Integration of Informatics and Health Informatics into Health Educational Programs of Higher Education in Greece

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Abstract

Objective: The aim of this paper is to study the inclusion of Informatics and Health Informatics subjects in the health sciences departments' curricula of higher education in Greece. Its main purpose is to determine the level of health informatics knowledge, dexterities and skills that these departments provide for their graduates.
Method: Informatics and Health Informatics subjects were recorded from the departments' curricula available on their official Web sites. Afterwards, these subjects were categorised based on the description of the objectives, the content and the syllabus of each department and on the Goals of Informatics Education identified by the American Medical Informatics Association.
Results: Our research indicated that most of the subjects mainly focus on introductory concepts and applications rather than on advanced issues of informatics, resulting, mostly, in producing Information Technology users rather than Health/Medical Informatics specialists.
Conclusion: The study presented in this paper points out the imperative need of health educational programs of higher education in Greece to adjust their curricula to the current educational requirements in order to provide their graduates with the necessary knowledge in health information technologies.

Keywords

Health Informatics, Medical Informatics, Education, Health Sciences Curricula.

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1 Introduction

International technological developments in Information and Telecommunication Sciences, in relation to the evolution of medicine and the other basic sciences, have already radically transformed the entire health services spectrum in the developed countries. Health Informatics applications aim at implementing information systems and methods in healthcare organizations in order to provide solutions for problems related to information and knowledge processing and lead to the improvement of the administration of healthcare organizations and the quality of healthcare [1]. Furthermore, Health Informatics applications can help to overcome the conventional procedures of disease prevention, diagnosis and treatment, since the use of telemedicine can provide reliable health services even in the most remote places. Advanced tools, such as the electronic patient record, data accessibility from different places and the e-health card can radically change the scene by providing effective health services [2]. For these reasons, the need for continuous education and training of healthcare professionals in Information and Communications Technology (ICT) is indisputable so that they can acquire the appropriate knowledge and practical skills for the effective integration of Information Technology (IT) in the healthcare sector [3, 4, 5].

Many academic programs in health informatics are currently being offered worldwide, either at an undergraduate or postgraduate level. In addition, many health departments have included IT subjects in their curricula in order to provide their graduates with IT knowledge [3]. However, the term "health informatics professional" [6] has not yet been defined clearly. It may refer either to health information technology users or medical

informatics specialists [5, 6]. For this reason and, as there is a great variety of educational programs all over the world, the establishment of a common educational framework in the field of health/medical informatics is widely acknowledged. Therefore, the International Medical Informatics Association (IMIA) has submitted international educational proposals, which should be adopted by universities and educational organizations [7, 8, 9], determining whether their graduates are IT users or specialists.

Furthermore, in the US, certification in nursing informatics has been available for more than ten years, since the American Nurses Association adopted the Scope and Standards for Nursing Informatics Practice, which defines the IT competencies and knowledge that nurses should have in order to efficiently integrate information technology in their practice. These competencies comprise three different levels of knowledge/skills as follows:

i) basic computer literacy skills such as word processing, spreadsheets, databases etc;

ii) information literacy skills such as search and retrieval of information from the internet etc; and

iii) overall informatics knowledge such as privacy, confidentiality and security of information in nursing practice, interpretation of patients' information, informatics applications in nursing etc [10].

There are many surveys worldwide for recording informatics and health informatics subjects in health departments of higher education [11, 12, 13]. In Germany, for example, there have been obligatory medical informatics subjects for medical students since 1970 [13]. In the US, a survey in 266 nursing programs revealed that more than forty percent (40%) of the undergraduate programs and approximately one third (1/3) of the postgraduate programs include subjects covering IT topics, such as computer-based patient record, the ethical use of information systems, informatics nurse competencies, information systems in nursing practice, education, management, research and etc [14].

Such a survey in Greece has not been conducted so far. Therefore, the main purpose of this work is to record Informatics and Health Informatics subjects in health sciences departments of higher education in Greece. In addition, there is an attempt to investigate the educational trends of these departments according to their objectives, their content and curricula, through a categorisation based on certain rules identified by the American Medical Informatics Association (AMIA), regarding the basic level of IT knowledge of health professionals [15].

