BUILDING HEALTH INFORMATICS CAPACITY IN GHANA BY INVESTIGATING HEALTH INFORMATICS EDUCATION TO IDENTIFY CHALLENGES AND DESIGNING STRATEGIES TO ADDRESS THEM

BY

ISSAH NANDZO SAHIDU

(PG 6547611)

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DECLARATION

I, Issah Nandzo Sahidu, hereby declare that this submission is my own work towards Master of Philosophy Health Informatics and that, to the best of my knowledge, it contains no material of previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

Issah Nandzo Sahidu ..... ……

(PG6547611) Student Signature Date Certified by:

Dr. J. B. Hayfron-Acquah …… ……...

(Supervisor) Signature Date

Certified by:

Dr. M. Asante …… ……

(Head of Department) Signature Date

ABSTRACT

Health Informatics (HI) is a new program offered at some universities in Ghana. However, some of the students pursuing this program have some negative concerns about how the program is being offered. The study investigates into health informatics capacity building in the three universities offering health informatics in Ghana. The study aims to find the challenges these universities are encountering in the teaching and learning of health informatics, possible causes of these challenges and recommended solutions to these challenges from lecturers and students. These universities include Kwame Nkrumah University of Science and Technology, Catholic University College and University of Ghana. Both qualitative and quantitative data collection approach was adopted for this study. Questionnaires comprising of both closed and open-ended questions were administered to health informatics lecturers and students from the three universities. The study reveals some challenges the three universities are encountering in offering HI. These challenges include: lack of practical lessons, inadequacy of lecturers, lack of specialization in particular aspects of health informatics courses, lack of teaching aids, lack of partnership learning programs and various levels of students incompetency. The study also reveals the causes of these challenges, these include: lack of teaching aids, unavailability of experience health informatics lecturers in Ghana, lack of capacity building for lecturers, refusal to use available teaching aids, unsuitable lecturer time table and lack of practical instructors. The study also came out with suggested solutions to these challenges. These suggested solutions from the lecturers and students seek to call on the universities to: establish well resource laboratories, employed experience lecturers, allow students to choose some courses to suite their missions, introduce partnership learning

programs with other health informatics related institutions, purchase health informatics teaching aids and organise enough practical lessons.

The study recommends for the three universities to address the challenges related to them to avoid producing inefficient health informaticians. The universities can address these challenges by using the suggested solutions provided in the conclusions of this study.

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ABBREVIATIONS

CDSS	Clinical Decision Support Systems
IMIA	International Medical Informatics Association
CAHIIM	Commission on Accreditation for Health Informatics and Information Management Education.
BMHI	Biomedical and Health Informatics.
ECTS	European Credit Transfer System
IT	Information Technology.
AMIA	American Medical Informatics Association
AHIMA	American Health Information Management Association
IΦE	International Partnership for Health Informatics Education.
UMIT	University for Health Sciences, Medical Informatics and technology
OHIH	Office of Health, the Information Highway at Health Canada.
PDF	Portable Document Format.

SPSS	Statistical Package for Social Science
HI	Health Informatics.
UG	University of Ghana
CUC	Catholic University College
KNUST	Kwame Nkrumah University of Science and Technology
PRLCIE	Peer-Reviewed Literature of Clinical Informatics Education
WHO	World Health Organisation
ITC	Information Systems Curriculum
IC	Informatics Curriculums
ITC	Information Technology Curriculum

CHAPTER ONE

1.0 INTRODUCTION

According to Lee, the Director General of WHO (2003), "Now is the time to make it happen where it matters, by turning scientific knowledge into effective action for people's health."

Health informatics is described as being at the intersection of the domains of healthcare and information technology and can be defined as: ―the scientific field that deals with biomedical information, data, and knowledge – their storage, retrieval and optimal use for problem solving and decision making in health care. It accordingly touches on all basic applied fields in biomedical science and is closely tied to modern information technologies, notably in the areas of computing and communication (www.openclinical.org /healthinformatics.htm)

Health informatics is the field concerned with acquiring, storing, and using information in health care, usually (but not always) involving the application of information technology (Shortliffe and Perreault, 2001). Health informatics is the science that underlies the academic investigation and practical application of computing and communications technology to healthcare, health education and biomedical research. This broad area of inquiry incorporates the design and optimization of information systems that support clinical practice, public health and research; modeling, organizing, standardizing, processing, analyzing, communicating and searching health and biomedical research data; understanding and optimizing the way in which biomedical data and information systems are used for decision-making; and using communications and computing technology to

better educate healthcare providers, researchers and consumers. Tools and techniques developed from health informatics research have become and will remain integral components of the best strategies in biomedical research and the best practices in healthcare delivery and public health management (www.medicine.virginia.edu/clinical/departments/phs/informatics/HealthInfDef-page).

There will be instances, of course, when the services of information professionals will emerge as an important part of the clinical team, particularly in critically ill hospital patients. For these instances, Davidoff and Florence have argued that a new professional, the informaticients, must emerge, (Davidoff and Florence, 2000). The evolution of the health informatics is perhaps the most bewildering and comprehensive enhancement of health care that has been witnessed in the past years. Health informatics is sometimes called medical informatics. It encompasses the use of dedicated software, hardware devices and sophisticated computer networks with the capacity to gather, evaluate and transmit medical information. The items that are necessary for constructing such a system include information technology, clinical directives, medical jargon and data storage (Landers, 1999).

Medical informatics can be applied in various health settings, including rehabilitation centers, hospital care, and general practice and primary care facilities. There are basically three areas in the health informatics field where the use of information systems may be used to create more operating efficiencies and effectiveness: clinical, administrative and medical information. For example, there is a tremendous emphasis on implementation of uniformed system for electronic medical records. Not only will it help cut health care cost, but also improve the overall quality of care to clients. In addition, it also has an impact on

scheduling, billing, clinical research and the sharing of medical information. Health informatics has restructured the operation of health care both within and outside health care centers. Successful areas of Health informatics include: Reminder systems, Electronic health records, Data repositories, Coding, Ontology and vocabularies, Data sharing (Landers, 1999).

Health informatics combines the fields of medicine, information science and information technology to formulate various systems for generating, validating, securing and integrating health-related data. The purpose is to deliver effective health care to patients. It involves bringing together various resources, techniques and systems to maximize the use of the wealth of medical knowledge, technological advances and drug breakthroughs that are available. It is used in a wide variety of health-related fields, including dentistry, pharmacy, nursing, medical research clinical care and public health. There are many reasons for the continued growth and development of the health informatics profession. It has multiple application possibilities in delivering better and less expensive health care. Doctors can take advantage of a constantly expanding knowledge base that enables them to make better use of the latest information when making medical decisions. This ability is further improved with the assistance of technology such as clinical decision support systems (CDSS), or electronic prescribing system, which abolishes the need for physicians to write prescriptions. It can also facilitate data mining, which provides information regarding thing like the effective of certain prescribe drugs. It may also help eliminate many prescription mistakes and lower the cost of treatments (Landers, 1999).

Health informatics as a program is study at different academic levels in some educational institutions in Ghana these include Kwame Nkrumah University of Science and

Technology (Graduate level), University of Ghana (Undergraduate and Graduate level), Catholic University College (Undergraduate level).

1.1 Problem Statement

Despite the importance of health informatics in the health sector, there is lack of human capacity in this field as they are now being trained by some universities. Although health informaticiens are being trained by some universities in Ghana, there seems to be some challenges facing the training of these professionals. Health informatics students are claiming they are being faced with a lot of challenges as they study this program.

1.2 Objective

This research aims to investigate and bring out the challenges (if any) universities in Ghana are facing in offering health informatics, possible causes of these challenges (if any) and suggested solutions to these challenges. This is an attempt to contribute to how Ghana could build her human capacity in Health Informatics to improve the efficiency and effectiveness of the healthcare services delivery.

1.3 Research question

i. What are the challenges facing the teaching and learning of health informatics in universities offering health informatics in Ghana?

ii. What are the causes of these challenges facing the teaching and learning of health informatics in universities offering health informatics in Ghana?

iii. What are the possible solutions to address the challenges facing the teaching and learning of health informatics in universities offering health informatics in Ghana?

1.4 Justification

Health informatics is a new program offered in some universities in Ghana. As a new program the foundation need to be build well if not inefficient health informaticiens would be produce. Inefficient health informaticiens in the health sector can result in deaths of patients. Health informatics students have come to realize that health informatics is being taught with a lot of challenges especially the practical aspect. The lack of practical knowledge would go a long way to affect the health care delivery by informaticiens in the various healthcare centers.

Ghana‟s health sector is welcoming and integrating information technology into its existing work processes but just like in many developing countries, Ghana is experiencing a shortage of qualified professionals in Health Informatics because of the scarcity of this professional. For effective policy-making, planning, management, monitoring and evaluation, research and patient care usage, quality health data based on the recommended health sector standards is needed. Therefore, it is imperative, that the captured data is comprehensive, timely, accurate, complete and reliable (Vision-2012, 2009).

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Brief History of Health Informatics

Worldwide use of computer technology in medicine began in the early 1950s with the rise of the number of computers (www.en.wikipedia.org/wiki/Health_informatics). In 1949, Gustav Wagner established the first professional organization for informatics in Germany (www.en.wikipedia.org/wiki/Health_informatics). Specialized university departments and Informatics training programs began during the 1960s in France, Germany, Belgium and The Netherlands. Medical informatics research units began to appear during the 1970s in Poland and in the U.S. Since then the development of highquality health informatics research, education and infrastructure has been a goal of the U.S. and the European Union (www.en.wikipedia.org/wiki/Health _informatics). Since the 1970s the most prominent international coordinating body as far as health informatics is concerned has been the International Medical Informatics Association (Haux, 2010).

Below are various ways some researchers and organisations have sought to contribute to the building of health informatics human capacity.

2.2 Building Health Informatics capacity: The case of The Commission on

Accreditation for Health Informatics and Information Management Education (CAHIIM)

The Commission on Accreditation for Health Informatics and Information Management Education (CAHIIM) studied the issues and needs of programmatic accreditation at the graduate level in health informatics. CAHIIM incorporated the work of a blue ribbon Health Informatics Workgroup in 2008 and a CAHIIM Health Informatics Committee in 2009 consisting of four appointed Commissioners to the CAHIIM Board representing health informatics educators and practitioners. Recognizing that there is a significant difference among the health informatics knowledge domains, a variety of interpretations of health informatics curricula across academic institutions, and that both the field of health informatics as a formal discipline and as an academic program are evolving, a set of curricular components are used to form curriculum guidelines. For purposes of assessing an academic program in health informatics, CAHIIM views the discipline through the lens of three major facets or domains. **Information Systems Curriculum (ISC)** components focus on such issues as information systems analysis, design, implementation, management and leadership. **Informatics Curriculum (IC)** components are concerned with the study of structure, function and transfer of information, socio-technical aspects of health computing, and human-computer interaction. **Information Technology Curriculum (ITC)** components focus on computer networks, database and systems administration, security, and programming (www.cahiim.org/Files-Standards/2012_HI_Masters_Stndrds_elec.pdf).

These three facets are aligned for the purpose of meeting the information needs of the various stakeholders within health care and related systems. An academic program in health informatics must include the curriculum components from all three facets.

Graduates of a program must have formal exposure and show an understanding of the interconnections between the three facets. Programs and students may choose to emphasize one or more facets consistent with their mission, goals and objectives. The kind of knowledge learned (knowledge dimension) and the process used to learn (cognitive processes) must be consistent with the program"s emphasis, goals and objectives.

The following published competencies were assessed by the CAHIIM Health Informatics Committee for frequency and commonalities which resulted in the curricular components as viewed through the lens of the three major facets:

- Recommendations of the International Medical Informatics Association (IMIA) on Education in Biomedical and Health Informatics; First Revision (2010)
- AMIA Board White Paper: Core Content for the Subspecialty of Clinical Informatics,
- The Development of A Model Curriculum for Applied Health Informatics
  - Joint Work Force Task Force: Health Information Management and Informatics Core Competencies for Individuals Working With Electronic Health Records
- Competencies for Public Health Informaticians 2009

It was determined that the analysis of existing published competencies would be used to populate each of the three broad facets with specific curriculum components. The five published documents combined with the work of the 2008 Health Informatics Workgroup, and assessment of curricula from existing health informatics academic programs provide

a basic framework on which to build and assess a graduate level program. As the process evolves refinements to the health informatics master"s degree curriculum components will be made (www.cahiim.org/Files-Standards/2012 _HI_ Masters_ Stndrds_elec.pdf).

2.3 Building Health Informatics capacity: The case of the peer-reviewed literature of clinical informatics education (PRLCIE) and others.

