elements used in nursing education and to explain the process of building NEMDS.

Summary

This chapter included an introduction that explains the need and importance of standardizing health care languages in general and for developing taxonomies and dataset for the nursing community specifically. It discusses the different NMDS that exist in the nursing profession and their value to nursing practice and research. It explains the importance of developing a NEMDS and the potential advantages to the nursing education community. This chapter also includes statement of the problem, statement of the purpose, specific study aims, and the significance of the problem. The next chapter reviews the literature on the methods used previously in developing a taxonomies and

data sets, presents a conceptual framework for developing taxonomy to build a NEMDS, and defines terms used in the design and methodology.

Chapter Two: Review of Literature

This chapter reviews research related to the key variables of the study using the following search terms that were related to the study concepts: nursing minimum dataset, nursing database, classification systems, taxonomies, ontology, nursing data elements, coding scheme, unified nursing language system, focus group, Delphi studies, on-line surveys, and nursing education. The review is based on a computerized literature search of the following databases, 1980 to 2005: Cumulative Index in Nursing and Allied Health Literature (CINAHL), Medline, and Psych Info. Additional studies were identified through citations in other published articles and manual searches. The literature search identified 290 articles related to the search terms used. These resources were reviewed, screened, and narrowed down to 75 which met the inclusion criteria. Articles were excluded from the literature review if they only tangentially related to the study purpose. Most of the articles did discuss the development and uses of a minimum dataset, as well as the use of Delphi method in depth. The discussion of the literature includes only research-based articles, books, and research conference presentations. Both quantitative and qualitative research articles focusing on the variables were included in the review. The theoretical frame work is discussed in depth. The chapter concludes with a section on definition of terms.

Minimum Dataset in Nursing and Health Care

Definition and Value

The NMDS was defined by Werley and others as “a minimum data set of items of information with uniform definitions and categories concerning the specific dimension of nursing which meets the information needs of multiple data users in the healthcare system. The NMDS includes those specific items of information, which are used on a regular basis by the majority of nurses across all types of settings” (Werley et al., 1991, p.422; PITAC, 2004).

In an era of growing pressure from the nursing profession, policy makers and society to justify and legitimize nursing contributions to health care and its cost (Werley et al, 1991; PITAC, 2004), there is a need for developing a unified nursing language system (Coenen & Schoneman, 1995; PITAC, 2004). Standardized nursing language, if collected on an ongoing basis, enables nurses to evaluate services and to compare data across populations, settings, geographical areas, and times (Delaney et al., 1992). Exchanging existing sources of information that are based on a common architecture with standardized data definitions will enable computer-aided decision support, automated error detection, and rapid analysis for research (PITAC, 2004). The nursing community began developing classification schemes, nomenclatures, and taxonomies through research (McCormick et al., 1994).

The initiative for an NMDS started in the United States of America (USA). Established by Werley and others in 1991, it has been accepted widely as a tool to describe nursing care systematically (Clark & Lang, 1992; Mortensen, 1996; Sermeus and Delesie, 1997; Goossen et al., 2000). The Nursing Minimum Dataset (NMDS)

represents the first attempt to standardize the collection and retrieval of essential nursing data (Werely et al, 1991). It is widely used in clinical nursing practice today. Coenen et al., (2001, p.9) stated that “The NMDS and a nursing information system using standardized classification systems for nursing diagnosis, interventions and outcomes provides an opportunity to describe nursing practice.”

In conclusion the purposes of the NMDSs are to establish comparability of nursing data across population, describe the diversity of population and the nursing care of patients and families across settings, define variability of nursing activities, determine the complexity of nursing work load, and establish general indicators for the quality of nursing services from benchmark information. The NMDS can be also used for projecting nursing care trend analysis, resource allocation, budget negotiation, funding determination, and policy making. It can stimulate nursing research through links to the detailed data existing in nursing information systems and other healthcare information systems and dataset. (Saba, 1992a; Anderson & Hannah, 1993; Coenen & Schoneman, 1995; McCormick, & Zielstorff, 1995; Averill et al., 1998; Prophet, Delaney, 1998; Goosen et al., 2000; Coenen et al., 2001).

The focus today on evidence-based practice in nursing urges nursing educators to modify their curricula and teaching methods to incorporate research findings from nursing practice and research. To build the knowledge base for nursing education, one of the first important steps is to define the terms and data elements used in nursing education, and to develop an ontology and taxonomy in nursing education that allows our discipline to organize and manage knowledge electronically. (Junger, 2004; Moody, 2004; NLN, 2004)

The process of reaching consensus regarding the essential data elements needed to build a taxonomy, ontology, and MDS in any nursing field is considered to be very complex, dynamic, ongoing, and a starting point for creating an infrastructure to organize information that builds the knowledge-base for nursing

Steps for Developing MDS

The process of building any MDS is very complex, time consuming, labor-intensive, and requires several stages to accomplish.(Goossen, et al, 1998). For developing any MDS, the following five important steps have to be completed consecutively: 1) identification of data item or element as a variable; 2) accurately defining each variable; 3) determining the universal value of each variable; 4) using of appropriate terminology in documenting the variable; and 5) aggregating and coding data into databases for different purposes of health care management, research, and policy (Goosen et al., 1998). The NMDS for example first identified items related to hospital patient demographics, medical diagnosis, nursing process, structure, interventions, outcomes of nursing care, and complexity of care (Werley et al., 1991; Delaney et al., 1992; Rantz, 1995; Keenan & Aquilino, 1998; Denehy & Poulton, 1999). McCormick et al. (1994) emphasized the need to develop the specifications of the resources and the procedures required to map language to identify concepts and specific data elements so that uniformity can be attained. Many nursing languages used today to describe nursing practices supported the development and identification of NMDS. Belegen and Tripp-Reiner (1997) confirms that taxonomies of North American Nursing Diagnosis (NANDA), Nursing Interventions Classification (NIC), and Nursing Outcomes

Classification (NOC) were the building blocks of the nursing knowledge on the NMDS. The American Nursing Association's (ANA, 2001) committee on databases to support clinical nursing practice also recognized those classification systems (Goossen et al., 2000). But accessibility and utilization of computerized data continues to be a challenge because standardization in definitions, codes, classification, and consensus on common terminologies of health information are difficult. Complexities of integrating health information from diverse sources, and lack of investment in information technologies by the health care industry are the main causes for lack of the needed standardization (Renner & Swart, 1997).

Another example of MDS in nursing is the Nursing Management Minimum Dataset (NMMDS), which began in 1989. Huber and Delaney, the co-principal investigators of the NMMDS project based the conceptual framework for the data needs of nurse executives on Donabedian's classic ideas of structure, process and outcomes as the components of quality (Donabedian, 1980). The NMMDS was also based on the Iowa model of nursing administration (Gardner et al., 1991) and on the NMDS of Werley and Lang (1998). Huber and Delaney found difficulty in standardization of definitions due to the lack of uniformity of the *management* elements in the nursing management literature. Therefore, research with nursing experts in management, informatics and uniform data sets was conducted to identify and develop a research-based NMMDS (Huber 1997). As a result eighteen acute care-based NMMDS variables were developed, and research studies to establish validity and usefulness were conducted in two forms. Consensus surveys and consensus-building invitational workshops were used to test the acute-care-based data set for its portability and linkage potential across settings. Surveys were sent

to selected, non-acute care settings such as long term care, occupational health, ambulatory care, home health, and community health. The two surveys, focused on consensus and determining the adaptability of the NMMDS to each setting. The eighteen variables, clustered into the broad categories of environment, nurse resources, and financial resources. Definitional variations and measurement issues made reaching consensus across settings difficult and slow. Variables such as cost and satisfaction were the most difficult for the group to reach a consensus.

Warner describes that one way for identifying the exact term is to just extract the specific terms we want information about, from existing controlled vocabularies and taxonomies and languages, or, sometimes, if we are building a taxonomy or MDS in a new field and there are no other resources available, the only option, is to start from scratch to identify them via using a focus group method (Warner, 2005). The next step in building the MDS, is finding common and accurate definitions of the term and data elements (Goossen, et al, 1998). Once we have the term then: we need to add control of synonyms on the terms considered equivalent by defining the terminology to be specific to our meanings and needs. Finding common definitions for the terminologies used in the data elements for building any taxonomy or dataset has been the repetitive obstacle in the literatures ever since, Kirt, (1985) raised several concerns in the process of developing Nursing Diagnosis Classification (NOC) related to unified common item definitions. Kirt identified the problems of lack of clarity in the level of abstractedness or concreteness of the terms; the need for identifying common denominators to clarify the use of cues, signs and symptoms, and definition characteristics as major problems. She stated that to move towards universal validation, massive data about the use of nursing

diagnosis were needed, and that clear conceptual and operational definitions of nursing diagnoses that are acceptable and useful in multiple practice settings was required (Creason, Poue, Nelson & Hoyt, 1985; Jones, 1982; Kim et al, 1984).

After specifying the terms or the data elements, and defining it accurately, the next step is choosing the best, most consistently clear and unambiguous labels or names available for the content by which the user will navigate. Leahy quoted a Chinese adage, "the beginning of wisdom is calling things by their right names" (Leahy, 2004). There are several options for obtaining labels and determining the universe values of those terms; the option selected depends on what we want to do with the term and what resources we have at our disposal to create the labels, agreed terminologies, and categories of the essential variables.(Goossen, et al, 1998; Warner, 2005). Several steps follow this to develop a classification system, and taxonomy to build a MDS. Ontology is the next step, and this means categorizing and labeling the data elements into a specific scheme that helps classification (ICONS, 2002). This step requires grouping the identified and defined data elements into major categories or classifications by arranging the terms into one or more hierarchies proceeding from general to specific (Werley & Lang 1988). Determining other associative or related term relationships among terms or labels is essential for developing a navigation scheme within the developed taxonomy or other taxonomies (Warner, 2005). For instance, Karpiuk et al. (1997) studied the comparability of nursing diagnosis and nursing intervention across eight settings in South Dakota using the 16 category classification scheme developed by Werley and Lang (1988).

Coding the data elements accurately and consistently will help automated collection, storing and retrieving of data. Coding the data element need to be transparent

to all data users (Robins, Braddock, & Fryer, 2002). There is no one specific way to code data elements, codes can be specified using Arabic or Roman numeral numbers, alphabetic letters of the language in which the MDS is built, or any other codes that helps the automated documentation based on the information technology available in hand.

Theoretical and empirical validation of the taxonomy and the MDS is essential before presenting the MDS to the specific community of the data users (Reynold,1971; Turner, 1986; Ryan-Wegner,1992; Goossen,et al, 1998; Griens,Goossen, Vander Kloot, 200; Warner, 2005). Finally disseminating the MDS to the specific data user community and aggregating the data in the national data repository systems is the ultimate important step for the dataset to have a global meaning (Goossen, 1998). Adaptation of this process in nursing education can be useful in developing a blueprint to build a NEMDS.