At this point, it is useful to point out that in Greece higher education comprises two different types of institutes: Universities and TEI (Technological Educational Institutes). Both of them provide bachelor degrees and include separate academic departments. Some of these departments, for administrative reasons, are grouped in academic units, though others, for practical or historical reasons, are not part of any unit. Therefore, we may have "school of medicine" and "department/faculty of medicine", which, however, lead to the same bachelor degree of medicine.

2 International – European Status

The European Union considers that Medical Informatics (the term is often used synonymously with the term Health Informatics) [16] may promote and evolve health care delivery and also may enable the provision of quality health services even in the most remote places of the world [16, 17]. Telemedicine services, electronic patient records and medical interconnected networks could help towards this direction.

Indicatively, we report that in England undergraduate and postgraduate programs in Health Informatics focus on providing e-health services. For example, at the City University of London, the postgraduate program of Health Informatics offers knowledge and skills that aim at:

i) how ICT can be used to enhance the organization and the delivery of efficient health services; and

ii) the acquisition of skills for the integration and usage of ICT in order to encounter complex problems and enhance the delivery of effective healthcare services [18].

In Austria, Medical Informatics studies focus on the quality of information, on the structure of medical information and on the planning and support of medical systems [19].

In Germany, innovative Medical Informatics courses, at an undergraduate and postgraduate level, aim at generating skilled personnel with:

i) knowledge that combines IT with the individuality of the medical sector; and

ii) knowledge that covers various topics, such as medical records, medical image processing, medical simulation, bioinformatics and standards of medical data transmission [8].

In Ireland, the M.Sc. program in Medical Informatics aims at providing special knowledge so that the students can acquire an integrated picture of the role of ICT in health and understand the principles of Health Informatics. Additional objectives are:

i) the study and application of Health Informatics with emphasis on theory and practice; and

ii) the assessment of medical legal and ethical issues and the necessary support on the methodology of research [20].

AMIA, in order to contribute to the achievement of the "Goals of Informatics Education for Health Professionals" specified in AMIA's spring conference in 1999 [15], established in 2005 the 10×10 Informatics Education Program with the ultimate goal of providing education and training for 10,000 healthcare professionals in applied

Table 1: The main findings concerning Information Technology subjects by level of study.

Level of Study	Number of departments and percentages	Number of IT subjects and percentages	Mean	Minimum number of IT subjects	Maximum number of IT subjects
Undergraduate	51 (58.6%)	113 (48.3%)	2.22	1	12
Postgraduate	36 (41.4%)	121 (51.7%)	3.36	1	20
Total	87 (100%)	234 (100%)	2.69	1	20

health and medical informatics across the United States within 10 years. Many academic institutions participate in the program and provide basic health informatics skills but, also, specialized knowledge in areas such as electronic health records, health information exchange, standards and terminology and error prevention [21]. Claremont Graduate University and Oregon Health Science University conducted, in 2007, a research aiming the assessment of the AMIA's 10×10 program. The participants where graduates of the program and the results indentified that the 10×10 program meets the AMIA's goals and participant's needs and expectations to a satisfactory degree and that there can be improvement modifications in the area of course content and course delivery [22].

Undergraduate and postgraduate programs in Medical Informatics are also held by other universities in Europe and the world. Their ultimate goal is to have specialized scientists, whose IT knowledge will help to provide efficient, effective and high quality healthcare services [23].

3 Methodology - The Categorization of Informatics and Health Informatics subjects of Health Sciences Departments

We accomplished the recording of informatics and health informatics subjects of the departments of health sciences from their curricula available on their official Web sites [24]. We, afterwards, classified these subjects in certain IT categories through their outlines, the detailed description of their contents and the teaching goals of each department, as specified in their curricula. The categories were set forth and the subjects included were classified based on the 'Goals of Informatics Education for Health Professionals' identified by the AMIA spring conference in 1999 [15], regarding the required core informatics knowledge, dexterities and skills for health care professionals. In detail, the IT categories set forth are the following:

- **Introductory Concepts:** This category includes the basic concepts and definitions of Informatics and Health Informatics, history, operating systems, hardware structure of computers, office automation, networking concepts, terminology of Health Informatics and the presentation of the most widespread applications of Information technology in health care organizations etc.