The peer-reviewed literature of clinical informatics education offers a variety of recommendations on what to teach to students who are qualifying in a health profession, and why to teach it. However, there is a paucity of literature that goes beyond learning needs, competency specifications and content outlines. It would be most helpful to curriculum designers and educators to be informed by literature that elaborates on what is involved in making such education a reality and on the experience of staff and students who participate in it. This gap in the literature has been identified by Van Veen and colleagues as an issue for informatics broadly (Van *et al*., 2004).

The literature of health professional education recognizes that curriculum is both an entity and a process. As an entity it comprises not only the expected competencies and roles; but also the learners at the centre of the enterprise; assessment linking competencies and learners; the conditions and resources for learning; and the social, political and cultural context in which the learning occurs. As a process it comprises design, implementation, evaluation and renewal (Bordage and Harris, 2011).

Given this more extensive view of curriculum, clinical informatics education initiatives need to be able to refer to rich descriptions and critical discussions of teaching and learning strategies and methods; of the alignment of assessment with objectives and standards; of

approaches to quality management and continuous improvement. Initiatives to address the need for clinical informatics education among future health professionals should thus aspire to be scholarly, that is "work upon which other scholars can build and equally important that other scholars can review, assess and critique (Shulman, 2011).

Health informatics Education should be on evidence based - for example, Patel et al. offer an example of applying empirical findings from the learning sciences to the development of curricula (Patel *et al.*, 2009). It should be modeled on good practice; for example, Kaufman D. offers "seven principles to guide teaching practice", namely those learners should have opportunities to: be active contributors; work on real life problems; proceed from their current knowledge; use self direction; practice and get feedback; reflect on their practice; and learn from role models. Therefore, this study uses ideas underpinning these aspirations and fundamental to an entity and process view of curriculum as the basis for a selective review of the literature on implementation and evaluation of clinical informatics education for future health professionals. This study aims to give insights into how clinical informatics education has been approached in the past, and it aims to distil lessons and suggest future directions for delivering ongoing curriculum reform in this important aspect of health professional education (Kaufman, 2004).

2.4 Building Health Informatics Capacity: the case of The International Medical Informatics Association (IMIA)

IMIA‟s Working Group 1 and some of its associated members have made enough effort to design and develop academic curricula frameworks in health informatics. IMIA has also made a number of recommendations on how the education and training programs should be conducted and carried out and continue to evaluate and redesign the framework. The

recommendations encourage and support the sharing of courseware (Mentas and Ammenweth, 2000).

Key Principles of the IMIA Recommendations state that in order to provide good quality health care, training and education in biomedical and health medical informatics is needed for various **H**ealth care professions, in different modes of **E**ducation, with different **A**lternate types of specialization in BMHI, at various **L**evels of education, which corresponding to respective stages of career progression which can be achieved by having qualified **T**eachers to provide biomedical and health informatics (BMHI) courses, which will lead to recognized qualifications for biomedical and **H**ealth informatics positions.

2.4.1 IMIA Recommendations for Learning Outcomes in Biomedical and Health Informatics

For education in BMHI two kinds of major learning outcomes can be identified (Mentas and Ammenweth, 2000). They specify the

- Learning outcomes for all health care professionals in their role as IT users: Enabling health care professionals to efficiently and responsibly use information and knowledge processing methodology and information and communication technology. These learning outcomes need to be included in all undergraduate curricula, leading to a health care professional qualification. On the other hand there are:
- Learning outcomes for BMHI specialists: Preparing graduates for careers in BMHI in academic, health care (e.g. hospital, primary care), government or industrial settings. These learning outcomes need to be included in all curricula, leading to a qualification as specialist in BMHI. Obviously,

between the specialisation of a health care professional as IT users and a health care professional as a BMHI specialist, various levels concerning depth and breadth of learning outcomes exist. Some programmes may focus on either health care professionals or on health informatics specialists.

Other programmes may focus on a kind of intermediary level, where students are educated to communicate with physicians and nurses as IT users on one side and health informatics specialists on the other side. The learning outcomes define the levels of knowledge and skills needed. The desired outcomes determine the educational components either in courses/course tracks in BMHI as part of educational programs or as dedicated programs in BMHI. The knowledge and skill levels are classified into four domain areas:

- BMHI core knowledge and skills,
- medicine, health and biosciences, health system organisation,
- informatics/computer science, mathematics, biometry, ▪ optional modules in BMHI and from related fields.

In order to achieve the learning outcomes mentioned above, their educational components should be considered for inclusion into the respective educational programs (Mentas and Ammenweth, 2000).

All health care professional graduates should, in their role as IT users, have the levels of knowledge and skills mentioned for IT users. Analogously, those professionals in health care, being BMHI specialists, should have the levels of knowledge and skills specified for them. The levels of knowledge and skills mentioned may particularly work well for

developed, industrialised countries, with high levels of access to, and use of, information technology, and which have highly developed health care infrastructures. Developing countries may at the beginning have the need to adapt them with regard to the level of technology. The principles of BMHI, however, can still be taught, developed and applied in the absence of high levels of information and communication technology (Mentas and Ammenweth, 2000).

2.4.2 IMIA Recommendations for Bachelor Programs in Biomedical and Health Informatics

The curriculum of a program leading to a bachelor degree in BMHI should be application related aiming to prepare students for a professional career in the field. The objective of this undergraduate education is to equip students with specialized knowledge in the field of BMHI and the skills to apply the acquired knowledge in a variety of practical situations (Mentas and Ammenweth, 2000).

Given the diversity of the discipline, students at the bachelor program level need to understand the breadth of the field and become familiar with the spectrum of BMHI (capturing all sub-domains such as bioinformatics, clinical informatics, public health informatics etc.). The challenge here is to provide knowledge and skills that students can apply in practice while recognizing that areas of interest could be explored further and in more-depth at the graduate educational level. In order to achieve the levels of knowledge and skills recommended to achieve a broad depth and breadth of all educational components, the length of study for the instructional component of a bachelor program in BMHI should be at least three years. This corresponds to a student workload of 180 European Credit Transfer System (ECTS). This composition can be varied from very

strong technical information technology (IT) skill acquisition to less IT skill and a stronger health application focus, depending on the desired learning outcomes (Mentas and Ammenweth, 2000).

It is important to recognise the need for teamwork as all health informatics projects require input from more than one person each with their own unique skill set, so that the team as whole is able to address all project aspects in a cohesive and coordinated manner (Mentas and Ammenweth, 2000). The objective of an informatics-based approach to BMHI is to focus on the machine processing of data, information and knowledge in health care and medicine with a strong emphasis on the need for advanced knowledge and skills of BMHI, of workflow, people and organisational aspects, of mathematics, as well as of theoretical, practical and technical informatics/computer science, especially semantic interoperability, ontology based software engineering and its relationship with effective and safe data, information and knowledge processing and representation (Mentas and Ammenweth, 2000).

2.4.3 IMAI Recommendation on Courses/Course Tracks for BMHI Specialists In order to achieve the levels of knowledge and skills in BMHI, the student workload associated with these educational components in BMHI should be at least 60 ECTS (European Credit Transfer System) credits, i.e. one year of full time studies. This is similar to dedicated master programs in BMHI.

For all health care professionals domain area (2) should focus on health system organisation, area (3) on practical informatics and project management. For nurses it should be possible that specialisation can be included in a post registration nursing curriculum. For health care managers, knowledge and practical skills of information

systems architectures, including characteristics required to achieve semantic interoperability and information systems/network management should particularly comprise work and information flow supporting enterprise functions for administration, controlling, quality management and executive decision making (Mentas and Ammenweth, 2000).

2.4.4 IMIA Recommendations for Biomedical and Health Informatics Courses as Part of Informatics/Computer Science Programs. Courses/Course Tracks for Biomedical and Health Informatics Specialists

In order to achieve the levels of knowledge and skills in BMHI, recommended in for specialists, the length of studies for educational components in BMHI should be at least 60 ECTS credits. Applying methods and tools of informatics in health care institutions, and for concrete problems in diagnosis, therapy, nursing and health care management should be emphasised. It is essential to include ontology based software engineering and the need to separate knowledge from system configuration, as these concepts are fundamental to achieving semantic interoperability and safe clinical decision support systems. This assists informatics or computer science students to gain more knowledge about the health care environment. Health information systems management should include the development and implementation of software and hardware components of health information systems. In medical signal and image processing technical and informatics aspects should particularly be considered (Mentas and Ammenweth, 2000).

2.4.5 IMIA Recommendations for Master and Doctoral Programs in Biomedical and Health Informatics

For programs leading to a master or doctoral degree, it is the comprehensive formal methodological foundation for BMHI that dominates the instructional component of the program. The objective is to provide scientific education that captures the theoretical foundations of the field, provides specialized knowledge and equips students with both practical skills and analytical approaches that will allow them to further the knowledge base of the discipline (Mentas and Ammenweth, 2000).

Graduates will be able to master both the practical methods and tools and the leadership of independent research. Unlike undergraduate bachelor programs, these graduate and post-graduate programs emphasize a formal penetration into the knowledge and foundation of the discipline and promote methodological expertise and independent analysis. Graduates are expected to contribute to the field and lead its scientific advancement. In order to achieve the levels of knowledge and skills in BMHI and in order to achieve the desired broad depth and breadth of the educational components, the length of study should be at least one year full time for a master degree, corresponding to at least 60 ECTS credits. Two years of study, corresponding to 120 ECTS credits, should be preferred. Ph.D. studies or Ph.D. work should usually last three to four years (Mentas and Ammenweth, 2000).

It is expected that master students have successfully finished either (a) a bachelor program in BMHI, (b) a bachelor or master program in medicine, biology, public health, health administration or another health science, or (c) in computer science/ information science. For cases (b) and (c) additional complementary courses (for (b) in informatics/computer

science and for (c) in health and biosciences, health systems) should be offered. For programs leading to a doctoral degree, independent comprehensive research should be carried out by the student in addition to the instructional requirements already mentioned. Knowledge and skills should also have additional depth and breadth and students may choose to gain additional insight into elective fields that are at the core of their research.

2.4.6 IMIA Recommendations on How to Commence with Biomedical and Health Informatics Education

BMHI affects all health care professionals. To commence education in this field, IMIA recommends that education in BMHI for all types of health care professionals, including the different types of specialization and levels of education is considered. The first step is to consider the level of practice of the individual. Within informatics, one may practice more at the applied level in operational settings or may be an academic who teaches and/or performs research. For countries without formal informatics educational programs, additional steps are necessary. In this instance, teachers have to be educated („teach the teachers“) first, or, e.g., retiring BMHI faculty in developed countries could also perform this service. Next, courseware has to be prepared (or adapted) and institutes for health informatics or medical informatics must be established within universities, usually inside medical or health sciences faculties (Mentas and Ammenweth, 2000).

The next consideration for informatics educational programs is/are the mode(s) of education to be chosen, considering the specific profile and possibilities of the respective universities. Besides lectures it is of importance that practical experience within health care institutions (e.g., in hospitals) are offered. Besides „traditional“ lectures and exercises within universities, different models of flexible, distance and supported open learning

should be actively pursued. Problem oriented learning might particularly support the relevance of BMHI as it requires integration of information and a crossdisciplinary understanding (Hasman and Boshuizen, 2001.).

Courses and programs in BMHI must be of high quality. Teachers of courses in BMHI must have adequate and specific qualifications in this field. It must be possible to obtain such qualifications for lecturing in BMHI from universities or other institutions of higher education (Mentas and Ammenweth, 2000).

Education of students in BMHI, which goes beyond introductory courses in the use of information and communication technology, only makes sense if positions for these graduates exist or are created. The qualifications of such BMHI graduates must be recognised and we are recommending that health care organizations realize the need of positions as specialists in BMHI (Mentas and Ammenweth, 2000).

2.4.7 Building Health Informatics capacity by providing Support (expert advice) for Institutions offering Health Informatics Programs and Courses: The case of IMIA

To support education of high quality in the field of BMHI, IMIA offers help by providing expert advice to persons and institutions in this field, as far as the resources of IMIA allow. This might especially be needed when commencing with educational activities and when national institutions are not yet established to do this. IMIA is also currently establishing services for the accreditation of such educational programs. BMHI courses inside programs and specialised programs in this field can upon request add to the description of their course track or program the phrase „endorsed by the International Medical Informatics Association" and can use the IMIA logo in this context.