NMDS in Different Countries

Although nursing data are usually absent from health care data collection systems around the world (Clark & Lang, 1992), many countries are developing NMDS systems. In Belgium, all general hospitals were required by law in 1988 to collect data for an NMDS four times per year. In Australia, the objective of the Community Nursing Minimum Data Set Australia (SNMDSA) is to introduce standardization and comparability of community nursing data (Australian Council of CNS, (Renwick1994). In Canada, the Alberta Association of Registered Nurses suggested the inclusion of nursing components into the Hospital Medical Records Institute (HMRI) data bases, addressed as health information nursing components (Hannah et al., 1995). In

Switzerland an NMDS is under development (Van Gele, 1996; Weber, 1996). The national health services in England established an information management and technology strategy that incorporates nursing care clinical data. The United Kingdom (UK) is in its early stages of developing nursing care description items on the NMDS (Wheeller, 1991, 1992). In Scotland the Core Community Minimum Data Set Scotland (CCMDS) includes nursing data in a multi-disciplinary data set for use in automated records. In the Netherlands there is an increased interest by several professional organizations to develop a Dutch NMDS for policy development, funding, budgeting and staff allocation in the health care system (Goossen et al., 2000; Griens, Goossen, & Vanderkloot, 2001).

Benefits of NMDS

Goossen et al. (1998) identified the advantages the above countries are finding in developing and adapting the NMDS. These include collection of and computerized documentation of retrievable nursing data, excellent opportunities for comparing and contrasting nursing practices at different levels, ability to share nursing data with other health professional databases, predict resource allocation needs (Saba and Zuckerman, 1992), serve as a cost-effective data abstraction tool, establish retrospective validation of the defining characters of nursing elements; determine the costs of direct nursing care; and serve as a mean of forecasting frequency and trends in nursing diagnosis, intervention, and outcome. The computerized standardized data aids in the problem detection and solution, decision making, policy revision and reformulation (Delaney et al., 1994).

Taxonomies, Standardized Languages, and Classification Systems

The terms taxonomy, ontology, classification are often used interchangeably. They are ways of organizing information of things into categories (I.I.P, 1993; Warner, 2005; Oppenheimer, 2001; I.C.O.N.S, 2002). They are controlled vocabularies and organized lists of words and phrases or notation systems, that are used initially to tag content, and then to find it through navigation or search (Warner, 2005). There are hundreds or thousands of controlled vocabularies floating around in nursing. Unfortunately a great deal of disagreement exists as to the individual definitions of each of the controlled vocabularies and their classification. This is the main reason why there are many challenges associated with developing accurate nursing standardized taxonomies

Taxonomy (Greek word *taxinomia*, *taxi* = order and *nomos* = law) refers to the classification of things or the principles underlying the classification it self. Almost everything can be classified according to some taxonomic schema. Taxonomies can be hierarchical in structure or schematic that refers to arrangements based on the relationship between the different data elements. A taxonomy might be a simple organization of objects into groups or a tree structure of classifications for a given set of objects where at the top of this structure is a single classification and below are the more specific classifications that apply to subsets of the total set of classified objects (Warner, 2005). Taxonomy can be artificial or natural, hierarchic by order, or schematic by relation.

Following the development of NMDS, and in the beginnings of 1950s, there was a tremendous effort by many nursing researchers to standardize the nursing language in the main three categories and elements of NMDS: nursing diagnosis, nursing intervention

and nursing outcomes (Prophet, Delaney, (1998); Delaney, et al, (1992). The research team has described 433 nursing interventions, each with a label, definition, and a list of defining activities (McCloskey & Bulechek, 1995; Bowles, Naylor, (1996), as well as, delineated 196 outcomes, each with an outcome label, a definition, outcome indicators, and a measurement scale (Johnson & Mass; Gudmundsdottir, Delaney, Thoroddsen, Karlsson, 2004).

At present there are only five major classifications or taxonomies for Standardized in Nursing Languages (SNLs): North American Nursing Diagnosis (NANDA), The Nursing Intervention classification (NIC), The Nursing Outcome Classification (NOC), The Home Health Classifications (HHC), and The International Classification of Nursing Practice (ICNP),

Among the few recent initiatives of developing classifications in nursing, see Table 2.

is the study of Classifying Nursing –Sensitive Patient Outcomes, the research conducted at IOWA College of Nursing by (Mass, Johnson, & Moorhead, 1996). The Iowa study describes the resolution of conceptual and methodological problems that define the inductive approaches followed to develop NOC. Another example of the initiatives in nursing, is the study by Osoba (2002) in Canada, he proposed a taxonomy of psychometrically based, health related quality of life instruments related to three levels of decision-making of health care: macro, meso, and micro levels.

In recent decades, various disciplines in different countries, especially in medicine and psychology, have been conducting qualitative and quantitative research to develop different taxonomies and classification systems. For example, The department of Internal

Medicine, Communication, Psychiatry, and the health services research center in primary care , at the University of California, developed a classification system of patients' requests in office practice (Kravitz, Richard, Bell, Carol, 1999). Another study by Robins, Braddock, & Fryer (2002), was an attempt to classify and categorize ethical issues of undergraduates in medical education. Department of Social and Organizational Psychology in the Netherlands developed a taxonomy of situations to reflect self and social identity (Ellemers, Spears, Doosje, Bertjan, 2002). Cloningers (2005) published a handbook on Classification of Sanities, focused on developing a taxonomy of well-being.

Stucki (2005) developed a classification for rehabilitation medicine by adapting The International Classification of Functioning and Health (ICF). Oppenheimer, (2001) in the department of nutrition sciences, at Brooklyn College suggested a new classification of population. Psychiatrist around the globe are reconsidering how to classify the conditions they treat, for example; McHugh, 2005 published a commentary article for grouping mental disorder into clusters based on adapting the International Classification of diseases (ICD). Similarly, department of Psychology at University of Iowa developed a diagnostic taxonomy in Psychiatry based on the structure of DSM-IV (Clark, Watson, Reynolds, 1995).

The strategies used to develop the taxonomies in all these studies and many others, included reviewing literature, searching other databases, concept analysis, use of surveys of experts, and focus group method. The starting point for developing any of the above taxonomies was to determine the concepts that represent the field, develop standardized definitions for those concepts, and reach consensus on the terminologies

used. The final stage was arranging these terminologies, according to a specific relational, and hierarchical schemes in an ontology that leads to the birth of a taxonomy.

Burkhart and colleagues emphasized that taxonomy developers must identify the concepts relevant to nursing, categorize the concepts into discrete labels, and continually update the taxonomies to capture changes in nursing practice. The problem is that today many nursing standardized taxonomies have emerged, which has caused conceptual confusion over the terms and terminology being used. The ANA database committee is continuously calling for a unified nursing database that conceptually links all nursing standardized taxonomies based on conceptual congruence. According to ANA the nursing community never did create one unified nursing database, but rather developed individual nursing standardized taxonomies that partially support linking the clinical nursing terms across databases. They further add that the method for developing and linking standardized taxonomies is through mapping (ANA, 2001; Burkhart, Konicek, Rndebra, Moorhead, and Rowich, 2003). Nevertheless to compare nursing data across diverse populations, geographic areas and times, accurate reference terminology is essential for inter- vocabulary mapping. In other words, further efforts are needed not only to build unified definitions/ vocabularies/ classifications of various data elements at different level of abstraction, but also to compare and link the data to existing information systems (Delaney, Reed, & Clark, 2000).

Table 2

List of Taxonomies and Classification Systems in Nursing

Name of the Nursing Taxonomy and Classification System	Abbreviation
North American Nursing Diagnosis Association	NANDA
Nursing Intervention Classification	NIC
Nursing Outcome Classification	NOC
Home Health Classifications	HHC
International Classification of Nursing Practice	ICNP

Information technology influences predictive changes in the health care systems where nursing education acts as an agent of change. It is the responsibility of nursing educators to shape nursing practice and prepare members of interdisciplinary health care teams that demonstrate flexibility, accountability and leadership in dealing with ever-changing environments. At the moment there are two nursing organizations that are engaged in progressive work to develop a NEMDS, the American Association of College Nursing (AACN), and the National League for Nursing (NLN). The AACN has goals of promoting educational reforms, providing standards and resources, and fostering innovation to advance professional nursing education, research and practice. The AACN has identified eight hallmarks to inform students and new graduates, nurse educators, executives, and practicing nurses about the key characteristics of health care settings that promote professional nursing practice. These hallmarks focus on utilization of technological advances in clinical care and information systems to create a Nursing Education Minimum Dataset (AACN, 2003). Similarly, the National League for Nursing

has five goals to promote quality nursing education and prepare the work force to meet the needs of diverse populations in a constantly changing health care environment (NLN, 2002). These five goals are: 1) setting standards of quality nursing education; 2) faculty development; 3) promotion of evidence based teaching, 4) developing and 5) providing strategies to evaluate educational outcomes, student achievement, and nursing work force competencies. The NLN meets these goals through four different advisory councils that have identified several task groups directed toward accomplishing these goals. The NLN Nursing Education Minimum Data Set (NEMDS) Task Group is charged with identifying data elements of nursing education, standardizing vocabularies, creating nomenclatures, and developing a common taxonomy related to nursing education (NLN, 2004). The NEMDS will lay the foundation that will advance nursing education knowledge development, and advancement of nursing education research. Focus group discussion with expert nurse educators, administrators, and researchers is a common preferable method to first identify the key data elements in nursing education. This method has been widely used in identifying the data element of other MDS. It has also been used to obtain clusters, classifications, or grouping and categorization of the data elements into main domains and, finally, it has been used to define and reach consensus regarding the labeling of a common specific terminology of the data elements. The focus group method usually precedes the Delphi process and helps to identify the variables needed to construct the instrument that can be used in the Delphi survey. The goal of the focus group is to reach saturation about the issue or topic in hand to produce an ontology of essential terms and concepts (deClercq, Blom, Hasman, Korsten, 2000; Biolchini, & Patel, 2004).

The Delphi method on the other hand, is the common approach for reaching consensus among experts on a common taxonomy and ontology of the essential terms and data elements necessary to build the NEMDS.

Focus Group Method

Use of focus groups is a way to better understand how people feel or think about an issue, product, or service from a special type of grouping in terms of purpose, size, composition, and procedures (Krueger & Casey, 2000). The purpose is to listen and gather information. Participants are selected because they have certain characteristics in common that relate to the topic of the focus group (Belenger, Bernhardt, Goldstrucher, 1976; Belisle, 1998). The researcher creates a carefully planned series of discussions designed to obtain perceptions about a defined area of interest in a permissive, non-threatening environment and without pressuring participants to vote or reach consensus (Debus, 1990). The discussion is usually conducted several times with similar homogenous types of participants in a social interaction to identify trends and patterns, and reach saturation (Goldman & MacDonald, 1987). The whole idea of the focus group is to produce qualitative data regarding a specific issue from a focused discussion, to be used by researchers to make decisions (Krueger, 1998).