- **Applications on Health:** It includes the subjects that focus on the development, function and evaluation of computer applications at all levels of healthcare, such as hospital information systems, electronic patient record, databases, telemedicine and bioinformatics applications, processing of biomedical signals-images etc.

- **Software:** The subjects of this category cover concepts that include the principles of programming, application design and development using programming languages, problem solving using computers etc. The most common programming languages taught are C, C + +, Perl, Basic, Prolog, Visual Basic.net, Java etc.

- **Technology:** It includes subjects that focus on the management and operation of medical equipment, evaluation of medical devices, definitions of technology, nanotechnology, biomedical electronics, measuring instruments etc.

- **Hardware:** This category includes subjects whose basic aim is the understanding of the maintenance principles of medical devices and instrumentation, the limits and safety regulations of the laboratory equipment etc.

Following the determination of the above IT categories, all the undergraduate and postgraduate programs of Health Sciences were classified. This classification revealed that a department's curriculum might simultaneously pertain to more than one of the above categories since it might contain subjects that cover several topics of informatics, i.e. the basic concepts and definitions of informatics, the development, function and evaluation of computer applications and the evaluation of medical devices.

When the integration of the curricula in the above categories was completed, we carefully codified the resulting classification following all the rules of conceptual consistency [25] and afterwards we proceeded to data processing and analysis with the statistical processing program Predictive Analytics Software (PASW), former Statistical Package for the Social Sciences (SPSS).

Table 2: IT subjects by IT category in health science departments of higher education in Greece.

IT Categories	Number of IT subjects	Percentage %
Introductory concepts	24	10.3%
Applications on Health	20	8.5%
Technology	4	1.7%
Introductory concepts and Applications on Health	66	28.2%
Introductory concepts and Technology	8	3.4%
Introductory concepts and Applications on Health and Technology	16	6.8%
Introductory concepts and Applications on Health and Technology and Software	22	9.4%
Applications on Health and Technology	3	1.3%
Introductory concepts and Applications on Health and Software	14	6.0%
Applications on Health and Technology and Hardware	10	4.3%
Applications on Health and Technology and Software	5	2.1%
Introductory concepts and Applications on Health and Software and Hardware	12	5.1%
Introductory concepts and Applications on Health and technology and Software and Hardware	10	4.3%
Applications on Health and Technology and Software and Hardware	20	8.5%
Total	234	100.0%

4 Results - Key Findings

4.1 Information Technology Subjects by Level of Study

A list of all the health sciences departments of Universities and TEIs of the country was obtained from the site of the Ministry of Education, Lifelong Learning and Religious Affairs [24]. According to their curricula, almost sixty percent (58.6%) of the departments contain IT subjects at undergraduate level and about forty percent (41.4%) have IT subjects at postgraduate level.

The total number of IT subjects at undergraduate and postgraduate level is 234. On average, we recorded 2.69 subjects by department. The maximum number of IT subjects in a department's curriculum is twenty (20), while the minimum number is one (1), which is also the mode. In undergraduate studies, the average number of subjects on informatics is 2.22 and the total number is 113 subjects. Postgraduate studies present a better picture since these numbers are 3.36 and 121 respectively. All the findings described above are presented in detail in Table 1.

4.2 Total Picture of IT subjects by Category

The curricula of health sciences departments of Greek Universities and Technological Educational Institutes mainly focus on the teaching of introductory concepts of informatics and applications on health since we recorded 66 subjects (28.2%) that cover the above IT categories. We additionally recorded 24 subjects (10.3%) that cover just the category of introductory concepts of informatics and 9.4% of the total subjects (22 out of 234 subjects) that combine introductory concepts of informatics, applications on health, technology and software. We furthermore identified that the curricula of health departments of higher education in Greece focus on applications on health (20 subjects, 8.5%), the combination of applications on health, technology, software and hardware (20 subjects, 8.5%), and the combination of introductory concepts, applications on health and technology (16 subjects, 6.8%). The curricula of health sciences departments cover other categories too but with lower percentages. All these findings are presented in Table 2.