This is conditional to the IMIA recommendations being fulfilled and once the quality of the program, including organisational integration and resources, has been assessed by IMIA appointed experts. Single courses cannot be considered, only course tracks or programs. The fulfillment of the recommendations and the assessment of the quality of the program will be examined by a committee usually consisting of four members of IMIA‟s Working Group on Health and Medical Informatics Education or other persons, experienced in BMHI education, and will be approved by the IMIA President and the Chairperson of IMIA‟s Working Group on education. After approval, a written certificate, signed by the IMIA President, the Chairperson of IMIA‟s Working Group on Health and Medical Informatics Education will be given to the respective organisation. Requests should be submitted to the Executive Director of IMIA (Mentas and Ammenweth, 2000).

2.4.8 Building Health Informatics capacity through educational partnership programs: The case of IMIA

IMIA‟s Working Group on Health and Medical Informatics Education is a group devoted to BMHI education. Its activities include to disseminate and exchange information on BMHI programs and courses and to support BMHI courses and exchange of students and teachers. The Working Group intends to advance the knowledge of (1) how informatics is taught in the education of health care professionals around the world,

(2) how in particular BMHI is taught to students of computer science/informatics, and (3) how it is taught within dedicated curricula in BMHI. Working Group members contribute to various Web-based catalogues of BMHI programs, In addition, IMIA‟s

Working Group on Health and Medical Informatics Education operates a mailing list to facilitate communication between all persons interested in BMHI education worldwide. For subscription, instructions on the Working Group‟s web site should be followed. IMIA encourages the development and sharing of courseware of high quality for courses in BMHI. This will help to further establish courses in this field. It also encourages the use of its IMIA Working Group on education‟s web site and list server for the dissemination of information about such courseware (Mentas and Ammenweth, 2000).

International Medical Informatics Association (IMIA) encourages and recommends international activities in educating health and medical informatics specialists. IMIA also recommends the international exchange of students and of teachers in this field. It encourages the establishment of international programs to support this and to exchange courseware. Programs should be built up in a modular way, and international credit transfer systems such as the ECTS should be used in the respective national programs to support these international perspectives (Mentas and Ammenweth, 2000).

2.5 Building Health Informatics Capacity: The case of the International Partnership for Health Informatics Education (IΦE)

In 1999, a group of five universities, including the University of Amsterdam (Jaspers *et al*., 2001), the Universities of Heidelberg and Heilbronn (Leven and Haux, 1998), the University of Minnesota (Jaspers, 2005) the University of Utah (Patton and Gardner, 1999) agreed that internationalized studies should constitute an integral part of their educational programs. In 2002, the University for Health Sciences, Medical Informatics and Technology (UMIT) also joined the partner-ship (Haux, 2004). The European universities offer medical informatics programs at the B. Sc., M.Sc. and Ph. D. levels [815,

20, 21]. The US universities offer the M.Sc. and Ph.D. degrees (Patton and Gardner, 1999). The overall aim of this co-operation was to form a network for training and educating medical informatics students on an international level to prepare them for leading positions in medical information and communication technology (Jaspers *et al*., 2000).

These students are the next generation experts who will be responsible for the appropriate application of ICT to optimize complex information processing in health care. The sharing and dissemination of their knowledge and practical experiences with other students and faculty should help them to become more proficient in their field. IΦE aims to achieve its mission by:

- Supporting and encouraging the exchange of students and faculty between universities,
- organizing yearly joint master classes,
- offering a joint European course on strategic information management,
- organizing student workshops at international conferences, and
- developing and sharing courseware by encouraging our students to become more internationally oriented, we hoped to prepare them for international positions in the medical informatics field and to enhance their marketability and employability.

IΦE encourages student and faculty exchanges among partner schools. With the student exchange program, they aim to tailor students‟ master thesis work to their individual interests and to offer optimal challenges to deepen their knowledge and skills in a specific medical informatics subject. Students may, for example, be interested in a research topic which is not a main theme in the research program of their home university but is in the

research domain of another IΦE partner university. The student exchange program offers these students the option to carry out (part of) their master thesis project at the university that is well known for its expertise in a specific research area. For example, in the past, the University of Minnesota was far ahead of the

University of Amsterdam in its research in the area of telemedicine. Consequently, Amsterdam students interested in telemedicine fully subscribed to telemedicine projects at the University of Minnesota. Both universities have covered public health informatics as research themes. Such exchanges have led students to carry out part of their research at their home site and part of their research at a host university. Thus these students are offered the opportunity to profit from both worlds and bring home new ideas that may add to their knowledge and final research outcomes. The objective of the faculty exchange program is to deepen students‟ knowledge of specific medical informatics subjects by having IΦE faculty members that are expert 4.

According to Jaspers *et a*l 2000, efficient information management is vitally important to assure high quality and cost effective clinical patient care in clinical health care. In this context, the need for medical/informatics specialists to support effective information processing in health care, through use of ICT, has become clear. Since medical informatics is a relatively new discipline, IΦE are convinced that specialists should be able to share and profit from each others‟ knowledge and experience on an international scale. International exchange program IΦE has been able to supplement the students‟ medical informatics education by providing exposure to: 1) research programs and the specific faculty expertise from other universities, 2) knowledge of other international students‟ research work and their accomplishments and 3) other international health care systems,

and health care organizations‟ information and communication architectures and infrastructures (Jaspers *et al*., 2004).

It is believe that IΦE promotes professionalism of future medical informatics specialists by exchange of knowledge and educational experience in the medical informatics field across both national and international borders. Other universities have also co-operated in joint projects to promote, programs mentioned, course materials were prepared or offered by faculty of various universities in order to fully exploit partners‟ expertise. For the most part, in these programs, students acquire their fundamental medical informatics knowledge at one educational institution (Jaspers *et al*., 2004).

IΦE international partnership hopes to continue to stimulate students to become more internationally oriented by having them prepare their thesis abroad, by attending IΦE international master classes, by having the European students attend the course on strategic information management in hospitals and by having them present their research master thesis work to an international audience. In addition, faculty exchange within IΦE will deepen students‟ knowledge of medical informatics topics, advance their methodological skills and teach them to appraise new research areas. In the future, IΦE may offer these and other opportunities for additional interactions among students, faculty and institutions to contribute to enhancing professionalism in the medical informatics field. IΦE has discovered that many exciting experiences occur when people in the same discipline from different countries can meet, interact and share research knowledge (Jaspers *et al.*, 2004).

The Office of Health, the Information Highway at Health Canada (OHIH) and the

University of Victoria developed a partnership to promote health informatics education (Lau and Heidi, 2003). Canadian health informatics educators from eight universities have developed a national graduate training program by pooling the expertise and resources of existing research teams (Hebert, 2003).

CHAPTER THREE

3.0 METHODOLOGY AND ANALYTICAL FRAMEWORK

3.1 Introduction

This chapter provides the framework by which data was collected, codified, synthesized and analyzed towards achieving the objectives of this research. The chapter provides relevant information on the in-depth explanation of the research design and approach, data collection methods, sampling processes, size and methods and also provides explanations for which specific research methodology is preferred over others for this research.

The study covered all the three universities offering health informatics education in Ghana, this include University of Ghana, Kwame Nkrumah University of Ghana and Catholic University College. Information about health informatics education in Ghana was abstracted from lecturers and students. Thus to determine the amount of education,

training and development being provided by this institutions and the degree to which the provision conforms to the standards specified in learning to manage health informatics.

The main purpose of this study is to obtain an insight into the current curriculum development of health informatics capacity building in Ghana, in order to propose further recommendation for efficient development. For this reason this research will take an investigatory and descriptive approach, with a combination of techniques such as literature review, observation and other relevant documentation reviews. An investigatory study is undertaken when you want to carry out a detailed examination or inquiry, in order to find out about something or somebody. An investigative research is intended to unearth secret, hidden or obscure information that can build a more comprehensive picture of the issue under investigation (www.powerbase.info/index. php/investigative_Research).

3.2 Research Design

The national survey covered the teaching and learning of Health Informatics. The questionnaires were answered by the person(s) responsible for teaching Health Informatics and persons studying health informatics in the three(3) university offering HI in Ghana. These people were chosen because they are directly involved in the teaching and learning of health informatics and they are the appropriate informants the researcher can get the information from. Research is not a blind excursion into the unknown with the hope that the data necessary to answer the questions at hand will somehow fortuitously turn up; It is a carefully planned attack, a search-and-discovery mission explicitly outlined in advance (Leedy and Ormord., 1989). Every research thus requires defined framework upon which it will be conducted. A research design is that plan or blueprint of how a researcher intends to conduct his/her research (Sarantakos, 2005). The design also shows

how research questions will be connected to the data, and what tools and procedures to use in answering them (Punch, 2004). For this study, survey research design using questionnaires formed the framework upon which the study was conducted.

Survey is the most widely used data-gathering technique in sociology and in many other fields (Lawrence, 2007). Survey research involves acquiring information about one or more groups of people, perhaps about their characteristics, opinions, attitudes or previous experiences by asking those questions and tabulating their answers (Leedy and Ormrod, 1989). It is interested in the accurate assessment of the characteristics of whole populations of people. Rarely however does it study whole populations. The methodological basis of survey research design is inclusive of both interviews and questionnaires (Smith, 1975).

3.2.1 Ethical Considerations

"All social research involves consent, access and associated ethical issues, since it is based on data from people about people" (Punch, 2005a). The study had ensured that informed consent is obtained from participants. Full information about the research including the reasons they have been chosen to participate was provided. Participants‟ privacy, confidentiality and anonymity were guaranteed although the research did not have interaction or dealings with private and confidential personal information. Consent letter and a covering letter to administer the questionnaires were provided. Similarly, permission was sought from schools being used for the case study; they will need to give permission for access to archival material and documents useful to the study. The schools were assured that findings will be used appropriately, as well as their reporting and dissemination.

3.2.2 Data collection

Data was collected through a questionnaire survey from lecturers and students in the program area. Data were collected on the following parameters

i. Teaching aids ii. Skills and knowledge gained by students iii. Practical aspect of the program iv. Collaborative learning

v. Specialization in health informatics courses vi. Adequacy of HI lecturers vii. Strategies to be employed to address the challenges (if any) facing the teaching of health informatics

3.2.3 Design of the Questionnaire

A questionnaire is a self-report instrument used for gathering information about variable of interest to an investigation. Questionnaires usually require particularly selfexplanatory instructions and question design since there is often no interviewer or proctor present to interpret the questionnaire to the subject or respondent (Smith, 1975). This method was employed in generating information from student and lecturers. Openended and close-ended questions were used to respond to the demand of the various variables in the analysis. An open-ended question is a question that leaves the respondent free to respond

in a relatively unrestricted manner. By contrast, a closedended question restricts choice of response by forcing the respondent to respond in terms of present categories or alternatives (Smith, 1975). The questionnaires are of two types; type one is to be answered by the lecturers and the type two to be answered by the students. The questionnaire for the lecturers is made up of parts; part „A" is for personal data and part „B" is concerned with identification of challenges and recommendation in teaching health Informatics. The questionnaire for the students is made up of three sections. Section „A" is for personal data, section „B" is concerns with identification of challenges, possible causes of the challenges and recommendation in teaching health Informatics. Section „C" is concerned with the competency level in the skills and knowledge students" gain from studying health informatics. The questionnaire for the lecturers is made up of 25 questions and the questionnaire to be answered by the students is made of 36 questions.

3.2.4 Sampling Design

Ideally what one wants to study is the entire population. However, some time is usually impossible or unfeasible to do this and there one must settle for a sample. In research, sampling design is an important component for data collection. The first step in the selection of a sample is to consider a sampling design (Twumasi, 2001). The issues that are usually involved are: How wide a coverage is acceptable? What type of respondents will be able to give answers to research questions? Whether the selected group of respondents will be adequately representative of the study population? What typical groups of respondents are available? What typical study population can be selected? All these are relevant questions which come to mind when selecting sampling design for a study (Twumasi, 2001). All universities offering health informatics in Ghana are covered

in this research. A census study was carried out in this research work. One approach of carrying out a research is to use the entire population as the sample.

Although cost considerations make this impossible for large populations, a census is attractive for small populations (e.g., 200 or less). A census eliminates sampling error and provides data on all the individuals in the population. Virtually the entire population would have to be sampled in small populations to achieve a desirable level of precision (Israel, 1992). All the health informatics lecturers and health informatics students of University of Ghana were given the questionnaires; as a questionnaire is a set of questions for gathering information from individuals (www.cdc.gov/Healthy Youth/evaluation/pdf/brief14.pdf). All the health informatics lecturers and on campus students of Catholic University College were also given the questionnaires and finally all the Health informatics lecturers and students of KNUST Kumasi campus were also given the questionnaires. The researcher could not retrieve all the questionnaires given out to the informants, so a response rate was calculated to find the confidence level and margins of errors as seen in table 3.1. This was done to find out if the confidence level and the precision of the response meet acceptable standards of validity and generalization of the results. The response rates were used to identify the confidence level and margins of errors using the survey response rate requirement chart in appendix 3. This chart is provided by Principal Great Brook Consulting (Frederick, 2011). The precision level of response from lecturers of KNUST was around ± 20% indicating 80% confidence levels and so the response could not be generalized, as the precision level is beyond ±5%. The rest of the responses were accepted as their precisions were ±5% and below at confidence level of 95%. In statistics, typically we look at 95% confidence intervals and sometimes 99%

confidence intervals as the true value of the population mean will fall within these limits (Andy, 2005).