Focus groups have been helpful in assessing needs, generating information for constructing questionnaires, developing plans, testing new ideas, and developing outcomes (Greenbaum, 1998). Focus group method is used often in developing the questionnaires for building taxonomies and the MDSs (Jackson, et al, 2003; Kravitz, Bell, Franz, 1999; Volrathongchi, Delaney, Phuphaibul, 2003). Once the questionnaire has

been developed with the main data elements, Delphi survey methods come in handy for reaching consensus on these data elements.

The Delphi Method

The Delphi method is an established method of conducting nursing research. The Delphi method has been defined as, “A method for systematic collection and aggregation of informed judgment from a group of experts on specific questions or issues” (Reid, 1988), “in a cost effective and time efficient manner” (Skews et al., 2000; Keeney et al., 2001). “It is a significant methodological tool for solving problems, planning, and forecasting” (Polit & Hungler, 1995). It is highly motivating and interesting (Phill, 1971) and educational for the participants and the researcher (Stokes, 1997). Consensus occurs after surveying information using a sequential questionnaire, iteration, and controlled feedback in a series of rounds (Goodman, 1986; Jones & Hunter, 1995). A summary of each previous round is usually communicated to, and evaluated by the panel before the next round of questionnaires is sent because the views of the participants converge through informed decision making (Duffield, 1993).

It is an accepted and useful technique for achieving a consensus of views among expert panels regarding a given area of uncertainty or lack of empirical evidence, through utilization of questionnaires, iteration and the provision of feedback, and with full, partial or quasi anonymity (Phill, 1971; Reid, 1988; McKenna, 1994; Hasson, Keeney, & McKenna, 2000). The name Delphi is inspired by the temple complex at the city of Delphi in Greece where the Greek God Apollo Pzthias was a master in prediction of the future (Evertt, 1993). Therefore, the Delphi method is associated with forecasting the

future. It has been widely used for the past sixty years in business, industry and healthcare research with a variety of methodological interpretations and modifications (Powell, 2003; Hanafin, 2004). It is believed that the first national Delphi study was used in 1944 to predict the outcome of a nuclear strike on the United States; it was initiated by RAND, Research and Development Corporation of the American military (Dalkey & Helmer, 1963; McKenna, 1994; Gupta & Clarke, 1996). Today it has gained wide popularity, having been used in more than 1000 different studies. It has been used more than 300 times in nursing and health research in the past 15 years (Boweles, 1999). Predicting future change is one of the main motivations for using Delphi techniques.

Delphi as a research methodology has been presented as a survey (Wang et al., 2003), as a method (Linstone & Turoff, 1975; Crisp et al., 1997), as a procedure (Rogers & Lopez, 2002, and as a technique (Broomfeild and Humphries, 2001; Snyder-Halpern, 2002; Sharkey & Sharples, 2001). For this study purposes we refer to it as a survey.

Types of Delphis

A number of different types of studies that used the Delphi methods have modified the technique itself. Hasson et al., (2000) and Hanafin (2004) listed and defined four types:

The Classical Delphi. This is the traditional Delphi where true anonymity, iteration, controlled feedback, and stability in responses on an issue are a must. This type uses the traditional mailing of questionnaire to reach consensus.

The Policy Delphi. This type of Delphi is aimed at developing policies and promoting participation by obtaining as many divergent opinions as possible to have

polarized group responses and structured conflicts. It may provide only selective anonymity as some of the responding groups might meet.

The Decision Delphi. This type of the Delphi is used for decision making purposes and social developments. The decision makers often involved in the problem participate in the Delphi to reach consensus based on structured thinking. It only provides quasi-anonymity as participants are nominated for their positions and expertise and mentioned by their names. Their responses, however, are anonymous to other participants.

The Real Time or Electronic Delphi: This type is a modification that makes use of computer technology where responses using a voting system are made known immediately to the assembled panel. The internet presents endless possibilities for this type of approach (Berreta, 1996). Questionnaires are emailed electronically to each participant, surveys are completed online, and data is directly downloaded into a database on completion of each round. The data is automatically transferred from the web-based system to an Excel spreadsheet and is ready for analysis (Nathan et al., 2003). This also provides only quasi-anonymity as the researcher has a full knowledge of the participant's identity.

Delphi surveys can be objective and quantitative in nature (Blackburn, 1999; Monti & Tingen, 1999), or they can be subjective and qualitative in nature (Fitzsimmons & Fitzsimmons, 2001; Hanafin, 2004). The following explanations are in continuous debate for defining and defending the credibility of Delphi surveys. Robson (1993) argued that the position of the researcher in the Delphi studies remains as an uninvolved observer only for expert inclusion, data collection, statistical measures application, and

consensus identification. That is why this method is objective and quantitative, and the participants are positivist because they are agreeing on a single reality. On the other hand, Schwandt (2000) states that “we are all constructivists by nature, because every mind is active in constructing knowledge and every participant is able to build an opinion”. However most importantly it is the arrangements that the researcher makes of the necessary environmental inputs as a feedback, that build up the true internal representation of the topic within the participants. It is not built only by their intrinsic capacities for reason, logic or conceptual processing.

Relatively in the Delphi surveys, a process of individual feedback about group opinion with opportunities for respondents to change their decisions primarily on the basis of the specific feedback provides a close example for the use of environmental inputs to build up internal representation regarding the issue under study. And that is why a Delphi survey also can be subjective and qualitative in nature as participants are constructivists (Gergen, 1995, p.18; Hanafin, 2004).

Individual attitudes and beliefs do not form in a vacuum; people need to listen to others’ attitudes and understandings so that they can recognize their own (Marshall & Rossman, 1995; Reed & Roskell, 1997). This is the central aim of suggesting the use of Delphi survey in research to produce a NEMDS. We are seeking to achieve consensus among the participants (constructivist) through providing opportunities to recognize and acknowledge the contributions of each participant. Because we assume that multiple realities exist, we need to explore and study them all to be able to choose from them and to reach to a decision.

Delphi Survey Benefits

The Delphi survey has several advantages. It is an efficient and economical way of combining collective human intelligence, knowledge, and capabilities of a group of experts (Lindeman, 1975; Jones, Sandeson, & Black, 1992; McKenna, 1994; Murphy et al., 1998). It may be used to develop both qualitative and quantitative data (Reid, 1988), provide controlled anonymous feedback, and tolerate large panelist diversity (Keeney, Hasson, & McKenna, 2001). In addition, it lacks interviewers' and researchers' bias (Hitch & Murgatroyd, 1983). The Delphi technique also reduces geographical limitations (Jones & Hunter, 1995), helps minimize the effects of groups' interactions, and facilitates free expression of opinions (Goodman, 1987; Murphy et al., 1998; Snyder-Harpen, 2002). Objectivity of process and outcome of the Delphi methods are maintained as the biasing effects of factors such as personality traits, seniority and experience are minimal due to the anonymity among respondents (Jairath & Weinstein, 1994; McKenna, 1994). Other advantages related to the use of the Delphi questionnaires are the capacity to capture a wide range of inter-related variables and multidimensional features (Gupta & Clarke, 1996) and the quality of respondents' contribution is enhanced as they can complete the questionnaire on their leisure pace and time. The last advantage reduces time pressure and allows for in-depth reflections and contemplation of responses (Linstone & Turoff, 2002; Snyder-Harpen, 2002).

Online Delphi Survey Benefits:

The literature shows that, in comparison of electronic surveys to the traditional mailed surveys, researchers (Kiernan, Oyler, Kiernan and Gilles, 2005) have found that the electronic surveys had an effective response rate of 95%, significantly better than that of the traditional mailed surveys (79%). Also the completion rate of the qualitative questions that measure the knowledge, attitudes, behaviors and intentions were equal in both surveys. In conclusion they stated that the “electronic surveys can achieve as effective response rate as a traditional mail survey; be as effective in the completion of quantitative questions; elicit longer, more substantive qualitative answers than the traditional mail survey; and evoke the same evaluative views”. The use of electronic surveys may result in high data quality, less time, and low costs (Dillman, 2000; Archer, 2003; Morerel-Samuel, 2003).

The responses from the Delphi subjects on the essential data elements can be analyzed using multidimensional scaling to identify similarities and dissimilarities among the data elements. The MDS method can further refine the instrument by grouping the data elements statistically into more specific meaningful dimensions.

Multidimensional Scaling

The rate of increase of human understanding depends on organizing concepts that allow us to systematize and compress large amount of data. Systematic classification generally precedes understanding (Schiffman, Reynolds, and Young 1981).

Multidimensional scaling can help systematize data in areas where organizing concepts

and underlying dimensions are not well developed. Multidimensional Scaling is a useful mathematical tool that enables the representation of similarities of objects spatially as in a map. Objects judged to be similar are represented as points close to each other in a resultant geometrical space, and objects judged to be dissimilar are represented as points distant from each other in the same space. Besides expressing all combinations of pairs of similarities and differences with a group of objects, MDS also represents the underlying relationship among the objects under study (Shepard 1972). MDS gives more meaningful representation and interpretable solutions for the data by obtaining measures of similarities among objects under study. The computational strategy is to find spatial arrangements of low dimensionality where the rank order of the distances between items in the space correspond with the rank order of similarity measures in the data with minimal error (Schiffman, Reynolds, and Young, 1981).

Multidimensional scaling does not require a prior knowledge of the attribute to be scaled; rather it provides a space that reveals dimensions relevant to the object. The dimensions underlying a given set of stimulus are typically unknown in advance, and the problem of determining them is the major purpose of MDS (Lantermann & Feger 1980). However, interpretations of the dimensions are skills that develop with experience and through knowledge of the properties of the objects (stimuli) under scaling. In order to capture the full complexity of the data, the points are allowed to assume positions within 2, 3 or even 4 dimensional space. However a lower- dimensional representation is more parsimonious in that; 1) it represents the same data by means of a smaller number of numerical parameters (the special coordinates of the points); 2) to the extent that fewer parameters are stimulated from the same data, each is generally based upon a large subset

of the data, this gives greater statistical reliability; and 3) most significantly a picture or model of dimensional space is much more accessible to human visualization. On the other hand, sometimes one or two dimensions are not enough to accommodate the full complexity of the relationship of items on given data (Shepard 1972; Young, Hamer, 1987; Young, Hariss, 1994).

History of Multidimensional Scaling:

MDS has primarily two phases in its development. The first phase was started in 1938 by Young & Householder who explained the matrix of distances in Euclidean space, followed by the “Princeton” approach by Torgerson in 1952 which achieved a workable method of classical MDS in psychology that inspired people associated with Gulliksen’s psychometric group at Princeton University. Ten years later, phase two of the development was completed by Shepard- Kruskal when he put the conceptual basis for the “Non metric variety of MDS” under the name (analysis of proximities). Since then it has been used in different disciplines: ergonomics-(Coury, 1987), Forestry (Smith and Iles, 1988), Biometrics (Lawson and Ogg, 1989), ecology (Tong, 1989), and Nursing (Young, Hamer, 1987; Houfek, 1992; Wilson & Retsas, 1997; Griens, Goossen, & Kloot, 2001).