4.3 Information Technology Subjects by Level of Study and IT Categories

The recording of the subjects by level of study revealed that at undergraduate level, teaching is mainly focused on introductory concepts of informatics (19 out of 113 IT subjects of that educational level, 16.8%) and the combination of introductory concepts of informatics and applications on health (38 IT subjects, 33.6%). It is worth mentioning that at the same level teaching also covers the combination of introductory concepts, applications on health and technology (16 IT subjects, 14.2%) and other categories too but with much lower percentages (see Table 3). Indicatively we report: introductory concepts, applications on health and software and hardware (10.6%), introductory concepts, applications on health, technology, software and hardware (8.8%) etc.

At postgraduate level, the picture is slightly different since approximately twenty three percent (23.1%, 28 out of 121 IT subjects of that educational level) focus on introductory concepts and applications on health and more than sixteen percent of the subjects (16.5%, 20 IT subjects) focus on the combination of applications on health, technology, software and hardware. We also recorded 17 IT subjects (14.0%) focusing only on applications on health and approximately twelve percent (11.6%) of the total IT subjects covering the combination of introductory concepts, applications on health and software. Of course, at postgraduate level teaching covers other IT categories too, but with lower percentages. These percentages and all the above results are presented in detail in Table 3.

Table 3: IT subjects by level of study and categories.

IT Categories	Undergraduate Level		Postgraduate Level	
	Number of IT subjects	Percent %	Number of IT subjects	Percent %
Applications on Health and Technology and Software and Hardware	0	(0.0%)	20	(16.5%)
Introductory concepts and Applications on Health and Technology and Software and Hardware	10	(8.8%)	0	(0.0%)
Introductory concepts and Applications on Health and Software and Hardware	12	(10.6%)	0	(0.0%)
Applications on Health and Technology and Software	0	(0.0%)	5	(4.1%)
Applications on Health and Technology and Hardware	0	(0.0%)	10	(8.3%)
Introductory concepts and Applications on Health and Software	0	(0.0%)	14	(11.6%)
Applications on Health and Technology	0	(0.0%)	3	(2.5%)
Introductory concepts and Applications on Health and Technology and Software	9	(8.0%)	13	(10.7%)
Introductory concepts and Applications on Health and Technology	16	(14.2%)	0	(0.0%)
Introductory concepts and Technology	6	(5.3%)	2	(1.7%)
Introductory concepts and Applications on Health	38	(33.6%)	28	(23.1%)
Technology	0	(0.0%)	4	(3.3%)
Applications on Health	3	(2.7%)	17	(14.0%)
Introductory concepts	19	(16.8%)	5	(4.1%)
Total	113	(100%)	121	(100%)

4.4 IT Subjects by IT Category and Department(s)

The study of the curricula by department showed no major differentiations from the findings that we have already presented. Indicatively, we report that the curricula of the Greek Nursing departments mainly cover material related to introductory concepts and applications on health (33 out of 61 IT subjects, 54.1%) or material related to introductory concepts, applications on health and software (14 out of 61 IT subjects, 23.0%). We also point out that the curricula of the departments of Medicine mainly cover material that combine introductory concepts of informatics, applications on health, technology and software (13 out of 63 IT subjects, 20.6%), material that combine introductory concepts, applications on health and technology (11 out of 63 IT subjects, 17.5%) and material related to applications on health, technology and hardware (10 out of 63 IT subjects, 15.9%). The above results together with the findings for the rest of the departments are presented in Figure 1.

5 Discussion – Conclusions

The need for health professionals with the necessary dexterities, essential skills and appropriate knowledge, which render them specialized in the field of Information Technology, is widely accepted not only in Greece but also worldwide [19, 23].

This need has led higher education to continuously incorporate more Health Informatics subjects into the curricula of health sciences departments.

This study focused on the recording of Informatics and Health Informatics subjects in health sciences departments of higher education in Greece. It is the first time that such a survey has been conducted in Greece and it also attempted to investigate the educational trends of these departments according to their curricula, through a categorisation based on certain rules that have been identified by the American Medical Informatics Association (AMIA), regarding the basic level of IT knowledge of health professionals [15].