Table3.1: Confidence level/margins of error of questionnaires response rate

Item	Population/ questionnaires sent out	Questionnaires received	Response rate (%)	Confidence level/margin of error
CUC HI lecturers	2	2	(2/2)*100=100	100% , 0%
UG HI lecturers	8	7	(7/8)*100=86	95%, ±5%
KNUST HI lecturers	9	1	(1/9)*100=11	80%, ±20%
CUC 3rd year HI students	35	29	(29/35)*100=83	95%, ±5%
CUC 4th year students	65	53	(53/65)*100=82	95%, ±5%
Total CUC HI students	100	82	(82/100)*100= 82	95%, ±5%
UG 3rd year HI students	4	4	(4/4)*100=100	100%, 0%
UG 4th year HI students	11	11	(11/11)*100=100	100%, 0%
UG HI graduate students	9	8	(8/9)*100=89	97%, ±3%
Total UG HI students	24	23	(23/34)*100=96	98%, ±2%
KNUST HI graduate students	23	20	(20/23)*100=87	95%, ±5

3.2.5 Methods of Data Analysis

Qualitative data was cleaned with the aim of checking accuracy and consistency of information on each questionnaire in relation to the set objectives. A coding manual was designed after knowing the nature of responses. Both open and closed-ended questions

were coded. Quantitative data analysis was done by the use of vision 20 of the Statistical Package for Social Sciences (SPSS) computer software program. Thus, the key variables that are identifiable with the categorized teams of enquiry under study were grouped accordingly base on similarities and dissimilarities. Crosstabulation of the results were done between the lecturers and students with a Z-test. The Z-test is done to find out whether there is significant difference between the answers provided by lecturers and students.

The initial analysis involved noting patterns and consistencies in the "subjective" data, while also observing similarities and differences between data. The Miles and Hubermann framework for qualitative data analysis was used which is consistent with the interpretive approach. This approach offers a systematic approach to collecting, organizing and analyzing data from the respondents. The three components of this approach which occur concurrently throughout the data analysis are "data reduction", and "data display", which rests mainly on the operations of "coding and memoing" and "drawing and verifying conclusions" which assist in developing propositions.

Initial coding that involves "putting tags, names or labels against the pieces of data" is referred to as "descriptive" codes. These codes are valuable in initiating analysis, in enabling the researcher to get a "feel" for the data. These less abstract or descriptive codes are brought together at the second level of "inferential" or pattern coding. From this second level of coding it is possible to put together propositions for further discussion and analysis. Memoing is another operation that happens simultaneously with coding and may be "substantive" and "theoretical". These memos "may suggest still deeper concepts than the coding has so far produced". They may also "elaborate a concept or suggest ways of

doing that, or they may relate different concepts to each other. This last type of memo produces propositions". Instead of simply describing data, substantive and theoretical coding relate to conceptual analysis. One important methodological practice encouraged is to constantly record ideas as they occur as memos (Glaser, 1978).

The third stage of analyzing data involves developing propositions from the process of drawing conclusions and verifying to "integrate what has been done into a meaningful and coherent picture of the data". Essential intellectual tools in the conceptual analysis are the processes of abstracting and comparing (Punch, 2005b). The general nature of this type of analysis is constantly "developing higher-order concepts to summarize and integrate more concrete levels of data" while comparing concepts at their first level of abstraction enable us to identify more abstract concepts. The systematic and constant making of comparisons is therefore essential to conceptual development at all levels in the analysis of qualitative data (Punch, 2005b).

CHAPTER FOUR

4.0 RESULTS

4.1 Introduction

In this chapter, the essence is on presenting the findings of the study arising from the process of the analysis as describe in chapter 3. The structure of this chapter corresponds to the order of the researcher questions as enumerated in chapter one.

4.2 The state of health informatics teaching aids

Table 4.1 includes responses from health informatics lecturers and students from the University of Ghana either agreeing or not to the adequate use of health informatics teaching aids in their institutions.

Table 4.1: Contingency table showing the crosstabulation of response from University of Ghana lecturers and students towards adequate use of Health Informatics teaching aids during lessons.

		Adequate use of teaching aids		Total
		Yes	**No**	
Lecturer	**Count**	1_b	6_a	7
	% within lecturers	14.3%	85.7%	100%
Student	**Count**	3_b	20_a	23
	% within students	13%	87%	100%
Total	**Count**	4	26 86.7%	30 100%
	% within lecturers and students	13.3%		

In the contingency table 4.1, the Z-test indicates that each subscript letter of the values denotes a subset of adequate use of teaching aids categories whose column proportions do not differ significantly from each other at a precision level of 0.05. In other words, most of the lecturers and students responded towards one answer which is No. Table 4.1 revealed that 86.7% of both University of Ghana (UG) lecturers and students voted No for adequate use of health informatics teaching aids in University of Ghana. 85.7% of the lecturers and 87% of the students responded No to adequate use of teaching aids during lessons.

Table 4.2 includes responses from health informatics lecturers and students from the Catholic University College either agreeing or not to the adequate use of health informatics teaching aids in their institutions.

Table 4.2: Contingency table showing the crosstabulation of response from Catholic University College lecturers and students towards adequate use of Health Informatics teaching aids during lessons

		Adequate use of teaching aids		Total
		Yes	**No**	
Lecturer	**Count**	0_a	2_b	2
	% within lecturers	0.00%	100%	100%
Student	**Count**	15_a	67_b	82
	% within students	18.3%	81.7%	100%
Total	**Count**	15	69	84
	% within lecturers and students	17.9%	82.1%	100%

In the contingency table 4.2 the Z-test indicates that each subscript letter of the values denotes a subset of adequate use of teaching aids categories whose column proportions do

not differ significantly from each other at a precision level of 0.05. In other words, most of the lecturers and students responded towards one answer which is No. Table 4.2 shows that 100% and 81.7% of the Catholic University College lecturers responded with No for adequate use of health informatics teaching aids during lessons. 82.1% of both lecturers and students from Catholic University College agreed to the inadequate used of teaching aids during HI lessons.

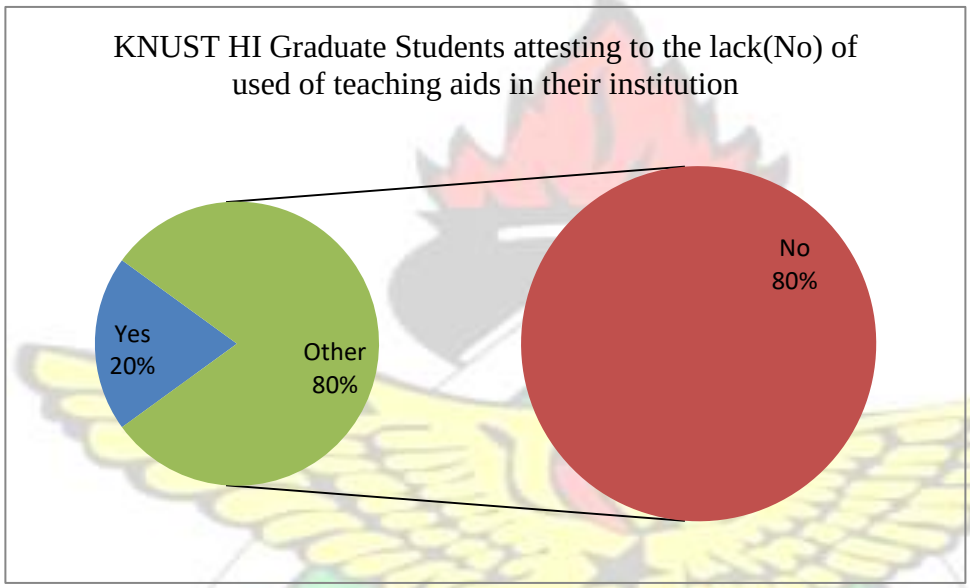

Figure 4.1: Response from Kwame Nkrumah University of Science and Technology students towards adequate use of health informatics teaching aids during lessons

Figure 4.1 illustrates response from KNUST students agreeing to the lack of use of health informatics teaching aids during their lessons. It shows that 80% of the students agreed that the usage of teaching aids during lessons is inadequate.

4.3 The state of health informatics practical lessons in Ghana's Universities

Table 4.3 includes responses from health informatics lecturers and students from the University of Ghana either agreeing or not to the inadequacy of HI practical lesson in their institution

Table 4.3 Contingency table showing the crosstabulation of response from University of Ghana lecturers and students towards adequacy of Health Informatics practical lessons

		Adequacy of practical lessons		Total
		Yes	**No**	
Lecturer	**Count**	1_a	6_b	7
	% within lecturers	14.3%	85.7%	100%
Student	**Count**	1_a	22_b	23
	% within students	4.3%	95.7%	100%
Total	**Count**	2	28	30
	% within lecturers and students	6.7%	93.3%	100%

In the contingency table 4.3 the Z-test indicates that each subscript letter of the values denotes a subset of adequacy of practical lessons categories whose column proportions do not differ significantly from each other at a precision level of 0.05. In other words, most lecturers and students responded towards one answer which is No. Table 4.3 indicates that 93.3% of both lecturers and students agreed that the HI practical lessons are inadequate. 85.7% and 95.7% of students and lecturers respectively agreed that

University of Ghana health informatics practical lessons are inadequate.

Table 4.4 includes responses from health informatics lecturers and students from the Catholic University College either agreeing or not to the inadequacy of health

informatics practical lesson in their institution

Table 4.4 Contingency table showing the crosstabulation of response from Catholic University College lecturers and students towards adequacy of Health informatics practical lessons

		Adequacy of practical lessons		Total
		Yes	**No**	
Lecturer	**Count**	0_a	2_b	2
	% within lecturers	0.0%	100%	100%
Student	**Count**	9_a	73_b	82
	% within students	11%	89%	100%
Total	**Count**	9	75	84
	% within lecturers and students	10.7%	89.3%	100%

In the contingency table 4.4 the Z-test indicates that each subscript letter of the values denotes a subset of adequacy of practical lessons categories whose column proportions do not differ significantly from each other at a precision level of 0.05. In other words most of the lecturers and students responded towards one answer which is No. It can be seen from Table 4.4 that 89.3% of both lecturer and students, 100% of lecturers and 89% of students responded No when they were asked if Catholic University College health informatics practical lessons were adequate.

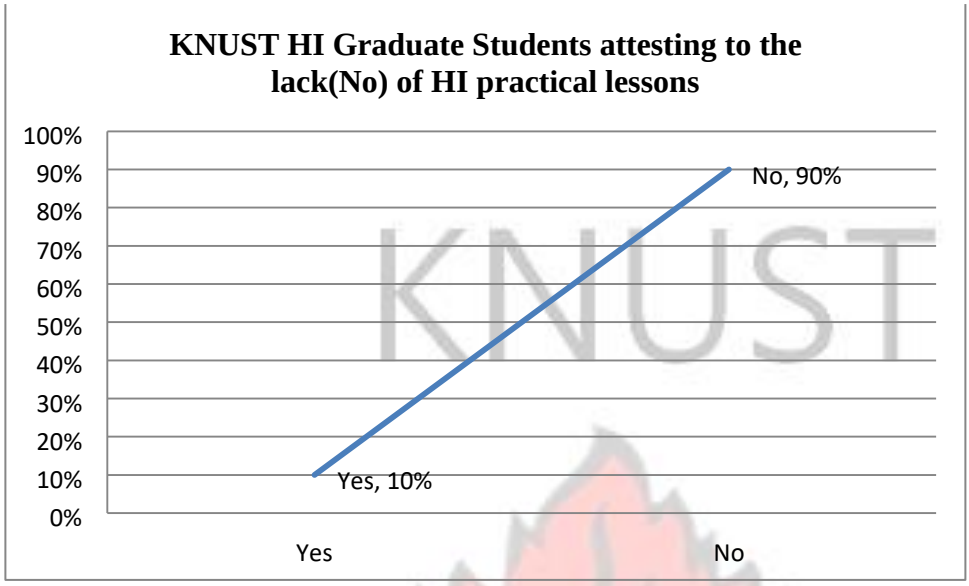

Figure 4.2: Response from Kwame Nkrumah University of Science and Technology students towards adequacy of health informatics practical lessons

Figure 4.2 illustrates response from KNUST students agreeing to the lack of health informatics practical lessons. It shows that 90% of the students agreed to the inadequacy of health informatics practical lessons and 10% claiming the practical lessons were adequate.