How to use MDS

To explain how the MDS works, the United States’ map was used by (Schiffman, Reynolds, and Young 1981). Asking one to measure with a ruler the distances among 10 diversely located American cities is straight forward project, but MDS did the opposite. It took the set of distances, (found in a table at the bottom of maps), and recreated the map.

The distances were represented by points or “special coordinates” in the special model in such a way that the significant features of the data about these distances were revealed in the geometrical relations among points. The resulting special representation attempted to capture fundamental properties of the distances solely by setting them into correspondence with positions within a spatial continuum. A computer program, Alternating Least Squares Scaling (ALSCAL) procedure, was used in an attempt to fit the data in such a way that the distances between cities in the derived space were in the same ratio as the flying distances used as data. Through eight iterations, i.e., the rank order of distances between pairs of cities along the line were compared with the rank order of the flying distances. In each iteration, a large measure of error is removed, as it improves the position that indicates reduction in differences between the rank order of distances in the space and the rank order of the flying distances between cities. A drop in stress levels in eight iterations from .80 to a stress level of .45 was accepted to stop further iteration. The stress measure is the square root of the normalized residual sums of squares, expressed as Kruskal’s stress, which value should be preferably lower than 0.10 (Kruskal & Wish, 1978).

The MDS procedures through numerous trials (iterations) recovers a meaningful direction hidden in the matrix of empirical data to determine underlying geometrical structure or model (U.S.A. map), from a collection of distances among objects in a space (cities) (Shepard 1972). Therefore, recently multidimensional scaling became the preferable statistical method used by minimum dataset builders for constructing the instrument in developing taxonomies. One example is the study by Griens, Goossen, & Kloot, (2001). They explored the minimum dataset for the Netherlands using

multidimensional scaling techniques. The technique helped in assigning scale values to the nursing data elements under investigation in such a way that similarities and dissimilarities between them were made possible to explain, and aided in making decision regarding the number of data elements and the categories to be included in developing the NMDS.

Conceptual Framework

The conceptual framework that was used to guide the methodology in this study is adopted from the systems theory. Generally the ideas of classic systems theory with structure, process, and outcomes was used widely in developing many Nursing Minimum Dataset, such as Nursing Management Minimum Dataset (NMMD), and the Clinical Nursing Minimum Dataset (NMDS), and other dataset such as North American Nursing Diagnosis (NANDA), Nursing Intervention Classification (NIC), and the Nursing Outcome classification (NOC). The system model is flexible, dynamic, user friendly and is well known in many disciplines. It was the most pragmatic choice to adapt systems theory for the development of NEMDS because not only did it allow flexibility and facilitate the codification scheme for nursing education language that could be electronically read, interpreted, and monitored, but also the system model makes it possible for coding schemes to commensurate with other nursing vocabularies. After an extensive literature search was conducted in nursing, education, and reviewing several models from the sociology, education, and psychology literatures for identifying the main nursing education variables that are commonly used. An example of a model from another field is Tinos's student integration Model (1975) from sociology. This model

focused on higher education community. Another example is Bean and Eaton's Psychological Model focused on organizational process of higher education, which incorporated background, organizational, environmental, and attitudinal and outcome variables. The systems model approach was adapted to build a taxonomic schema for engineering the essential terms and data elements in nursing education.

The methodology in this study adapted many attributes and variables "data elements" from the above two models from sociology, into the systems model. Each of the three domains; input, process, and output included nursing educational terms and data elements related to four major categories; Students, Organization, Faculty, and Curriculum. Each category incorporated several essential educational items "data elements". *System input* items for the student category included data elements such as: demographic data, academic profile, admission tests, recruitment plan, and retention in program. The organization category included elements such as type of institution, philosophy and mission, type of governance, type of funding, human/ non human resources, and training programs. The faculty category included data elements such as demographic data, faculty profile, and type of faculty. The curriculum category included data elements such as level of nursing programs from BSN, MSN, PhD, or others, the type of curriculum, distance learning and web based courses. *System process* items in the student category comprised data elements such as ongoing student evaluation, level of involvement with extramural activities /extra curriculum activities, learning skills, level of adaptation to environment and diversity. The organization category comprised data elements such as number and type of outreach, events and community interactions, level of congruency between the departments and the mother college or university in (the goals

objectives, strategic plans, marketing, budgeting, evaluation criteria, etc.). The faculty category comprised data elements such as teaching loads, committees and meetings, teaching methods and ongoing faculty evaluations. The curriculum category comprised data elements such as total credit hours, ongoing program assessment, faculty/student classroom and clinical ratios, clinical / theory credit hours ratio. *System outcome* items for student category included STUDENT OUTCOMES such as, graduation rate, attrition rate, certification examination pass rate, student satisfaction, and employment rate after graduation, honors/awards, progress to graduate studies, refereed publications and competencies. For the organization category the data elements included ORGANIZATIONAL OUTCOMES such as accreditation status, ranking status, and funding status. Faculty category data elements included FACULTY OUTCOMES such as publications/textbook, promotions on job, research funding, honors or awards, and scholarships. The curriculum category data elements included CURRICULUM OUTCOMES such as program evaluation, course evaluation, program and course accrediting status, see (Figure 1.).

The system model is defined as a whole which functions as a whole by virtue of the interdependence of its parts (Rapoport, 1968). Also defined the system model as a set of objects together with relationship between the objects (parts of the system), and their attributes (the properties of the object). (Hall&fagen, 1950). It is important to understand that all the data elements that are listed, classified, categorized, and coded under each of the system model domains: structure; process; and outcome, have to be in the outcome form, measurable, and quantifiable to help data collection and analysis, other wise there will be no use of gathering all these data if no meaningful conclusion can be reached

regarding them. It is suggested that when developing a NEMDS, a panel of expert educators should rate these terms and data elements using Delphi method based on the following: i) Does the item add important information about the school, faculty, student, and curriculum; ii) is the item measurable and quantifiable; iii) is the item essential for the NEMDS; vi) is it feasible to measure the item?

The above data elements are the very basic variables that are commonly used by any nursing education community around the world, further adaptation and introduction of various specific data elements can be done based on the needs of each school, state or country and their specific educational systems. This framework is just an example to show how to adapt the systems model for constructing the taxonomy of nursing education. Data elements under any of the above mentioned categories can be repeated in any of the three domains of the system theory based on the need and type of information needed regarding that specific data element.

The nursing education data elements organized in this system model need to be consistently coded for automated documentation. Once the nursing education data elements are classified, categorized, and coded, it can be called nursing education ontology that can form the taxonomy to build the NEMDS. Figure1. is a graphic arrangement of basic and general educational data elements that precede the ontology formation.

Specific nursing education terminologies and definitions presented by the Interagency Collaborative on Nursing Statistics (ICONS) are available in the appendix of this paper to help in further sub classification of the specific nursing education data elements by those who will be interested in build the NEMDS or taxonomies.

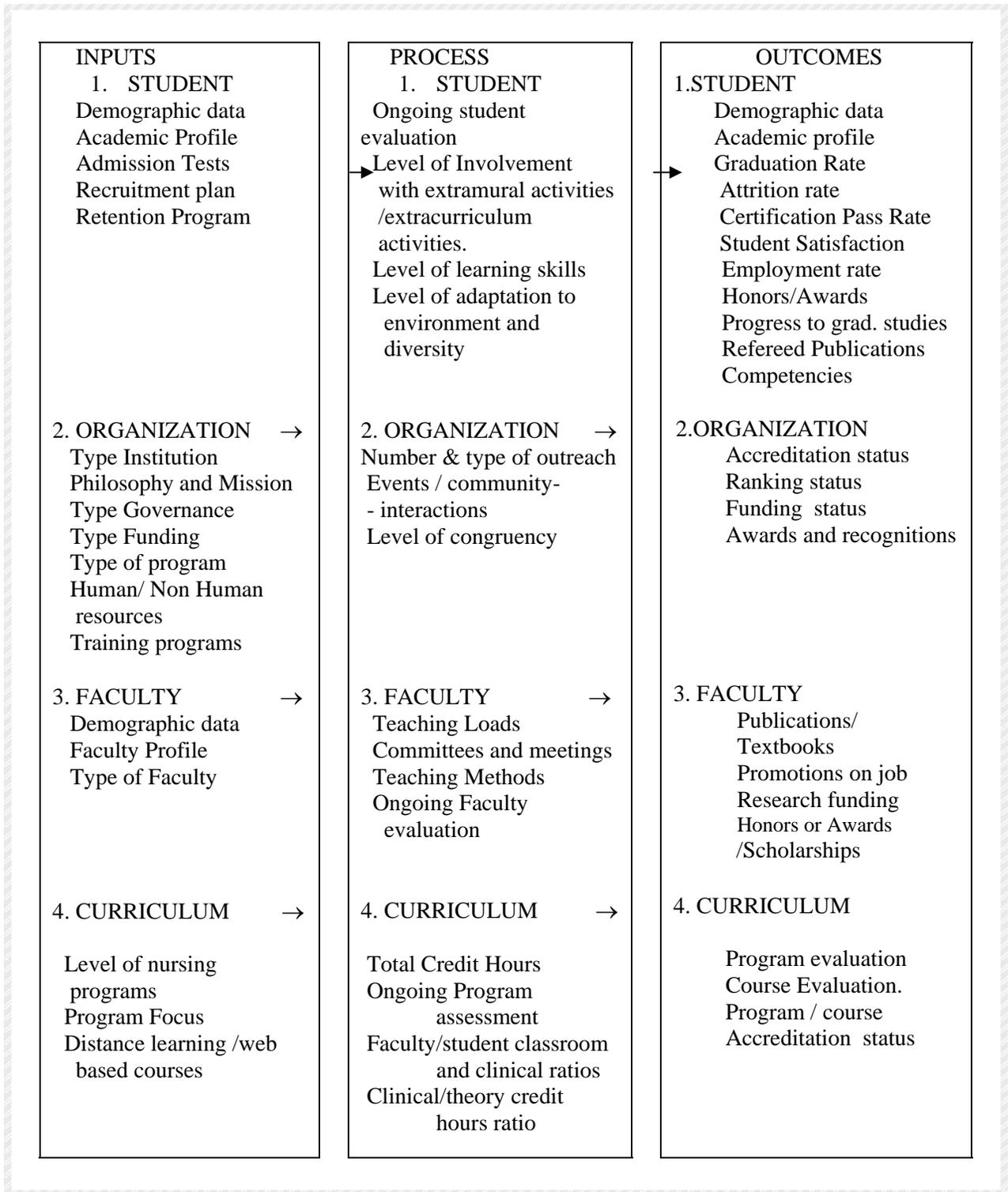


Figure 1. Example of Adaptation of Systems Model to Develop a Taxonomy for Building NEMDS

Definition of Terms

For the purpose of this study the key terms are defined as follows:

Taxonomy: a process of classification and organization of a particular set of information, items, or events, of a particular purpose, into a category within a complex hierarchy (I.C.O.N.S., 2002).