The recording of Informatics and Health Informatics subjects is accomplished through the departments' curricula that are available on their official Web sites. These subjects were classified in certain IT categories according their outlines, contents and the teaching goals of each department. Five IT categories were determined:

i) Introductory concepts,

ii) Applications on health,

iii) Software,

iv) Technology and

v) Hardware.

The formation of those categories was based on the Goals of Informatics Education for Health Professionals' that have been identified by the AMIA spring conference in 1999 [15], regarding the required core informatics knowledge for health care professionals. Afterwards, all the undergraduate and postgraduate programs of Health Sciences were classified in those categories. A department's curriculum could simultaneously pertain to more than one of those categories since it might contain subjects that cover several topics of informatics. When the integration of the curricula in the categories was completed, the resulting classification was carefully codified following all the rules of conceptual consistency [25] and after that we proceeded to data processing and analysis.

This analysis revealed that in Greece, at undergraduate level, the curricula of health sciences departments of

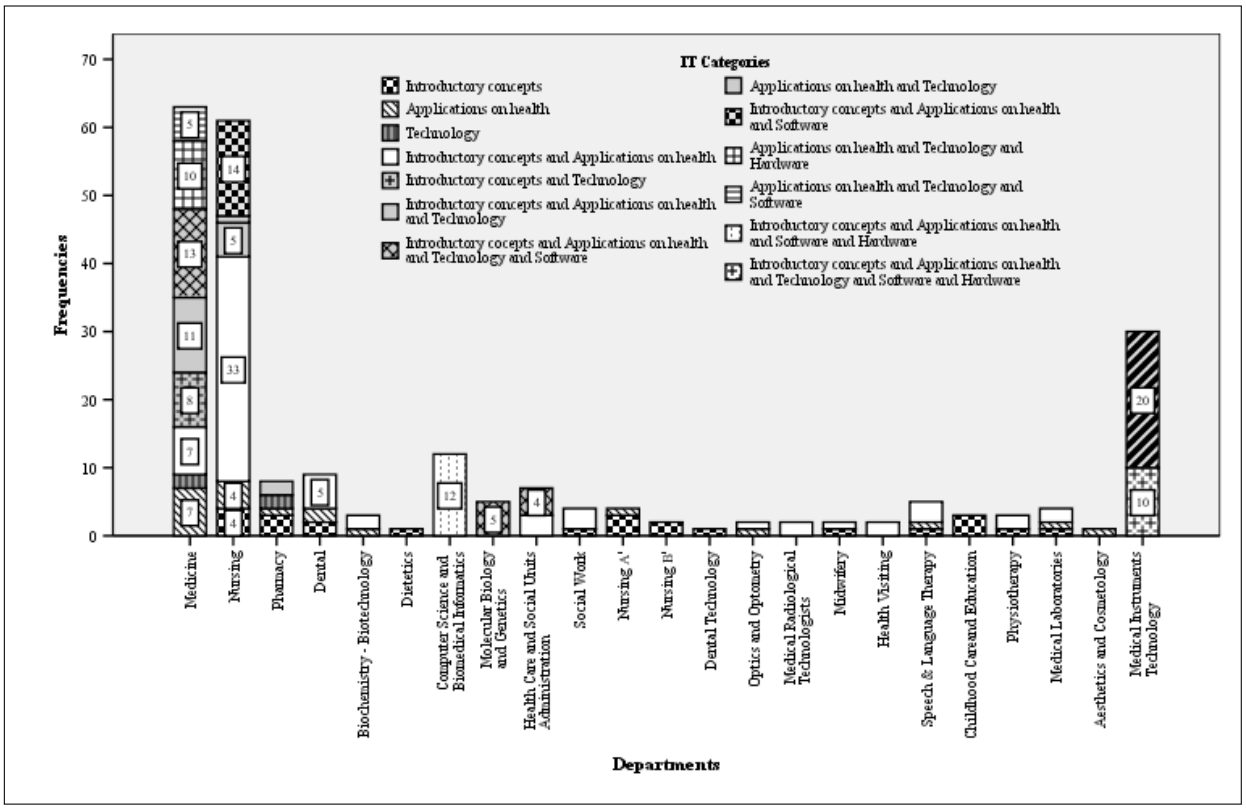

Figure 1: Number of IT subjects (frequencies) by IT category and departments. All the frequencies not shown in the chart are less or equal to three (<=3).