Table 4.5 includes responses from students of KNUST, University of Ghana and Catholic University College Ghana who are attesting to the quality level of practical lessons they had during their study of HI.

Table 4.5: Response from students attesting to the effectiveness level of Health Informatics practical lessons organized for them.

Students Institution	Quality Level of HI Practical Lessons			
	Excellent (%)	Very Good (%)	Good (%)	Poor (%)
University of Ghana	0	0	26	74
KNUST	0	0	25	75
Catholic University College	0	0	61	39

It is noticeable from Table 4.5 that there is no single response toward Excellent and Very Good quality HI practical lessons from all the universities offering health informatics in Ghana. It was notices that from the category of responses indicating Good quality HI practical lessons Catholic University College have 61% of the students attesting that the practical lessons organized for them were good in terms of effectiveness. 75% and 74% of the students from KNUST and University of Ghana respectively attest that the practical lessons organized for them were poor in terms of effectiveness.

4.4 The State of health informatics lecturers in Ghana's Universities

Table 4.6 includes responses from HI lecturers and students from the University of Ghana either agreeing or not to the adequacy of HI lecturers in their institution.

Table 4.6 Contingency table showing the crosstabulation of response from University of Ghana lecturers and students towards adequacy of Health Informatics lecturers

		Adequacy of HI lecturers		Total
		Yes	No	
Lecturer	Count	3_a	4_b	7
	% within lecturers	42.9%	57.1%	100%
Student	Count	7_a	16_b	23
	% within students	30.4%	69.6%	100%
Total	Count	10	20	30
	% within lecturers and students	33.3%	66.7%	100%

In the contingency table 4.6 the Z-test indicates that each subscript letter of the values denotes a subset of adequacy of HI lecturers" categories whose column proportions do not differ significantly from each other at a precision level of 0.05. In other words, most of the lecturers and students responded towards one answer which is No. 57.1% and 69.6% of the lecturers and students respectively responded No to the adequate Health Informatics lecturers. 66.7% of both lecturers and students voted No when they were ask if their university have adequate health informatics lecturers.

Table 4.7 includes responses from health informatics lecturers and students from the Catholic University College either agreeing or not to the adequacy of HI lecturers in their institution

Table 4.7 Contingency table showing the crosstabulation of response from Catholic University College lecturers and students towards adequacy of Health Informatics lecturers

		Adequacy of HI lecturers		Total
		Yes	No	
Lecturer	Count	0_a	2_b	2
	% within lecturers	0.0%	100%	100%
Student	Count	9_a	73_b	82
	% within students	11%	89%	100%
Total	Count	9	75	84
	% within lecturers and students	10.7%	89.3%	100%

In the contingency Table 4.7 the Z-test indicates that each subscript letter of the values denotes a subset of adequacy of HI lecturers‟ categories whose column proportions do not differ significantly from each other at a precision level of 0.05. In other words, most lecturers and student responded towards one answer which is No. 89.3% of both students and lecturers, 100% of the lecturers and 89% of the students do not agreed that Catholic University College have adequate health informatics lecturers.

Figure 4.3 illustrates response from KNUST students agreeing to inadequacy of health informatics lecturers. It shows that 70% of the students agreed to the inadequacy of HI lecturers and 30% claiming there are adequate lecturers.

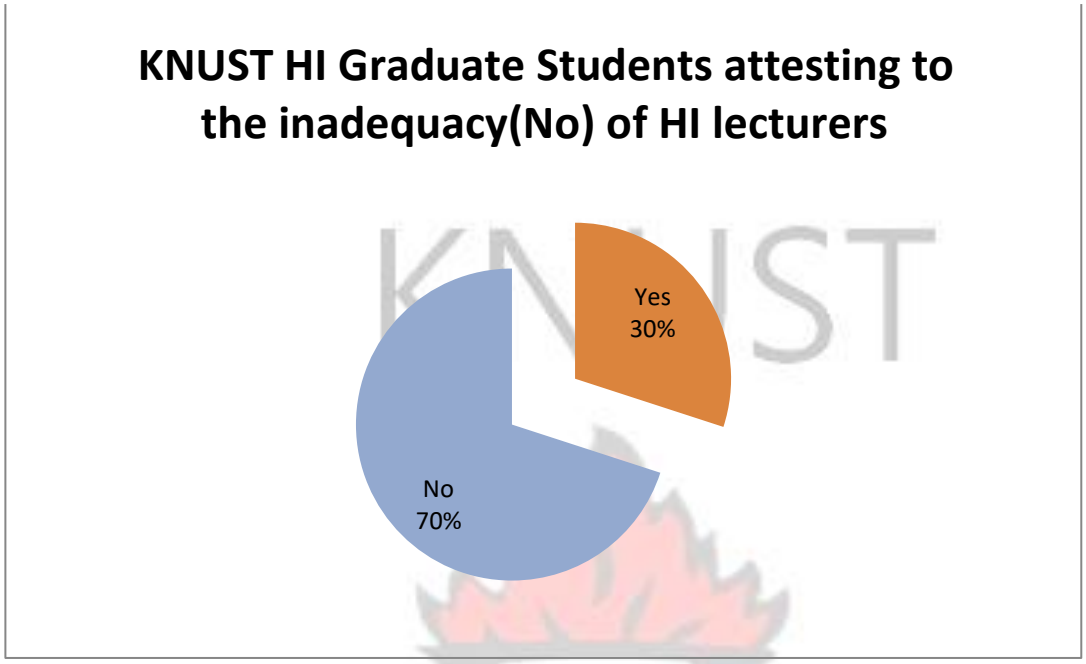

Figure 4.3: Response from Kwame Nkrumah University of Science and Technology students towards inadequacy of health informatics lecturers

4.5 Students Self Competency Test

The self competency test involve test on the skills/knowledge the students gain after going through the health informatics program. The skill/knowledge was base on the HI course outline of each university.

4.5.1 KUNST Students Self Competency Test

Table 4.8 includes responses on self competency (skills/knowledge) test from HI students of KNUST. The self competency test levels include **outstanding**, **exceed expectation**, **competent** and **incompetent.**

Table 4.8 KNUST students attesting to their competency (skill/knowledge) level in

Health Informatics courses they studied

Skill/Knowledge	competency Level 100%			
	Outstanding	Exceed Expectation	Competent	Incompetent
Legal and ethical issues in HI	0	0	55	45
Health concepts representations (terminologies)	0	0	10	90_p
Computer Networking Design	0	0	10	90_p
Epidemiological concepts and methods	5	20	55	20
Plan, develop and implement community base interventions	5	15	65	15
Use diagnostic decision support systems for patients	0	5	10	85_p
Principles and concepts of medical digital imaging	0	15	70	15
Concepts of telehealth	0	5	60	35
Health Knowledge management process	0	10	55	35
Database design	0	0	15	85_p
Database management	0	0	5	95_p
Evidence base healthcare approaches and methods	5	10	65	20

Table 4.8 shows that the highest responses towards outstanding were only 5% each for the following skills/knowledge (Epidemiological concepts and methods), (Plan, develop and implement community base interventions) and (Evidence base healthcare approaches and methods). There was no single response towards outstanding for the other skills/knowledge. It can also be seen from the table 4.8 that the highest response towards

exceed expectation is 20% for Epidemiological concepts and methods and the lowest response towards exceed expectation is 0% each representing Database design,

Database management, Health concepts representations (terminologies), Computer Networking Design and Legal/ethical issues in health informatics.. The highest response for competent is 70% which represents the skill/knowledge Principles and concepts of medical digital imaging, however the lowest response for competent is 5% which represent Database management. The highest response towards incompetent is 95% representing Database management and the lowest response towards incompetent is 15% representing Community base interventions and medical digital imaging. The percentages under the incompetent category which are above 50% have a superscript of „p" and in all they are 5 in number.

4.5.2 University of Ghana Undergraduate Year Four Students Self Competency Test

Table 4.9 includes responses on self competency (skills/knowledge) test from HI students of University of Ghana Undergraduate year four. The self competency test levels include **outstanding**, **exceed expectation**, **competent** and **Incompetent**

Table 4.9: University of Ghana Undergraduate year four students attesting to their competency (skill/knowledge) level in Health Informatics courses they studied.

Skills/Knowledge	Competency Test			
	Outstanding %	Exceed Expectation %	Competent %	Incompetent%
Computing in Public Health	0	0	71	29
Health Management Information Systems	0	0	86	14
Database Management	0	14	71	15
Geographic Information Systems	0	0	86	14
Information Security	0	14	57	29
System Analysis and Design	0	0	57	43
Data Analysis and Presentation	0	0	71	29
IT Applications in Health Management	0	14	71	15
Electronic Health and Data Systems	0	0	86	14

Table 4.9 shows that there was no single response towards **Outstanding** from HI students of University of Ghana Undergraduate year four. The highest response towards **Exceed Expectation** is 14% representing **IT Applications in Health Management, Information Security and Database Management.** The lowest response toward **Exceed Expectation** is 0 % representing each of the remaining skills/knowledge. The highest response towards C**ompetent is** 86% representing each of the following **Electronic Health and Data Systems, Geographic Information Systems** and **Health Management**

Information Systems. The lowest response towards **Competent** is 57% representing each of the following **System Analysis/Design and Information Security.**

The highest response towards **Incompetent** is 43% representing **System Analysis and Design.** On other hand the lowest response towards **Incompetent** is 14% representing **Electronic Health and Data Systems, Geographic Information Systems** and **Health Management Information Systems.**

4.5.3 University of Ghana health informatics Graduate Students Self Competency Test

Table 4.10 includes responses on self competency (skills/knowledge) test from University of Ghana HI graduates students. The self competency test levels include **outstanding**, **exceed expectation**, **competent** and **Incompetent.**

Table 4.10: University of Ghana Health Informatics graduate students attesting to their competency (skill/knowledge) level in Health Informatics courses they studied.

Skill/Knowledge	Competency Level (%)			
	Outstanding	Exceed Expectation	Competent	Incompetent
Health Terminologies	0	0	87.5	12.5
Principles of Epidemiology	0	12.5	87.5	0
Database Management and Administration	0	0	100	0
Information systems analysis and design	0	0	75	25
Health data and electronic health care records	0	12.5	87.5	0
Geographical information systems application	0	0	75	25
Foundation of public health	0	0	75	25
Research methods in HI	0	0	75	25
information security	0	0	75	25
Foundation of public health	0	0	75	25

Ethical and legal concern in HI	0	25	75	0

Table 4.10 shows that there was no single response towards **Outstanding** from HI students of University of Ghana Graduate year four. The highest response towards **Exceed Expectation** is 25% representation **Ethical and legal concern in HI.** The lowest response towards **Exceed Expectation** is 0%. The highest response towards C**ompetent is** 100 % representing Database Management and Administration. The highest response towards **Incompetent** is 25% representing **Health information security, Research methods in HI, Information systems analysis and design** and **foundation of public health.** The lowest response towards **Incompetent** is 0% representing **Ethical and legal concern in HI, Database Management and**

Administration Health data and electronic health care records and **Principles of Epidemiology.**

4.5.4 Catholic University College Ghana HI Undergraduate year four Students Self Competency Test

Table 4.11 includes responses on self competency (skills/knowledge) test from Catholic University Ghana HI undergraduates‟ year four students. The self competency test levels include **outstanding**, **exceed expectation**, **competent** and **Incompetent.**

Table 4.11: Catholic University College Health Informatics undergraduate year four students attesting to their competency (skill/knowledge) level in Health Informatics courses they studied.

Skill/Knowledge	Competent Level (%)			
	Outstanding	**Exceed Expectation**	**Competent**	**Incompetent**
Database system	0	0	82	18
Hospital record keeping	0	0	73	27
Biostatistics	0	0	73	27
Fundamentals of health informatics	0	18	73	9
Health informatics systems	0	0	55	45
Analysis of survey and population data	0	0	73	27
Managing database	0	0	64	36

Table 4.11 shows that there was no single response towards **Outstanding** from health informatics students of Catholic University Ghana Undergraduate year four. The highest response towards **Exceed Expectation** is 18% representation **Fundamentals of health informatics** and the lowest response towards **Exceed Expectation** is 0% representing the remaining skills/knowledge. The highest response towards C**ompetent is** 82 % representing **Database system** and the lowest is 55% representing **Health informatics systems**. The highest response towards **Incompetent** is 45% representing **Health informatics systems.** The lowest response towards **Incompetent** is 9% representing **Fundamentals of health informatics.**

4.6 Some challenges facing the teaching and learning of health informatics in the three universities; indentified by lecturers and students.