Ontology: a study of the categories of things within a domain, providing a logical framework for knowledge representation. Work on ontologies involves schema and diagrams for showing relationships between different things (I.C.O.N.S., 2002).

Dataset: A sequence list of individual data items (entity, attribute, or class) each with a clear label and set of permissible values (code set, and/or sub- classification) forming a specification which help to describe pre-defined information (NHS, 2005).

Classification Scheme: A system or process designed to support the reliable categorization of complex textual data values into a mutually exclusive predefined structure. Classification can be differentiated from frames by the presence of rules and coding standards.(NHS, 2005).

Coding System: A means of codifying simple textual expressions or values to support information retrieval. A coding frame does not require coding rules or complex categorization structure. A set of agreed-upon symbols, frequently numeric of alphanumeric, attached to concept representation or terms with regard to their form or meaning (NHS, 2005).

Minimum Dataset: a minimum data set of items of information with uniform definitions and categories concerning the specific dimensions of nursing which meets the

information needs of multiple data users in the healthcare system. (Werley et al, 1991, p.422; PITAC, 2004).

Nomenclature: A system of designations (terms)elaborated according to preestablished rules (I.C.O.N.S., 2002)

Database: A collection of interrelated data often with controlled redundancy, organized according to a scheme to serve one or more applications; the data are stored so that they can be used by several programs without concern for data structures or organization(I.C.O.N.S., 2002).

Controlled Vocabulary: Terminologic dictionary containing and restricted to the terminology of a specific subject field or of related subject fields and based on terminologic work (I.C.O.N.S., 2002)

Unified Nursing Language System: A system resulting from mapping terms among multiple nursing vocabularies and classifications schemes (I.C.O.N.S., 2002)

Systems Model: a conceptual organizational tool for organizing taxonomy of terms used in nursing education, based on the three major components of the systems model in engineering (Input, Process, Output) (NLN, 2003).

Inputs: An event external to a system which modifies the system in any manner. A variable at the boundary through which information enters, the set of conditions, properties or states which affect a change in a system's behavior, the medium of exogenous control. ([Krippendorff, 2004](#)).

Process: A process is a naturally occurring or designed sequence of operations or events possibly taking up time, space, expertise, or other resources, which produces some outcomes (define or undefined). A process may be identified by the changes it creates in

the properties of one or more objects under its influence. Process may be categorized as singular, recurrent, or periodic. A singular process would be one which occurs only once. Few processes in nature can be considered singular. Most processes found in nature are recurrent or repeat more than once. Recurring processes which repeat at a constant rate are considered periodic. (Krippendorff, 2004)

Outputs or Outcomes: Any change produced in the surrounding by a system. A variable at the boundary through which information exits. The products, results or the observable parts (subsystem) of a system's behavior. The medium through which a system may exogenously control others. An output could conceivably include all of a system's behaviors, but it becomes an informative concept only if some of its variables remain inaccessible to an observer or have no effect. (Krippendorff, 2004)

Summary

This chapter reviewed the research that has been already published that relates to the primary variables of the proposed study. It discusses the history and the process of developing taxonomies, standardized languages, and minimum dataset in nursing and healthcare around the world. It also explains the value of Minimum Dataset in nursing practice, education and research. This chapter includes an explanation for adopting the Delphi method in this research, and describes the different types of Delphi and the advantages of using the real-time electronic Delphi. The definition and purpose of multidimensional scaling, a history of its development, and an explanation of how to use multidimensional scaling were discussed briefly in this chapter. A description of the

conceptual framework the systems approach that was adapted for the study was included.

Definition of the variables such as taxonomies, ontology, minimum dataset, system model, input, process, and output were provided.

Chapter three will present the study design and the methodology for building a NEMDS.

Chapter Three: Design and Methodology

In this chapter the study design and methodology are reviewed, the review includes a thorough description of the sample, inclusion criteria, data collection instrument, data collection procedure, and data analysis plan. The research design proposed is a prospective descriptive study that identifies a generic methodology that can be used to develop a taxonomic schema for engineering the essential terms and data elements commonly used in nursing education to build a NEMDS.

Criteria for Sample Selection of Experts

The sample can be selected via a purposive (judgmental) sampling technique from any nursing membership database, but preferably from nursing education membership databases. The population of nursing educators needs to be screened by expert criteria to validate that we are building a minimum data set based on the responses and conclusions of respondents nominated for their expertise in nursing education. Participants can be identified as nursing education experts if they meet the following inclusion criteria: 1) 10 or more years of experience in full time academic teaching in a Bachelor of Science in Nursing (BSN), Master of Science in Nursing (MSN), PhD doctoral programs, or any other type of doctoral programs in nursing; 2) recognition as a leader in nursing education as evidenced by five or more nursing education research publications in refereed nursing journals. The inclusion criteria for subjects in addition to the previous two criteria can be

that the subjects must have an expressed commitment to participate and complete all stages of the study including the focus group discussion and the Delphi rounds. Nursing educator-experts have to be currently teaching in any university based undergraduate and/or graduate nursing programs because the BSN is the current entry level required for nursing service and education in many countries around the globe. The study to create a NEMDS can also include nursing educator experts who are researchers or currently holding administrative positions as Deans and program directors because of the knowledge they possess regarding nursing education.

Exclusion criteria include educators teaching in nursing programs located outside the country's boundaries and those nursing educators who can not speak the language fluently in which the NEMDS is going to be built. (due to the linguistic barriers and difficulties involved in reaching consensus on exact terms, meanings, definitions, and terminologies).

Population and Sample Size

Due to the nature of the methodology of developing a NEMDS that uses the Delphi method, the assumption is that the bigger the sample size, the better the statistical power we will have regarding the consensus on the taxonomy of essential data elements of nursing education to build NEMDS. Several points need to be explained. Precision of sample size is dependent on the following:

- 1) Population size of nurse educators within the databases.
- 2) Diversity and variation in the population characteristics. We need a larger sample size for high variations, and if we don't know the level of variation in advance, we can take a

conservative approach assuming more population diversity on a dichotomous (50/50) split.

3) Subgroups that exist within the sample for which estimates are needed, for example BSN, MSN, and PhD, nursing programs.

4) Sampling error, we need to have a tolerated sampling error at – or + 3 percent , at the 95% confidence level for the whole sample size(after taking out the ineligible and non-respondents).

A nationally representative sample can be selected through a non probability purposive sampling technique (Dillman, 2000). According to this survey methodologist, the sample size for the Delphi study varies depending on the level of desired margin of error. The sample size in the Delphi published studies varied widely between less than 20 (Duffield, 1993) to more than 200 (Broomfield, 2001) To estimate the starting sample size first one needs to estimate the number of questionnaires needed in the final sample, and then work backward, assuming 90 % of email addresses will be usable, 80% of the remaining subjects will respond, and 10% of the returned questionnaires will be illegible or incomplete.

Final sample size $\div 0.9 \div 0.8 \div 0.9 =$ starting sample size (Salant & Dillman, 1994)

It is important to have an up-dated, complete, and accurate list of nursing educators' membership database regarding their addresses and emails.

Methods and Steps for Building NEMDS

Based on adapting the definitions of MDS by Werley and others, similarly the Nursing Education Minimum Dataset (NEMDS) definition is as follows: A minimum

dataset of educational items of information with uniform definition and categories concerning nursing education which meets the information need of multiple educational data users in the nursing education system. The NEMDS includes those specific items of information that are used on a regular basis by the majority of nurse educators and nursing education community across all types of nursing programs and schools. Thus the NEMDS would add specific information to the existing nursing education data and statistics.

The initial steps in building the NEMDS are to:

1) Identify educational concepts and data elements. Keeping the above definition in mind one can easily say that the taxonomy and MDS development is a theoretical operation in which groups, classes, or sets of terms or data elements are systematically organized and linked according to some criterion. Therefore the first step is to identify essential terms and relevant nursing education data elements, and to conduct a concept synthesis. This first step may be derived inductively or deductively to formulate categories, classifications, taxonomies, and a coding system (Wagner, 1999).

The use of focus group proceedings and an extensive literature review to design the online of the Delphi survey questionnaire is the first suggested step in constructing the NEMDS.

The focus group can be used either before constructing the survey instrument to identify what data elements can be included in the questionnaire or after the consensus is reached by the Delphi survey for further classifications, labeling, coding, and ontology formations.

As discussed previously the literature review revealed four major nursing education categories: Student, Organization, Faculty, and Curriculum. Arranging these categories in three key domains of the system model, input; process; and outcome can serve as the blueprint for identifying and classifying the essential data elements for building NEMDS. Presenting these categories to approximately six focus groups with expert nurse educator participants from three major levels of nursing programs: BSN, MSN, and different Doctoral programs, (two discussions with each group), can lead to saturation of the information obtained. It is preferable to have 6-8 members in each discussion group (Kruger, 1999). The same inclusion criteria can be used to select focus group subjects as is used to select in the Delphi subjects to maintain the consistency of expert nurse educators.

Structured focus group social interaction and discussion is an initial attempt to identify inductively, and to include as many terms and educational data elements as possible, in order to avoid eliminating any terms prematurely. Another purpose served by the focus group is clustering or identifying data elements that seem closely related to each category and each domain (Walker & Avant, 1995). The audio or video taped focus group proceedings can be analyzed by four readers. Key educational words, phrases, metaphors and topics can be identified by multiple readings. Furthermore, patterns of connections between different data elements can be identified through discussion among all readers during serial meetings at which the coding of each transcript is compared among viewers.

2) *Define the data elements as nursing education terminologies.* A rigorous qualitative method of focus group helps in developing common vocabularies, nomenclatures, and

classifications of the educational data elements. Carefully and accurately defining the nursing terminology, labeling or naming them, grouping and clustering the identified elements by consensus into major distinctive themes or categories, helps to build the classifications and sub-classifications of data elements to create the taxonomy for building the NEMDS. The conceptual framework presented in Figure 1 can be used as a guideline to formulate the questions for the focus group discussions.

3) *Coding*. Once there is consensus on definition and specific unified terminology labeling or naming for each data element and terms, the next step is coding the data elements for automated documentation that can help in collection, storage and retrieval of each data element consistently throughout the different domains and major categories. This is essential, although there is no one specific method recommended to accomplish this. Each organization, field or discipline can choose different methods or codes accessible to their information technology. However, consistency in coding of all variables is crucial so that the same data element can be represented in two different categories. This will require two different codes for the same data element. One example is the data element of student demographics, which is labeled the same but repeated in two domains input and outcome. Each will give different meaning to the information when the data is collected therefore their codes have to be consistent yet different. The coding step may be accomplished through the use of the same focus groups as used in steps 1 and 2 or could be achieved using newly formed focus groups.