higher education mainly focus on introductory concepts of informatics and health informatics, as well as on the presentation and familiarization with computer applications in the health sector. This finding is consistent with the findings of other similar surveys, which, despite the well-documented importance of including informatics knowledge and skills within the curricula of health educational programs [14], have revealed equivalent results. In the U.S., for example, a survey showed that undergraduate educational programs for nursing emphasize mostly computer literacy skills rather than information literacy skills [14] and in Croatia, educational programs for health professionals mostly focus on the teaching of the basic IT knowledge in order to enable health professionals to manage health information properly [11].

At postgraduate level our study showed that the picture is slightly different since apart from introductory concepts of informatics and computer applications on health, the curricula of health sciences departments also includes subjects that focus on technology, software and hardware. In the U.S., a similar survey in nursing postgraduate educational programs revealed that the greatest percentage of nursing programs rated faculty at the "advanced beginner level" in teaching nursing informatics applications [14], which approximates our results. In a previous chapter we mentioned more postgraduate educational programs in universities in Europe and throughout the world that according to their curricula seem to focus on advanced topics of health and medical informatics (postgraduate programs in England, postgraduate programs in Germany etc.). However, no national surveys in these countries defining the level of informatics knowledge and competences provided by these programs have been conducted recently.

The fact that in Greece, more than one academic institute may cooperate in offering a postgraduate program, may have played an important role in creating this situation, since, as the scientific background of the students varies, the provision of specialized knowledge becomes extremely difficult. Information literacy skills that students have acquired in secondary education may have also played a significant role. First-year students should already have acquired basic informatics knowledge in secondary education, so that TEI and University educational programs could expand this knowledge in more advanced IT subjects. Specific validating tools and strategies for this informatics knowledge should be formed not only for entering the undergraduate programs but also for the postgraduate ones.

Based on the above observations we could point out that despite the growing need for highly specialized professionals in health information technologies, the departments of health sciences of higher education institutes in Greece, mainly, prepare their students to be IT users rather than Health and Medical Informatics specialists. These two categories are defined into the IMIA's Recom-

mendations on Education in Health and Medical Informatics, regarding the level of informatics knowledge and practical skills acquired by health educational programs of higher education [7]. Few are the departments of health sciences of higher education in Greece that constitute an exception to this observation and provide advanced knowledge and skills in the field of health informatics. This outcome may have an impact on the smooth function of health care organizations, due to the lack of professionals specialized in information technologies and in modern information systems management. It also reveals the imperative need for undergraduate and postgraduate programs of health departments in Greece to adjust their curricula to the current educational requirements in order to provide their graduates with the necessary knowledge in health information technologies and train them on the development, implementation and evaluation of health IT systems according to the recommendations of IMIA [7]. We highlight that in order to obtain a well-documented and complete picture of the level of informatics knowledge provided by health educational programs of higher education in Greece we intend to perform a study, through which, we will thoroughly determine the compliance of these programs with the international educational recommendations proposed by IMIA [7]. This way, we will have acquired a detailed picture of the situation in Greece, as we will have made all the appropriate comparisons not only according to AMIA categorization but also according to IMIA recommendations.

In addition, as a future work, we also intend to conduct a survey in order to record the integration of information technology subjects in secondary education in Greece. Our purpose is to determine the level of information literacy that students have acquired before entering the TEI and Universities and thus to find out the reasons why health sciences departments of higher education in Greece keep providing the basic IT knowledge that should have been provided in secondary education.

To conclude, we report that the rapid development of ICT, as well as their implementations and influence in the health care sector, have imposed continuous specialized education and training of health professionals in information technology subjects, in both theoretical and practical issues [26]. These issues may cover subjects such as smart cards, telematics, telemedicine, medical image processing, health management information systems, security of health information systems etc. The basic aim of the institution authorities should be the constant adjustment and enrichment of the curriculum of health sciences departments, in order to create capable and skilful professionals that could fully utilize the advantages of new technologies, having as an ultimate goal the promotion of health care [27].

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