Challenges identified by lecturers and students of Catholic University

- Lack of lecturers
- Inadequate collaborative leaning programs with other health informatics related institutions
- Lack of practical application health informatics
- Lack of more informatics course compared with public health courses
- Lack of health informatics software programs for learning.
- Lack of research / teaching assistance

Challenges identified by University of Ghana lecturers and students

- Inadequate lecturers
- The computer labs are not put into use
- Inadequate practical lessons
- Lack of hardware and software for effective teaching
- Lack of capacity building for lecturers

Challenges identified by KNUST health informatics students

- Lack of practical lessons
- Lack of collaborative learning with other health informatics related institutions
- Lack of use of teaching aids for effecting learning
- Lack of health informatics software learning programs
- Inadequate lecturers
- Students are not allowed to choose particular courses to suit their mission and

goals.

4.7 Suggestions from respondents towards improving the teaching and learning of health informatics.

This includes suggestion from both lecturers and students towards addressing the challenges facing the teaching and learning of health informatics in their institutions.

The following represents responses in the form of suggestions from University of Ghana lecturers toward improving the teaching and learning of health informatics in their institutions

"Capacity building for lecturers"

"Provide computer laboratory with learning programs to facilitate practical lessons"

"Lessons can be simulated to help in increase practical knowledge"

"Institution should invent appropriate software/hardware that support practical learning in consultation with faculty"

"Effort should also be made to include lecturer who have practical experience"

"More software should be acquired"

"Data warehouse should be develop"

"Special practical sessions/time should be provided for on the time table in addition to the regular lecture time table"

"Workshops and seminars with experienced or foreign lecturers can also be helpful".

The following represents responses in the form of suggestions from Catholic University Ghana lecturers toward improving the teaching and learning of health informatics in their institutions:

"The university needs to establish informatics laboratories and simulation platforms"

"Employ Lecturers and Research/Teaching Assistant"

The following represents responses in the form of advice from University of Ghana students toward improving the teaching and learning of health informatics in their institutions:

"My institution should include practical work to make sure students are well equipped with practical experience"

"More practical sessions should be focused rather than the theory"

"The institution should get practical course instructors"

"The university should maintain student who seems to be good in the practical aspects"

"The institution needs a working computer lab for the program and need well seasoned and permanent lecturers"

"Available computers should be put into used"

"We need efficient lecturers and more practical lessons"

"They university should collaborate with other university for effective learning"

"The computer laboratory should be use for effective studies"

"There is the need for more collaboration with other health institution"

"The school authorities should provide a well resource computer lab for practical purposes"

"More lecturers should be employed"

The following represents responses in the form of advice from Catholic University College Ghana students toward improving the teaching and learning of health informatics in their institution:

"We need practical application health informatics"

"Provide more practice time"

"The institutions should take the practical aspect serious than the theory"

"Employ more lecturers or teaching assistants to help in the practical aspect" "The institution must provide adequate teaching aids to improve the practical aspect"

"The university should collaborate with other institution across the nation to enable them offer practical assistance to it"

"Provision of laboratory for practical lessons"

"Engage students in the practical aspect of the course"

"Employ more teaching assistance and computers should always be readily available for the students"

"Create in the program more informatics courses than public health courses"

"There should be enough lecturers, computers and outreach programs to facilitate learning"

"Install health informatics educative programs in our computers laboratory and more teaching assistance to take us through practical lessons"

"Need more books and practical lessons"

"Improve on lecturers and student relationship"

The following represents responses in the form of advice from KNUST students toward improving the teaching and learning of health informatics in their institutions:

"They should employ people who have adequate knowledge about the practical aspects to teach us"

"They should do well to get the necessary teaching aids for us to use and practice with".

"They should have practical IT session since that would be the major tool on the field"

"They should enforce practical attachment of students to hospitals"

"Students on the course should be made to attached to some health centers to help them have firsthand experience"

Equipments for Clinical Decision Support System and Electronic Medicine should be purchase by the University for the University Hospital, so that health informatics students would use for practical lessons"

"Computer simulations should be made available for students to use." "Lecturers should create improvise hospitals with hypothetical problem dramatized for students to indicate how they would solve it in the context of health informatics"

"The university need to collaborate with international institutions especially for research; is very essential".

"The universities need more health informatics teaching aids"

"Breach courses should be taken more seriously"

"The program should not be too theoretical"

"The health informatics program should be given to the school of medicine to handle it"

"The university should get lecturers who practice or have practiced in the area of health informatics before "

"They should make the program practical oriented and collaborates with health and other academic institutions"

CHAPTER FIVE

5.0 STUDY DISCUSSION

5.1 Introduction

The data generated from lecturers and students shows considerable similarities and consistencies with some minor variations across the 3 universities. This brings into focus the generalization and validity of the findings. The main interest of this study is to find the challenges facing the teaching and learning of health informatics, possible factors that cause these challenges and the appropriate suggestions to address these challenges.

It was discovered that almost all the HI lecturer from Catholic University College attested to the inadequate use of health informatics teaching aids during their lessons. Some of the lecturers from Catholic University College indicated that the lack of used of the teaching during lessons is due to the fact that the teaching aids are not available for them to use. This lack of teaching aid in catholic University College is further emphasized by the HI students, where almost all the student (81.7%) agreed that Catholic University College Health Informatics program is facing a big challenge in the teaching and learning of health informatics as far as teaching aids are concern. Most of the students stated that this lack of teaching aids is due to the unavailability of these teaching aids. It appeared that there is a general agreement by both students and lecturers of Catholic University College that there is inadequate used of HI teaching aids in their institutions and this most of them claim is due to the unavailability of the teaching aids in their institutions.

The lack of used of HI teaching aids in University of Ghana was confirmed by the health informatics lecturers in this University. Almost all the health informatics lecturers (85.7%) in the University of Ghana confirm they lack of use of teaching aids during lessons; this lack of use of the teaching aids the lecturers indicated is due to the unavailability of the teaching aids in their institution. Similar viewpoints on the use of health informatics

teaching aids shared by the University of Ghana lecturers were also shared by 87% of the University of Ghana students. This reflects the fact that both the lecturers and students of University of Ghana attest that the use of HI teaching aids is inadequate.

The case of KNUST students was not different from students of the other two universities as far as the inadequate use of teaching aids is concerned. Almost all the students (80%) from KNUST attested to the lack of the use of HI teaching aids in KNUST during lessons. Some of the KNUST students attributed the lack of used of the teaching aids to the unavailability of these aids and some also attributed this to the refusal of lecturers to use the available aids. Unfortunately the lecturers from KNUST do not respond to the questionnaires and hence their view on this lack of teaching aids could not be shared.

The views of the lectures of University of Ghana (UG) indicated that the practical HI lessons are inadequate. This view was shared by almost all the health informatics lecturers in UG (85.7%). This challenge of inadequacy of practical lessons some of the lecturers attributed to the lack of health informatics teaching aids and unsuitable lecture time table1. Almost all the UG students thus 95.7% of them also indicated that the practical lessons are inadequate. This therefore shows that there is a general acceptance by both **(93.3%)** lecturers and students to the fact that HI practical lessons are inadequate in UG. 74% of the students also shared the view that the few HI practical lessons they were taken through were poor in terms of effectiveness. This finding is there for seen as a challenge since IMIA made a recommendation that one of the objectives of an informatics-based approach to BMHI is to focus on practical and technical informatics/computer science (Mentas and Ammenweth, 2000).

The situation at Catholic University College Ghana is not different from that of University of Ghana as far as the inadequacy of practical lessons is concern. All the lecturers at Catholic University attested to the inadequacy of HI practical lessons in their institutions. The lecturers also stated that this inadequacy of HI practical lessons is partly due to the lack of HI teaching aids and lecturers in their university. In respect of the inadequacy of HI practical lessons the views of the students of Catholic University College Ghana largely complement to those of the lecturers, as 89% of them agreed that the HI practical lessons are inadequate. Most of the students also indicated that this inadequacy of HI practical lessons is due to lack of teaching aids and inadequate lecturers. This finding is seen as a challenge as it seems not to be in concordance with finding made by IMIA (Hasman and Boshuizen, 2001). IMIA pointed out that besides lectures it is of importance that practical experience within health care institutions (e.g., in hospitals) are offered for students (Hasman and Boshuizen, 2001). The quality of the HI practical lessons in Catholic University College Ghana is also poor in them of effectiveness as 69% of the students attest to this.

The inadequacy of HI practical lessons seems to run through all the 3 universities offering HI in Ghana. This deduction was made base on the fact that the case of KNUST is no where far from that of the other two universities. Almost all the students (90%) of KNUST agreed to the inadequacy of HI practical lessons in their institutions. KNUST students also attributed this lack of practical lessons to the lack of teaching aids, lack of collaborative learning with HI practical related instructions and practically experienced instructors in some areas of this field. The HI graduate students from KNUST indicated that the HI practical lessons they were taken through were poor in terms of quality. This indication

was realize when almost all the HI graduate students (75%) of KNUST attested to the fact that the HI practical lessons they were taken through were poor in terms of effectiveness. This finding from KNUST is seen as a challenge since it is inconsistent with recommendations made by IMIA (Mentas and Ammenweth, 2000). IMIA recommendations for master programs in health informatics indicate that universities must equip students with both practical skills and analytical approaches that will allow them to further understand the knowledge base of the discipline (Mentas and Ammenweth, 2000).

The data generated from the HI department of University of Ghana indicated that 57% of the HI lecturers of University of Ghana attested to the inadequacy of HI lectures in UG. The lecturers‟ attestation was emphasized by the students as 70% of them agreed to the fact that University of Ghana HI department lack lecturers. The lecturers and students indicated that the cause of the inadequate HI lecturer might be due to the scarcity of the HI lecturers in Ghana and lack of capacity building for the available lecturers. The lack of HI lecturers is not only a challenge to University of Ghana but also a challenge to Catholic University Ghana. All the HI lecturers of Catholic University College Ghana share the view that there is lack of HI lecturers in Catholic University College (CUC). This view shared by the CUC lectures is also shared by the Catholic

University College of Ghana students, as 89% of them indicated that the university lack HI lecturers.

The case of KNUST is not different from that of the other two universities as far as the lack of HI lectures is concern. 75% the HI students of KNUST are of the view that the university lack HI health informatics lecturers. This finding suggests there is a challenge

as far as adequacy and efficiency of HI lecturers in Ghana universities is concern. This finding is seen as challenge because is contradicting recommendation made by IMIA (Mentas and Ammenweth, 2000). IMIA recommend that teachers of health informatics courses must have adequate and specific competence in this field, and the content and delivery of health informatics courses and programs must be of good quality (Mentas and Ammenweth, 2000).

In general, the competency test run on the students of KNUST shows in incompetency levels ranging from 15% to 90% on the courses the studied. It therefore shows that some of the students are in competent in the course the haves studied. This finding the researcher sees as challenge as it contradict recommendation made by Bordage and Harris (Bordage and Harris, 2011). Bordage and Harris stated that the literature of health professional education recognizes that curriculum is both an entity and a process. As an entity it comprises not only the expected competencies and roles; but also the learners at the centre of the enterprise; assessment linking competencies and learners; the conditions and resources for learning; and the social, political and cultural context in which the learning occurs (Bordage and Harris, 2011).

The competency level of UG undergraduate students in general, seems to be above average, as the incompetency level of the students range from 14% to 29% in the courses they have studied. It however indicates that there is still a challenge facing the teaching and learning of health informatics at the undergraduate level of UG, as some of the students complete this HI program without being competent in the courses. The case of the HI graduate students of UG is not different from that of the HI undergraduate students

as far as the competency level in the HI courses studied are concern. The incompetency levels of HI graduate students range from 13% to 25% on the courses the studied.

The incompetency level of Catholic University College students ranges from 9% to 45% of courses studied. Here again one can say there is a challenge facing the teaching and learning of HI at the CUC as a good number of the students claim they were not competent in the courses studied.

According to Creswell (1998) (Creswell, 1998) and Patton (1990) (Patton, 1990) the main purpose of qualitative studies is to comprehend and express participants live experience rather than achieving statistical power and generalization or replicable findings.