4) *Building a Taxonomy*: Based on the results of the focus groups, the taxonomy can be constructed. First, ontology can be designed, which means a graphical representation of the domains, categories, classification and sub-classifications of the essential terms and

data elements as shown in Figure 1. Next, an instrument that includes a listing of all obtained essential nursing education data elements and terms can be designed in a Likert scale for a three rounds Delphi survey to gain consensus on the elements (Henry, et al, 1987; pilot & Beck, 2004). Consensus can also be gained on the constructed taxonomy that can serve as the conceptual framework for building the NEMDS. Consensus on the taxonomy is better reflected on the NEMDS when the criterion of 70% agreement is reached on the majority of data elements on the questionnaire (Deshpande, & Shiffman, 2005).

5) *Empirical and theoretical validation.* Once consensus is reached regarding the nursing education taxonomy with schematically and hierarchically arranged essential nursing education data elements, evaluation of this generic taxonomy empirically and theoretically is an important step in validating the NEMDS. To evaluate the taxonomy *empirically*, the developers can pilot test the taxonomy and the NEMDS by verifying that similar essential nursing education data elements and terms appear in more than one study despite different samples and data collection methods. Empirical validation can occur even if the same educational terms and data elements have been conceptualized differently. For example, the faculty tenured item in the educational system of the United States may not be the case in the nursing education system of other countries like Saudi Arabia, but there may be a similar concept under different terminology. In addition the final taxonomy may have different codes, names, or sub-classifications, but should have all the data elements that represent the field of nursing education comprehensively (Ryan-Wenger, 1992; Goossen, et al, 1998; Griens, Goossen, Kloot, 2001). Both, global reliability (or the extent to which educators could consistently use the entire taxonomy

across all categories), and the category- by- category reliability, needs to be identified by the panel of expert raters when developing this taxonomy. The taxonomy *theoretically* can be validated also. An important issue in evaluating or validating any taxonomy is related to its theoretical structure and the consistency of concepts used in building that taxonomy so that we can indicate that the purpose of the MDS “ to generate comparable data” (Reynolds, 1971; Turner, 1986; Ryan-Wenger, 1992; Walker & Avant, 1995; Goossen 1998) is guaranteed.

6) *Disseminate and aggregate the data.* The real validation of such a NEMDS will not be clear until it is disseminated to the nursing education community including students; educators, administrators, researchers, and other nursing education data users, and the actual utilization of the NEMDS in their operational activities and practices within their organizations occurs. Only following actual use will true data be available for validation and further refinement of the NEMDS. Aggregation of the NEMDS in national and international databases is essential for the data collected to have a global meaning for guiding the advancement of nursing education practice and research (Goossen, et al, 1998). Figure 2 presents a graphical representation of the essential steps in building an NEMDS.

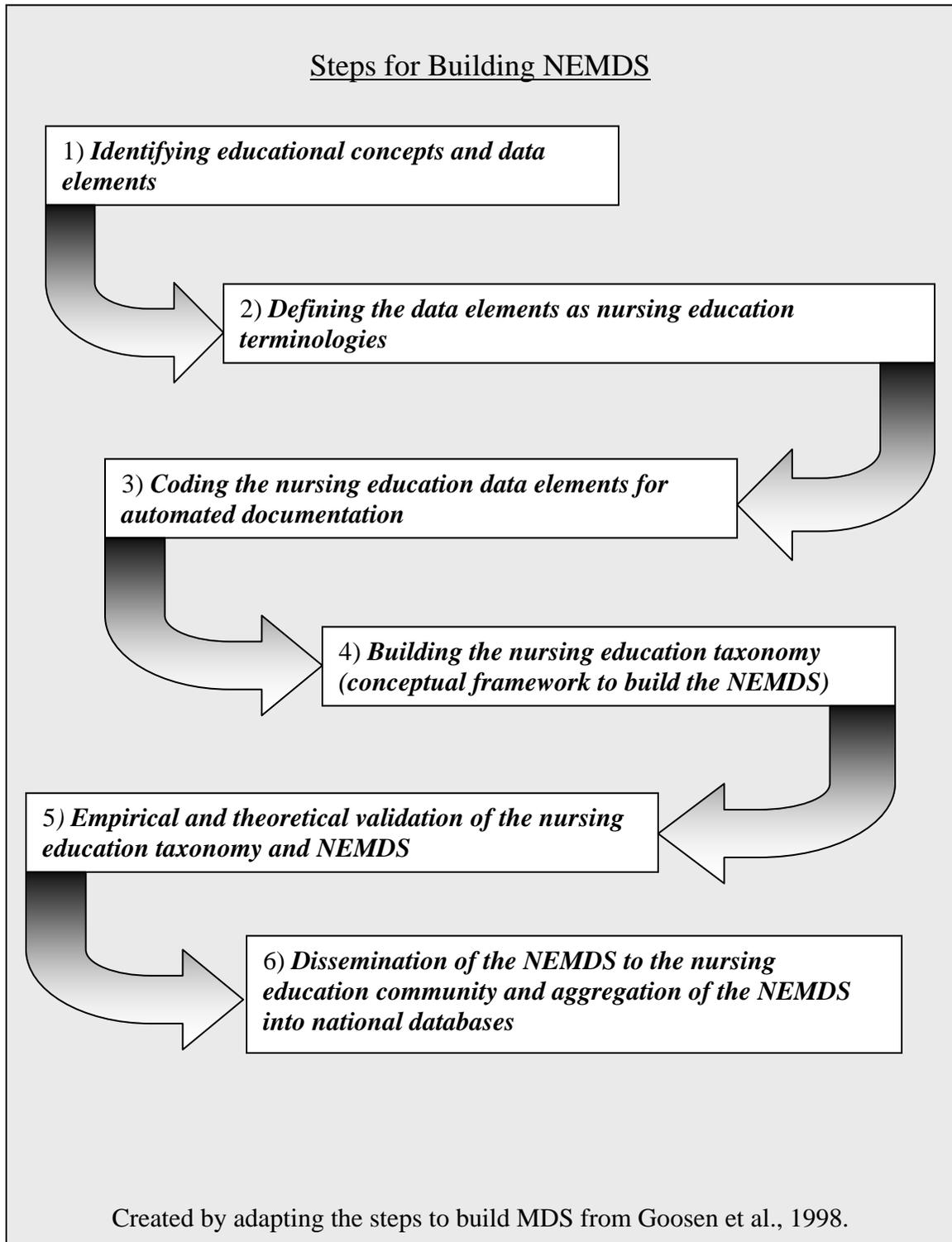


Figure 2 Steps for Building Nursing Education Minimum Dataset

Data Collection Instrument

With the advantages of computer technology in the 21st century it is more convenient, economical, and faster to use the electronic real time Delphi methods to reach consensus in a speedy yet accurate fashion. Online surveys reduce the attrition rates, increase response rates, and reduce costs that make the inclusion of a large sample size a possibility.

Survey Monkey (<http://www.surveymk.com/home.asp>) is a revolutionary intelligent tool that enables researchers to create professional online surveys and survey questionnaires quickly and easily with an unlimited number of questions, spanning an unlimited number of pages. The main features of this soft ware are that it helps in:

- 1) Designing the survey using just a web browser and their intuitive survey editor. Researchers are able to select from over a dozen types of questions (single choice, multiple choice, rating scales, drop-down menus, and more...). These powerful options allow researchers to require answers to any question, control the flow with custom skip logic, and even randomize answer choices to eliminate bias. In addition, they are able to have complete control over the colors and layout of the survey.
- 2) Collecting responses automatically by simply cutting and pasting a link to the survey, researchers also are able to use a popup invitation generator to maximize response rate, and use an automated email notification and list management tool to track the respondents.
- 3) Analyzing results, researchers are able to view results as they are collected in real-time. They are able to watch live graphs and charts, and then dig down to get individual responses and securely share survey results with others. Powerful filtering allows

displaying only the responses researchers are interested in. They are able to even download the raw data into Excel or SPSS. Survey monkey can create hundreds of questions and can reach an endless number of participants; it has many advantages over other similar software as: it can create Skip Logic (Conditional Logic), can customize the path a respondent takes through the survey by adding skip logic, and can eliminate unnecessary confusion by skipping non-applicable questions, and "order bias" by randomizing answer choices. It can reduce "drop-outs" and overall frustration; it help in improving the quality of the data by requiring an answer for every question; it can give the survey a professional feel by using a logo up to 50K in size at the top of every page in the survey; it also can create custom themes for every element of the survey for fonts, sizes, and colors. It can generate custom popup invitations for each website. By simply cutting and pasting the code into any webpage it will start generating invitations to increase response rates, To minimize annoyance to visitors, invitations only popup once. It also can serve as custom redirect - Once the survey is completed, respondents are redirected to the page of choice. Finally it helps to filter results - a powerful feature that helps in finding patterns in the results. It asks questions such as: "Show me only those respondents who answered choice x in question y." It is possible to filter any questions in the survey (even open-ended). The entire results section reflects researchers' filter choices. Results can be shared, others can view the results without giving them access to researchers' account, and the researcher has control as to which results can be visible and how the results may be used. Results also can be downloaded automatically in numerical form as well as the text form to a local computer for further analysis, and summary

results can be taken into Excel to create graphs. Detailed results can be saved into the hard drive for safekeeping, researchers can be in a complete control.

These incredible features of this soft ware make it difficult to resist suggesting its application to the methodology proposed to develop a NEMDS.

A survey questionnaire containing of a list of several terms and data elements commonly used in nursing education (as in the proposed systems model) can be constructed using information obtained from the literature search and focus group discussion results. The items can be organized in three domains based on the conceptual framework; Input, Process, and Output, under four major categories: student, organization, faculty, and curriculum.

The list of items on the questionnaires can be designed in a 7 point Likert- type scale. Participants need to be asked to read each item and rate their level of agreement about whether to include that item in the dataset or not, with a rating of one being strongly disagree and seven being strongly agree, based on the following criteria: i) does the item add important information about the school, faculty, student, and curriculum; ii) is the item measurable; iii) is the item essential for the NEMDS; and vi) is it feasible to measure the item. They can also be encouraged to express their opinions and points of view and write their comments about each item in the provided space on the questionnaire. Questions regarding demographic information such as age, sex, race, ethnicity, and number of years teaching in nursing programs, number of publications, nursing specialty, and others have to be constructed on the first round of the Delphi questionnaire along with the screening questions. The logic can be built in the questionnaire in such a way that if the nurse educators did not answer or meet the

inclusion criteria, the survey will automatically end and the participant will not proceed.

The estimated time for responding to the questionnaire should not exceed 35 minutes to complete (Dillman, 2000). The logic of all items on the questionnaires must be completed prior to moving to next question.

Thus the expectation is that there will be no missing data. A complete descriptions of the responding method and a business hour telephone number (preferably a toll free number), as well as the email address of the researcher need to be provided in a cover letter along with the instrument. Participants should be encouraged to ask any questions they may have regarding participation, the questionnaire, or the research itself.