The data generated from UG health informatics lecturers indicate that the lecturers are calling on the university to organize capacity building for them. It was common to see phrases such as; **"Workshops and seminars with experienced or foreign lecturers can also be helpful" and "capacity building for lecturers"**, when the lecturers were giving their suggestions toward improving the teaching and learning of health informatics in UG. This finding is similar to recommendation made by IMIA (Mentas and Ammenweth, 2000). IMIA recommends that teachers of health informatics courses must have adequate and specific competence in this field, and the content and delivery of health informatics courses and programs must be of good quality (Mentas and Ammenweth, 2000). It was also found that lecturers of UG are calling for HI teaching aids to help them deliver teaching and learning effectively. It was common to see phrases such as; **"Data warehouse should be developed"**, **"More software should be acquired"** and **"Provide computer laboratory with teaching programs to facilitate practical lessons".**

The finding also indicates that UG lecturers are calling for an increase in the number of HI lecturers. Not only are they calling for an increment in the number of HI lecturer but also HI lecturers with practical experience. As one of the HI lecturers stated; **"Effort should also be made to include lecturer who have practical experience".** The issue of adequacy of HI lecturers seems to have been single out as a concern by IMIA (Mentas and Ammenweth, 2000). IMIA recommend that before universities commence to offer HI educations to students the teachers must be available if not, teachers have to be educated („teach the teachers") first (Mentas and Ammenweth, 2000). The finding gathered from the UG lecturers also indicated that HI practical lessons in UG was nothing to be proud of, as the lecturers are calling for an increase in both the number of practical lessons and quality of practical lessons. It was common to see phrases such as;

"Special practical sessions/time should be provided for on the time table in addition to the regular lecture time table" and **"Institution should invent in appropriate software/hardware that support practical learning in consultation with faculty".**

This finding seems to be in concordance with finding made by IMIA (Mentas and Ammenweth, 2000). IMIA recommends that besides lectures it is of importance that practical experience within health care institutions (e.g., in hospitals) are offered HI students (Hasman and Boshuizen, 2001).

The data generated from CUC lecturers indicated that they are calling for HI teaching aids to assist them deliver HI lessons effectively. One of **CUC** lecturers stated that; **"the university need to establish informatics laboratories and simulation platforms".** This finding indicated that The CUC lecturers are calling the university to employ more

HI lecturers and teaching/research assistance. It was common to see phrases such as; **"Employ Lecturers and Research/Teaching Assistant".**

The finding from UG students in respect to suggestions they made towards improving the teaching and learning of health informatics are in consonant with those made by the UG lecturers. The data generated from the student of UG indicated that they are calling on the university to establish or purchase more HI teaching aids. The finding also indicated that students of UG are asking the university to improve the practical aspect of the HI program by: providing more practical sessions, getting practical course instructors, maintaining student who seems to be good in the practical aspects after completion and the school authorities should provide a well resource computer lab for practical purposes. The finding also indicates that the students are of the view that if the university organizes HI collaborative programs either within the country or outside the country, it would lead to the producing efficient health informaticiens. This finding is in line with recommendation made by IMIA (Mentas and Ammenweth, 2000). IMIA recommends the international exchange of students and of teachers in this field. It encourages the establishment of international programs to support this and to exchange courseware (Mentas and Ammenweth, 2000). The finding also revealed that the UG students are calling on the university to employ more permanent and efficient lecturers especially those with practical experience.

The outcome of the data reveals that suggestions made by students of Catholic University College (CUC) to a large extent are similar to those made by the students of UG and those made by CUC lecturers. The students of CUC indicated that the universities need to employ more HI lecturers and research/teaching assistance. A sizeable numbers

of the CUC students are calling on the university to equip the HI department with teaching aids such as the provision of health informatics computerized learning programs and computer laboratory. The finding also indicated that the HI student of CUC do no left out the need for the university to provide more practical aspects of the program. The students of CUC also perceived that the introductions of HI collaborative learning programs between their institutions and other HI related institutions will lead to effective learning. This finding is consistent with recommendation made by International Partnership for Health Informatics Education (IΦE), (Jaspers, *et al*., 2000). (IΦE) recommends the sharing and dissemination of knowledge and practical experiences between students and faculty would help them to become more proficient in their field (Jaspers, *et al*., 2000).

The data generated indicates that suggestions made by KNUST students are similar to those made by the other two universities. The finding shows that KNUST students are also calling on their university to include practical programs in the HI teaching and learning curriculum. They students of KNUST also shared the view that KNUST should introduce collaborative learning programs (especially in the area of research) with other health informatics related institutions for effective learning. This finding agrees with findings made by IΦE (Jaspers, *et al*., 2000). IΦE encourages student and faculty exchanges among partner schools; the aim of this is to tailor students‟ master thesis work to their individual interests and to offer optimal challenges to deepen their knowledge and skills in a specific medical informatics subject. Students may, for example, be interested in a research topic which is not a main theme in the research program of their home university but is in the research domain of another IΦE partner university. The student exchange program offers

these students the option to carry out (part of) their master thesis project at the university that is well known for its expertise in a specific research area (Jaspers, *et al*., 2000).

Data gathered from KNUST students also indicates that the students see the need for the university to acquire health informatics teaching aids both for the computer laboratory and the university hospital. The KNUST students are also calling for the employment of practically experience HI lecturers by the university. The case of specialization in aspects of HI was not left out as the students of KNUST are calling on the university to allow students to choose health informatics courses they want to specialize in. This finding is in congruence with finding made by Commission on Accreditation for Health Informatics and Information Management Education (CAHIIM) (www.cahiim.org/FilesStandards/2012_HI_Masters_Stndrds_elec.pdf). CAHIIM recommends that students can choose to emphasize one or more courses consistent with their mission, goals and objectives (www.cahiim.org/Files-Standards/2012_HI_Masters_Stndrds_elec.pdf).

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS:

6.1 Conclusion

This study has established a number of existing challenges facing the building of health informatics capacity in the Universities offering Health Informatics in Ghana and possible causes of these challenges. This study has also established a number of suggested solutions to these challenges. The challenges, their causes and suggested solution for University of Ghana are presented in table 6.1. The challenges, their causes and suggested solutions for

KNUST are presented in table 6.2. The challenges, their causes and suggested solutions for Catholic University College are presented in table 6.3. Almost the same challenges, causes and suggested solutions seem to run through all the three universities.

Table 6.1 University of Ghana Health Informatics challenges, possible causes of challenges and suggested solutions to these challenges

Challenge	Possible cause of challenge	Suggested solutions to challenge
Inadequate lecturers	Unavailability of HI lecturers in Ghana and lack of Capacity building for the available lecturers.	The university should organized capacity building programs for lecturer. The university can sponsor people to further their educations in well established HI universities in the world

Inadequate used of teaching aids during lessons	University lacks some teaching aids. Other teaching aids are available but not put into used.	University should consult well established HI universities to find out available teaching aids and purchased or develop these teaching aids. Also the teaching aids available should be put in use.
Inadequate / inefficient practical lessons	Lack of software/hardware HI programs. Practical sessions not provided on the time table. Lack of practical experience on the part of some course instructors.	Software/hardware should be develop or purchase to support learning. Special practical sessions should be provided on the time table. Workshops for lectures to learn from practical experience lecturers.
Student incompetence ranging from 13% to 29%	Possibly due to all the causes mentioned above	Apply all the above solutions

Table 6.2 Kwame Nkrumah University of Science and Technology Health Informatics challenges, possible causes of these challenges and suggested solutions to these challenges

Challenge	**Possible cause of challenge**	**Suggested solutions to challenge**
Inadequate use of teaching aids	Lack of HI teaching aids. Available teaching aids not put in to use.	Develop or purchase HI teaching aids. Lecturer should put available teaching aids in to use e.g. computer laboratory.
Lack of specializations in aspects of HI to suit mission of student.	Lack of lectures and infrastructure	Students should be allowed to choose specific course of HI that suit their missions and goals. More lecturers should be employed.
Lack of collaborative learning programs with other HI related intuitions such as hospitals.	Not provided on time table and lecturers of specific courses failing to organize it.	Collaborative learning programs should be organized

Inadequate lecturers	Unavailability of experienced HI lectures in Ghana. Lack of capacity building by university for HI course instructors.	University should organized collaborative learning programs with well established HI universities in the world for lecturers.
Inadequate/inefficient practical lessons	Lack of teaching aids. Failure of some lecturers to organized practical lessons. Poorly organized practical lessons	HI educational software/hardware should be develop or purchase. Lecturers should try and organized practical lessons. Practical lessons should be well organized.
Student incompetence ranging from 15% to 90%	Possibly due to all the causes mentioned above	Apply all the above solutions

Table 6.3 Catholic University College Health Informatics challenges, possible causes of these challenges and suggested solutions to the challenges

Challenge	**Possible cause of challenge**	**Suggested solutions to challenge**
Inadequate lecturers	Unavailable HI lecturers in Ghana. University refusal to employed more lecturers	University should sponsor some people to further their educations in well established HI universities and later used them as lecturers. University should employed more lecturers.
Inadequate practical lessons	Lack of teaching aids. Ill resources and unused laboratory. Lack of practical course instructors.	Teaching aids should be develop or purchase, the laboratory should be put into use. Practical experience lecturers should be employed. Practical lesson should be effectively organized.

Inadequate use of teaching aids during lessons	Lack of teaching aids. Refusal of lecturers to use available teaching aids	More teaching aids should be developed or purchase. Lectures should put available teaching aids into used.
Inadequate collaborative learning programs	Failure of lecturers to organized collaborative learning programs.	Lecturers should organized more collaborative learning programs with healthcare centers.
Incompetence on the part of some students	Possibly due to all the above mentioned causes	Apply All the above solutions

6.2 Recommendations

It is required of all the three universities offering health informatics education in Ghana to address the above challenges related to their institutions in order to produce efficient health informaticiens. It is recommended for these universities to use the suggested solutions as a guide to address these challenges. The challenges and suggested solutions are tabulated in the conclusion of this study. Further studies should consider developing software to aid the practical aspects of health informatics. Further studies should also search for available health informatics teaching aids and Institutions where universities offering HI can partner with for effect research and practical lessons.

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APPENDICES

APPENDIX 1

LECTURERS QUESTIONNAIRE

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

MPHIL HEALTH INFORMATICS

INTRODUCTION

This set of questions is to enable the researcher collect data that would enable him contribute to the building of health informatics capacity in Ghana by investigating in to health informatics education to identify challenges and designing strategies to address them .

This exercise is purely academic and your contribution would be treated confidentially. Your contribution by way of answering the questionnaire will be highly appreciated.

INSTRUCTIONS

You are requested to tick in the boxes [ ] provided for the appropriate option and provide brief answers to the other spaces provided. NA means not applicable.

SECTION A

PERSONAL DATA

1. Gender Male [ ] Female [ ]
2. Age 20-29 years [ ] 30-39 years [ ]
   40-49 years [ ] 50 - 100years [ ]

3. Which of the following Institution do you lecture a course in Health Informatics program?

   Kwame Nkrumah University of Science and Technology [ ]

   Catholic University [ ]

   University of Ghana [ ]

4. What is your academic qualification and area of specialty?

……

5. Which of the following level(s) are you lecturing Health informatics?

Undergraduate [ ]	**Graduate [ ]**
Year 1[ ]	Year 1 [ ]
Year 2 [ ]	Year 2 [ ]
Year 3 [ ]	Year 4 [ ]

6. How long have you been lecturing a course(s) in Health Informatics?

   0-1years [ ] 2-3years [ ]

   4-5years [ ] 6years and beyond [ ]

7. Which health informatics course(s) are you lecturing?

……
……
……

8. Which of the following do you belong?

Full time lecturer [ ]

Part time lecturer [ ]

SECTION B

Identification of Challenges and Recommendations for Health Informatics Education

9. Have your students been taken through any practical lesson? If No give reason(s) in the space provided.

Yes [ ] No [ ]

……
……
……

10. If your answer to question (9) above is yes, would you say the practical‟s lessons were enough? If no state reason(s) in space provided.

Yes [ ] No [ ] NA [ ]

.....
.....
.....

11. Again if your answer to question (9) above is yes, how would you rate the practical(s) in terms of quality/effectiveness?

Excellent	[ ]	Very good	[ ]
Good	[ ]	Poor	[ ]
NA	[ ]		

12. Specify in the space provided if you have any special advice for your institution that can improve the practical aspect of your programme?

.....
.....
.....

13. Is the use of health informatics teaching aids during lessons adequate? If No give reason in the space provided

Yes [ ] No [ ]

……

……..

14. Is your institution having health informatics teaching aids? If No provide reason(s) in the space.

Yes [ ] No [ ].
……
……

15. If your institution has health informatics teaching aids, how would you rate the manner/effectiveness in which the teaching aids are being put into use?