Two experts or more with extensive experience in survey construction should review the questionnaire for face and content validity. The experts will revise the questionnaire for greater clarity and ease of completion. Content validity to evaluate the relevance of the elements and to determine the content representativeness can be achieved through the use of the content validity index (CVI). In the CVI relevance ratings of the data elements are done using a seven-point ordinal rating scale with 1 representing an irrelevant data element and 7 representing an extremely relevant data element. The proportion of two experts who rated the questionnaire as content-valid determines the CVI for each data element. Cohen's Kappa technique can be used to assess experts' inter-rater reliability on items. A pilot testing of the first round of questionnaire needs to be conducted using a sample of 10 or more nursing education experts. The same expert inclusion criteria can be used in selecting respondents for the pilot testing as to nominate the study subjects. Questionnaire revision and modification based on the experts' responses during the pilot testing is helpful.

Institutional Review Board

Approval from the appropriate Institutional Review Board must be obtained prior to data collection. Because this is an on line electronic Delphi survey conducted by participation of volunteer healthy adults, informed consent waivers may be granted. The first round of the questionnaire can be accompanied with a cover letter that should provide complete information and detailed explanations about the nature of the research and the researchers' expectations of the participants. Subjects' completion and submission of the first round of the questionnaire will be considered to be their consent to participate in the study. All subjects' identifying information can be kept confidential and private. Full anonymity is maintained in this type of study.

Data Collection Procedures

Initially an online invitation needs to be sent to all nursing educators selected for the sample to participate in the online Delphi study to develop an NEMDS. In that invitation a brief orientation to the study can be presented. A few days later, the first round of the Delphi survey questionnaire, a unique Universal Resource Locator (URL) link to the website where the questionnaire is located, an ID number, and a password to access the site can be sent along with a cover letter. This letter should explain in detail the nature of the study, the aims of the research, how and why the subjects have been nominated to participate in this study, the importance of their participation, the benefits and risks of participating, and the developers' expectations of the participants. Instructions regarding the method of responding, suggested return date and time, and a complete address, business telephone numbers, and an email address of the researcher

needs to be provided. This facilitates answering any questions that respondents may have regarding their participation, the questionnaire, or the research itself. Because this cover letter will be used as an informed consent form, participants agreeing to participate, responding and submitting the first round of the questionnaire are considered as having provided their informed consent.

Each participant needs to be asked to rate and comment on all the items on the questionnaire. Using a voting system, responses can be made known immediately to the assembled panel. Responses to each round of questionnaires are analyzed and summarized. Draft feedback with graphic summaries can be returned to the experts for suggestions and revision, along with the revised and modified questionnaire based on the result from previous rounds. The respondents then can reformulate their opinions with the knowledge of the group's viewpoint in mind. This process of response-analysis-feedback can be repeated in rounds two and three using the same software, Survey Monkey, until general consensus of 70% agreement among participants is obtained.

Anonymity of data and respondents can be maintained only if the online Delphi is used without the focus group method, However confidentiality can be maintained throughout the study. Data can be held on personal, rather than network computers and data handling can be limited to few people. A ten day window to submit the survey electronically can be given for each round. Because the online Delphi can be fully anonymous, an email reminder has to be sent to all participants. Each round can be directly downloaded into Excel in a numerical data format and transferred to SPSS for analysis.

Data Analysis

Four types of statistical methods can be used to analyze the data.

First: A descriptive statistical analysis of the participant responses to each item on the Likert scale on the survey, using mean, median, and standard deviation can suggest consensus (Werley, 1986). Some researchers confirm that the degree of agreement can be assessed by variances, that is, the lower the variance the greater the consensus disagreement index is (Deshpande & Shiffman, 2005). The literature indicates that it is important to know at what level of agreement/disagreement consensus was reached. McKenna (1994) and Williams and Web (1994) indicated that acceptable levels of agreement using a Likert-type scale are reached at 51% and 55% levels of consensus. A consensus level of 70% will be acceptable for building the NEMDS. The mean, a measure of central tendency and the standard deviation, a measure of spread, represent the amount of agreement or disagreement within a panel on an item. All data can be analyzed using statistical analysis software (e.g., SPSS).

Second: Content analysis using the content validity index (CVI) for each item added by the Delphi experts will evaluate the relevance of the element and determine the content representativeness (Miiles & Huberman, 1994).

Third: The multiple-rater Cohen's kappa technique can be used to assess experts' inter-rater reliability on items in the instrument. Several examples exist in the literature (Colling, 2000; Siegal, 1988, Fleis, 1997). A Kappa of 0 indicates that observed agreement among raters is equal to agreement caused by chance alone. A kappa of 1.0 indicates perfect agreement among raters, beyond what would be expected by chance.

Kappa rating needs to be calculated for results of each round of the Delphi survey as well as an over all multiple rater kappa.

Fourth: Explanatory data analysis using the Multidimensional Scaling, a non metric approach can be conducted. The Multidimensional Scaling can give a more meaningful and interpretable solution of the instrument under study by obtaining measures of similarities and differences between several items among the three different levels of nursing programs. The computational strategy is to find special arrangements of low dimensionality where the rank order of the distances in the space correspond with the rank order of similarity measures between items with minimal error.

A computer program ALSCAL can be used to: 1) find a low dimensional space in which the points in the space represent the items being studied, and the original similarities and differences between the items among various groups of nursing educators, as well as to 2) represent the relationships among items as a geometric model or picture. The data matrix can be used to calculate a matrix of proximity scores between all pairs of items in the three different nursing programs. Proximity scores will reflect the degree of similarity or dissimilarity among a set of nursing education items being compared on different nursing education programs. The Multidimensional Scaling will help identify the relationships between those various nursing education data elements and group them under a few groups or dimensions. Based on the responses of the Delphi panel which will be subjected to several iterations to reach the lowest stress level possible, the researchers will be able to reach conclusion regarding the nursing education classification system(conceptual framework), or the taxonomy to develop the minimum dataset. The Multidimensional Scaling results either will confirm the proposed

conceptual model in the study, or suggest other classifications for nursing education data elements under lowest dimensionality.

Summary

This chapter described the possible research design, population, samples size, and sampling techniques. It explained two methods for data collection during different stages of the NEMDS development, focus group and Delphi methods. It discussed systematically the essential steps for developing the NEMDS.

The chapter also described the statistical techniques that can be used for data analysis and explained the advantages of using the multidimensional analysis to build a taxonomy of nursing education data elements for developing the NEMDS.

Chapter Four: Discussion and Conclusion

The purpose of this study was to develop a deeper understanding of minimum datasets and to create a generic methodology for building a NEMDS. The study attempted to fulfill three objectives: 1) identify the essential domains and commonly used data elements and essential terms in nursing education; 2) adapt the system model to serve as a conceptual framework and a taxonomic schema for organizing the essential data elements in nursing education; 3) describe the steps and the methodological process of developing NEMDS.

The steps formulated in this study, based on the literature review of previous experiences in developing minimum datasets in general, and in nursing specifically, represent a generic methodology for building the NEMDS. Due to the gap in concept synthesis of specific nursing education terminology, the study focused first on developing a hierarchic, schematic taxonomy of essential educational data elements. Because taxonomy development includes systematically organizing concepts and criterion links, its construction was considered a conceptual framework (Wegner, 1992; Rasch, 1987). The presented taxonomy in this study used several attributes to group and classify data that are increasingly inclusive and suggested ways for expanding the classification further by adding more specific data elements that are particular to any educational organization. The four major categories of student, organization, faculty, and curriculum were kept consistent through out the three domains of the systems model: input; process; and

outcome. Clustering nursing education data elements according to input, process, and outcome helps to link or/and distinguish cause from effect. Each cluster or grouping encourages the nursing education researcher to be directed at uncovering the hypothesized causal elements for a specific outcome. Furthermore distinctions identified by these simple clusters or groupings can render nursing education practice more intelligible by all observers.

Using two different methods of data collection such as focus group and online Delphi methods to build the NEMDS, although each serves a different purpose, can lead to a more valid NEMDS through findings of both quantitative and qualitative data from an expert nursing educator panel. Consensus and empirical and theoretical validation of the ontology and the taxonomy of the NEMDS will ensure the production of comparable data that can help in the evaluation and development of either the entire nursing education practice or some specific components of it. The consistency of the four categories used to cluster the data elements, student, organization, faculty, and curriculum, can make aggregation of data and comparison possible, and research questions can be addressed using these differentiating categories within the NEMDS. For example, researchers can compare variables of student outcomes from the output domain with teaching methodologies from the process domain to have some meaning to the data collected and allow predictions of outputs associated with various teaching methods. The NEMDS can allow data to be collected once, but used many times by different people, at different times, in different settings to make various inferences and conclusions regarding nursing education practices, nationally and internationally if we have a consistent taxonomy and nursing education language (Fayyad,1996; Epping et al, 2000).

The proposed methodology for developing the NEMDS meets the criteria of having an accurate dataset, because the categories and data elements in the taxonomy (the conceptual frame work used to develop NEMDS) are mutually exclusive, exhaustive, and consistent with the concepts that help nursing education researchers to describe, explain, and predict the outcomes in the field of nursing education. The NEMDS can help the transformation of simple information to meaningful knowledge that can be used by the school, state or country to advance nursing education, research, and practice.

Summary

This chapter discussed the characteristic of the proposed generic methodology for developing a NEMDS including the issues of: identifying, defining, and unifying the nursing education terminologies,; benefits of using various data collection methods and data analysis techniques, and the possibilities of upgrading, expanding and adding further sub-classifications to the proposed nursing education taxonomy to build the NEMDS.

Chapter Five: Limitations and Recommendations for Further Research

The literature has revealed several limitations to the process of developing minimum datasets as well as their uses in various disciplines. The process of developing this methodology supported the limitations from previous research and also revealed the following limitations:

- The most important limitation is the lack of clear definitions of variables and unified terminologies that constitute the universe of values for each variable. Sometimes the concepts of MDS data elements (terms) match the names of the vocabularies used, but the definitions of the MDS data element (terms) differ (Wheeller, 1992). A unified and standardized nursing education vocabulary, definitions, and defined relationships between nursing education terms and data elements is crucial for building a NEMDS (Delaney & Moorhead, 1995).
- The reliability and validity of the database often are confused with the validity and reliability of the classification system (Ryan and Delaney, 1995). Updating existing MDS systems is expensive because it requires upgrading the existing data collection methods, changing classifications, instruments, and educating new users (PITAC, 2004).
- Goosen and others (1998) confirmed that the NMDS that have been developed and applied in many countries have some common similarities, but there are also

differences in purpose, content, sampling techniques, research designs, data collection approaches, analysis and dissemination processes, and in the development stages. Consistency in those approaches and process, and in the information technologies used in developing a NEMDS can lead to a more universally accepted NEMDS and meaningful data regarding our nursing education practices.