Excellent	[ ]	Very good	[ ]
Good	[ ]	Poor	[ ]

16. Would you advice people who do not have background knowledge on computer science and health science to pursue health informatics at graduate level? If no state reason(s) in space provided.

Yes [ ] No [ ]

.....
.....

17. Are student allow by your institution to specialise in or choose some course areas of interest in health informatics?

Yes [ ] No [ ]

18. Do you support the idea of specialisation or choosing of course area of interest in health informatics? If No state reason(s) in space provided.

Yes [ ] No [ ]

.....
.....
.....

19. Is there any need for your department to collaborate with other department or institution to offer this programme effectively? If No state reason(s) in space provided.

Yes [ ] No [ ]

.....
.....

20. Did your institutions facilitate any collaborative or exchange learning programme with other institutions for you (for example visiting other Health informatics institutions to learn from them). If no state reason (if any) in space provided

Yes [ ] No [ ]

……
……

21. If your answer to question (20) above is yes, how would you rate the collaborative learning programme in general?

Excellent [ ] Very good [ ]

Good [ ] Poor [ ]

NA [ ]

22. Would you say your institution have adequate (quantity and quality) lecturers to offer this program? If no specify reasons in the space provided.

Yes [ ] No [ ]

……..

23. Provide in the space; health informatics related institution(s) you would suggest to your university to collaborate with for effective learning?

.....
.....

24. If you are encountering any other challenge(s) while lecturing this programme and is/are not stated above then you can specify it/them in the space below?

.....
.....

25. Provide in the space suggestions that you have for your institution that would help improve the teaching and learning of health informatics?

.....
.....

APPENDIX 2

STUDENTS QUESTIONNAIRE

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

MPHIL HEALTH INFORMATICS

INTRODUCTION

This set of questions is to enable the researcher collect data that would enable him contribute to the building of health informatics capacity in Ghana by investigating into health informatics education to identifying challenges and designing strategies to address them.

This exercise is purely academic and your contributions would be treated confidentially. Your contribution by way of answering the questionnaire will be highly appreciated.

INSTRUCTIONS

You are requested to tick in the box [ ] provided for the appropriate option and provide brief answers to the other spaces provided. NA stands for Not Applicable. Section C is in three phases each representing a university; chose the one representing your university.

SECTION A

PERSONAL DATA

1. Gender Male [ ] Female [ ]
2. Age 15-29 years [ ] 30-39 years [ ]

   40-49 years [ ] 50 – 100years [ ]

3. Level at which you are studying Health informatics

Undergraduate [ ]	**Graduate [ ]**
Year 1 [ ]	Year 1 [ ]
Year 2 [ ]	Year 2 [ ]
Year 3 [ ]	
Year 4 [ ]	

4. Which Institution are you pursuing Health Informatics?

   Kwame Nkrumah University of Science and Technology [ ]

   Catholic University [ ]

   University of Ghana [ ]

Section B

Identification of Challenges and Recommendations for Health Informatics Education

5. Is the use of Health informatics teaching aids adequate? Yes [ ] No [ ]. If No provide reason in the space provided.

……
…….

6. Would you say your institutions have enough teaching aid to offer this program?

Yes [ ] No [ ]. If No provide reason in the space provided.

……

……

7. If your institution has health informatics teaching aids, how would you rate the manner/effectiveness in which the teaching aids are being put into use?

   Excellent [ ] Very good [ ]

   Good [ ] Poor [ ] NA [ ]

8. Were you taken trough any practical lesson as part of your study of Health Informatics? If No provide reason in the space provided

   Yes [ ] No [ ]

……

……

9. If your answer to question (8) above is yes, would you say the practical lessons in general were enough?

   Yes [ ] NA [ ]

   No [ ]

10. Again if your answer to question (8) above is yes, how would you rate the practical lessons in terms of quality?

    Excellent [ ] Very good [ ] NA [ ]

    Good [ ] Poor [ ]

11. Specify in the space provided if you have any special advice for your institution that can improve the practical aspect of your programme

….....

.....

12. Is there any need for your department to collaborate with other departments or institutions to offer this programme effectively?

Yes [ ] No [ ]

13. Did your institutions facilitate any collaborative or exchange learning programme with other institutions for you (for example visiting other Health Informatics institutions to learn from them). If yes specify in the space.

Yes [ ]

Specify….....

No [ ]

14. If your answer to question (13) above is yes, how would you rate the collaborative learning programme in general?

Excellent [ ] Very good [ ] NA [ ]

Good [ ] Poor [ ]

15. Provide in the space; institution(s) you would suggest to your institution to collaborate with for effective learning?

….....

.....

16. This questions is for only graduate students; what is your academic background (area of speciality) before you gain admission to study this cause?

Computer Science [ ] Health Sciences‟ [ ]

Health informatics [ ] NA [ ]

Others (please specify)….....

17. How would you rate the effect (negatively) of your programme area (in question 18 above) in relation to your study of Health Informatics?

Great [ ] Much [ ]

Less [ ] Not at all [ ]

NA [ ]

18. Would you advice people who do not have background knowledge on **computer science** and **health science** to pursue health informatics at the graduate level? If no specify reason(s) in the space

Yes [ ]

No [ ]

Specify…..

….....

19. Would you say your institution have enough lecturers to offer this program? If no specify reason in the space provided

Yes [ ] No [ ]

……

……..

20. Are student allow by your institution to specialize or chose some course areas of interest in health informatics (electives and core courses)?

Yes [ ] No [ ]

21. Do you support the idea of specialization or choosing of course area of interest in health informatics?

Yes [ ] No [ ]

22. If you are encountering or have encounted any other challenge(s) whiles‟ studying this programme and is/are not stated above then you can specify it/them in the space below.

….....

.....

.....

23. Provide in the space suggestions that you have for your institution that would help improve the teaching and learning of health informatics?

….....

.....

.....

Section C Self Competency Test (Skill/knowledge you gain from learning health informatics) KNUST

Skill/knowledge	outstanding	Exceed Expectation	Competent	Incompetent
24. Legal and ethical issues in health informatics	[ ]	[ ]	[ ]	[ ]
25. Health concepts [ ] representation (terminologies)	[ ]	[ ]	[ ]	
25. Computer networking design	[ ]	[ ]	[ ]	[ ]
28. Epidemiological	[ ]	[ ]	[ ]	[ ]

concepts and
methods

29. Plan, develop and [ ] [ ] [ ] [ ]
implement community
base health interventions

30. Use diagnostic decision [ ] [ ] [ ] [ ]
support systems for patients

31. Principles and concepts [ ] of [ ] [ ] [ ]
medical digital imaging

32. Concepts of telehealth [ ] [ ] [ ] [ ]

33. Healthcare knowledge [ ] [ ] [ ] [ ]
Management processes

34. Database design [ ] [ ] [ ] [ ]

35. Database management [ ] [ ] [ ] [ ]
(database security)

36. Evidence based healthcare [ ] [ ] [ ] [ ]
approaches and methods (Literature
searching techniques, software tools
for collecting and organizing
search results) **Section C**

Self Competency Test (Skill/knowledge you gain from learning health informatics)

University of Ghana Undergraduate year four students

Skill/knowledge	Outstanding	Exceed Expectation	Competent	Incompetent

24. Computing in Public health [ ] [ ] [ ] [ ]
25. Health management Informatics systems [ ] [ ] [ ] [ ]
26. Database management [ ] [ ] [ ] [ ]
27. Geographic information Systems [ ] [ ] [ ] [ ]
28. Information security [ ] [ ] [ ] [ ]
29. System analysis and Design [ ] [ ] [ ] [ ]
30. Data analysis and presentation [ ] [ ] [ ] [ ]
31. IT application in Health management [ ] [ ] [ ] [ ]
32. Electronic health Data systems [ ] [ ] [ ] [ ]

Section C

Self Competency Test (Skill/knowledge you gain from learning health informatics University of Ghana Graduate Students

Skill/knowledge	Outstanding	Exceed Expectation	Competent	Incompetent

24.Health Terminologies [ ] [ ] [ ] [ ] 25. Ethical and legal [ ] [ ] [ ] [ ] concern in HI

26. Database Management [ ] [ ] [ ] [ ] and Administration

27. Information systems [ ] [ ] [ ] [ ] analysis and design

28.Health data and [ ] [ ] [ ] [ ] electronic health care records

29.Geographical information [ ] [ ] [ ] [ ] systems application

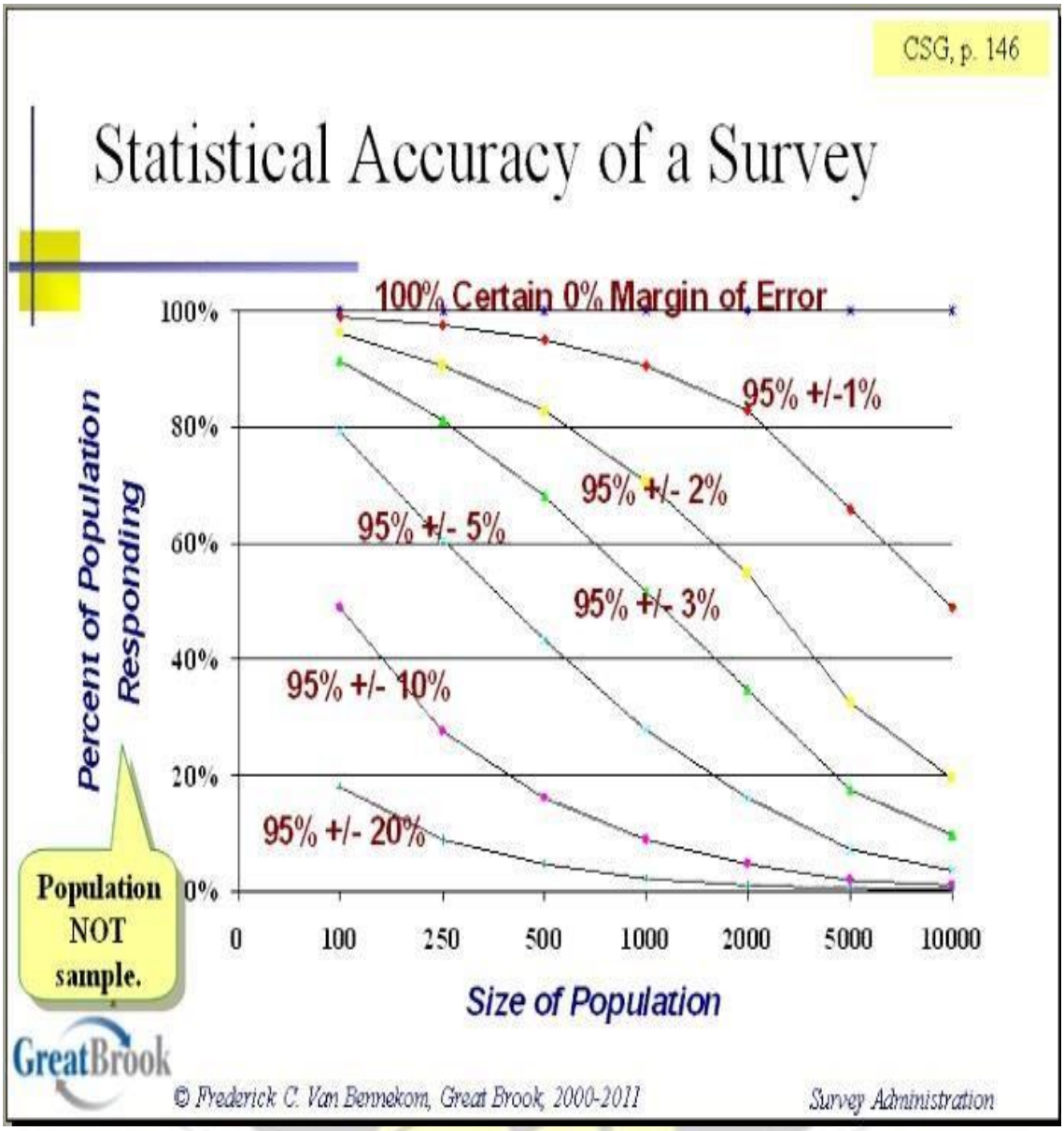
30. Foundation of public health [ ] [ ] [ ] [ ]

31. Research methods in HI [ ] [ ] [ ] [ ]

32.Health information security [ ] [ ] [ ] [ ]

33.Principles of Epidemiology [ ] [ ] [ ] [ ]

APPENDIX 3



SURVEY RESPONSE RATE REQUIREMENT CHART