- Although it is obvious that the idea of a NEMDS will help in having several advantages in assessing and improving the nursing educational structures, processes and outcomes, however the national and international comparisons of nursing education data will not be possible unless we have a unified nursing education language. Only a unified international nursing education taxonomy with common nursing education terminologies and definitions will allow the aggregation and comparison of nursing education data across the globe. If there is a difference in the level of consensus on the standardized incidence and prevalence estimates of specific and important data elements to be included in the NEMDS, or if the dataset is nationally and internationally incompatible with the items needed to construct the NEMDS, then it will limit the selection of research questions that can be answered by the dataset, and there will be nothing to compare.
- Most MDS intend to meet the data needs of users at all levels, administrators, researchers, educators, and providers. A growing body of evidence supports the assertion that MDS provides the discipline with substantial benefits regarding budgeting, financing, allocating resources, and assessing and evaluating services and for research. However, the literature in general and the nursing literature specifically lack the presence of empirical research that demonstrates the advantages of minimum

datasets in nursing. We need to have sound scientific practical research to answer the questions about whether the MDS are worth the effort and costs spent to develop them. As Goossen stated we need to balance the benefits and costs of creating minimum datasets with the results of using MDS.

- At the present time, there is no one universally uniform MDS in nursing in general or in nursing education specifically that is used with consistency world wide. To build one however, an international effort and coordination is needed. Collaboration between nursing education MDS developers around the world is important during the early planning and building stages, as well as during the MDS validation process to ensure the production of comparable data across geographical settings and time.
- Last but not least, understanding human nature and the variations among the existing cultures, and understanding the differences and similarities in the needs, difficulties, and resources of different populations, nursing education programs, and countries around the globe can help MDS developers to better identify the terms and data elements needed for building a more universally accepted MDS.

Summary

This chapter discussed the main obstacles commonly faced by the MDS developers, based on reviewing previous different experiences and the process of developing MDS. It listed specific limitations of developing MDS, and suggested recommendations for building one in nursing education. It also included directions for future research related to NEMDS.

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Appendix

Appendix A: Nursing Education-Related Terminologies

1. *Practical/Vocational Nursing Program**. A program of instruction, usually 12 to 18 months in length, generally within a high school, vocational/technical school or community/junior college setting, the completion of which results in a diploma or certificate of completion and eligibility to apply for licensure as an LPN/VN.
2. *Basic (or Entry or Generic Level) Program**. A program of instruction that prepares individuals for entry into registered nurse practice and eligibility to apply for licensure as an RN.
3. *LPN/VN to Associate Degree in Nursing Program**. A program of instruction to prepare registered nurses that is specifically designed to admit individuals licensed as practical/vocational nurses and, at completion, awards an associate degree in nursing and eligibility to apply for licensure as an LPN/VN.
4. *Diploma Nursing Program**. A program of instruction, usually two to three years in length, within a hospital-based structural unit, the completion of which results in a diploma or certificate of completion and eligibility to apply for licensure as an RN.
5. *Associate Degree Nursing Program**. A program of instruction, usually two years in length, generally within a junior or community college, the completion of which results in an associate degree (e.g., AS, AA, AAS, ADN, etc.) with a major in nursing and eligibility to apply for licensure as an RN.
6. *Baccalaureate Nursing Program**. A program of instruction, usually four years in length, within a senior college or university, the completion of which results in a baccalaureate degree (e.g., BA, BS, BSN, etc.) with a major in nursing, if not already licensed as an RN, and eligibility to apply for licensure as an RN.
7. *Master's Nursing Program*. A program of instruction within a senior college or university that builds on baccalaureate competencies and focuses on an area of specialization and the completion of which results in a master's degree (e.g., MSN, MS, MA) with a major in nursing and, if not already licensed as an RN, eligibility to apply for licensure as an RN.
8. *Doctoral Nursing Program*. A program of instruction within a senior college or university that prepares a clinical, educational, or research scholar and the completion of which results in a Doctoral degree in nursing (e.g., Ph.D., DNSc, Ed.D).
9. *Nurse Doctorate or Doctor of Nursing Program (ND)*. A program of instruction in a senior college or university that prepares clinical practitioner/scholars to assume advanced practice clinical and leadership roles. Generally ND programs are designed as generic (basic or entry-level) programs for individuals with bachelor's degrees in a discipline other than nursing. Upon completion, graduates are awarded a doctor of

- nursing (ND) degree. In general, ND students are eligible to apply for RN licensure after the first two years of the program. (Note: This program is different from a Doctoral Program in Nursing.)
10. *Post-Master's Certificate*. A formal, post-graduate program that admits RNs with master's degrees in nursing and, upon completion of a specialized area of study, awards either a certificate or other evidence of completion. (Note: This program is different from short term continuing education programs.)
 11. *Post-Doctoral Program in Nursing*. A program environment for research training designed to attract highly qualified candidates. Postdoctoral fellows must hold a doctoral degree in nursing and are expected to remain active in research upon completion of the program.
 12. *Basic (or Entry Level) Program*. A program of instruction that prepares individuals for entry into registered nurse practice and eligibility to apply for licensure as an RN.
 13. *Continuing Education Program*. An educational offering designed to help nurses maintain or expand their competence in their role. Such offerings may include workshops, institutes, self-study, clinical conferences, staff development courses, individual study, or other options. They do not include study for an academic degree or academic certificate (e.g., post-master).
 14. *Program Articulation*. A process through which two or more nursing programs cooperate to accommodate the learning needs and career goals of students, as they progress from one level of preparation to another, with minimal repetition and duplication of learning experiences.
 15. *Academic Year*. A designated period of time institutions use to measure a quantity of academic work to be accomplished by a student, or to define the period of time in which an academic year-based appointee renders services. Generally, an institution defines its own academic year, for example, from the beginning of the fall term through the end of the spring term.
 16. *Academic Health Center*. An academic health center consists of an allopathic or osteopathic medical school, at least one other health professions school or program, and at least one affiliated or owned teaching hospital.
 17. *Chief Executive Officer - Nursing Education Unit*. The individual who has primary and ultimate responsibility for a nursing academic unit. This may be the Dean, Director, Department Head, Chairperson, or other institutionally-determined title.
 18. *Non-Nurse Faculty*. Individuals who teach nursing students selected courses (e.g., pharmacology, nutrition, statistics), but who, themselves, are not nurses. These individuals may hold full or part-time faculty appointments in the nursing academic unit.

19. *Full-time Faculty.* Those members of the instructional, administrative, or research staff of the nursing academic unit who are employed full-time as defined by the institution, hold academic rank, carry the full scope of faculty responsibility (e.g., teaching, advisement, committee work), and receive the rights and privileges associated with full time employment. This faculty may be tenured, tenure-track, or non-tenure track (given that there is a tenure system in the institution).
20. *Part-Time Faculty.* Those members of the instructional, administrative, or research staff of the nursing academic unit who are employed part-time as defined by the institution, may or may not hold academic rank, carry responsibility for a specific area (e.g., teaching a single course), and may carry any number of titles (e.g., adjunct, clinical instructor). This faculty is typically not eligible for tenure.
21. *Tenure.* A system designed to protect faculty members' academic freedom and to provide enough financial security to attract able individuals to the profession. It is an affirmative commitment by an institution to a faculty member, generally offered after a probationary period of employment, as a right to continuing employment.
22. *Tenured Faculty.* Full-time faculties who have met the teaching, scholarship, service, and other criteria and requirements for tenure, as established by the institution, and have been awarded permanent or continuous employment at that institution.
23. *Tenure-Track Faculty.* Full-time faculty in a probationary period of employment preliminary to consideration for tenure. Tenure-track faculty are expected to meet the teaching, scholarship, service, and/or other criteria established by the institution for reappointment and eventual awarding of tenure, but do not claim any right to permanent or continuous employment at that institution.
24. *Non-Tenure-Track Faculty.* Full-time faculty employed in institutions with tenure that are not expected to meet all the teaching, scholarship, service, or other criteria associated with tenure at that institution. Non-tenure-track faculty, for example, may not be required to engage in scholarly activities or may have an increased teaching responsibility. In addition, they do not claim any right to permanent or continuous employment at the institution.
25. *Enrollments.* The number of students who are officially recognized by a school and program as being enrolled in that program, as of a given date. (Note: This includes transfer students and re-admissions.)
26. *First-Time Enrollments.* All students enrolled in a nursing program who have never before been enrolled in any nursing program.
27. *Basic (or Entry Level or Generic) RN Enrollments.* The number of students enrolled in a program preparing them for RN licensure eligibility, as of a given date.
28. *R.N.-to-Baccalaureate Enrollments.* The number of already-licensed RNs enrolled in a baccalaureate nursing program, as of a given date.

29. *Headcount*. The total number of individuals enrolled in a nursing program (i.e., LPN/VN, diploma, associate degree, generic/basic baccalaureate, RN baccalaureate, masters, etc.) on a specified date. It includes (1) all nursing students (students who have been formally accepted into the nursing program whether or not they have taken any nursing courses) and (2) admissions and transfer students. Excluded are (1) pre-nursing students (students who have not been formally accepted into the nursing program), (2) leave of absence students, and (3) continuing education students, unless they are degree-seeking.
30. *Full-Time Undergraduate Student*. A student enrolled in an associate degree, diploma, or baccalaureate program who is registered for 12 or more semester hour credits (or their equivalent) in a particular semester and who is eligible for awards, scholarships, appointments, etc. that are limited to students enrolled on a full-time basis.
31. *Part-Time Undergraduate Student*. A student enrolled in an associate degree, diploma, or baccalaureate program who is registered for less than 12 semester hour credits (or their equivalent) in a particular semester and who is not eligible for awards, scholarships, appointments, etc. that are limited to students enrolled on a full-time basis.
32. *Full-Time Graduate Student*. A student enrolled in a master's or doctoral program who is registered for 9 or more semester hour credits (or their equivalent) in a particular semester and who is eligible for awards, scholarships, appointments, etc. that are limited to students enrolled on a full-time basis.
33. *Part-Time Graduate Student*. A student enrolled in a master's or doctoral program who is registered for less than 9 semester hour credits (or their equivalent) in a particular semester and who is not eligible for awards, scholarships, appointments, etc. that are limited to students enrolled on a full-time basis.
34. *Graduations*. The total number of individuals who have completed and been graduated from a nursing program within a specified time period.
35. *Graduate from Post-RN Program*. An individual already licensed as an RN who has completed an academic program of study beyond the initial nursing education, leading to an associate, baccalaureate or higher degree.
36. *Graduate from Basic (or Entry-level or Generic) Program*. An individual who has graduated from a state-approved program and is eligible to apply for initial licensure as an RN.

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About the Author

The author received her BSN and MSN in nursing administration in Saudi Arabia. Her clinical experience is in adult critical care, emergency, and trauma care, and nursing leadership. She worked in military, educational/university, and Arabian American Oil Company hospitals.

She has taught nursing in various health sectors, including the Ministry of Health, and is a faculty member at the College of Nursing (since 1989), teaching BSN students a wide range of nursing courses. She is considered one of the pioneers in contributing to the nursing profession in the Kingdom, clinically and academically.

During her studies for the Ph.D., she joined the Honor Society of Nursing, Sigma Theta Tau International, and the National League for Nursing (NLN). Her two-year service on the task force group to develop A National Nursing Education Minimum Data Set at the NLN continues today. She has attended and participated in several nursing conferences nationally and internationally.