Dedicated Programs in Health and Medical Informatics
Approaches, Examples, and Graduates' Job Perspectives

Reinhold Haux,

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Technical University of Braunschweig
APAMI2006, Taipei, October 27st, 2006

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why giving a talk on education (and not on research) at APAMI2006?

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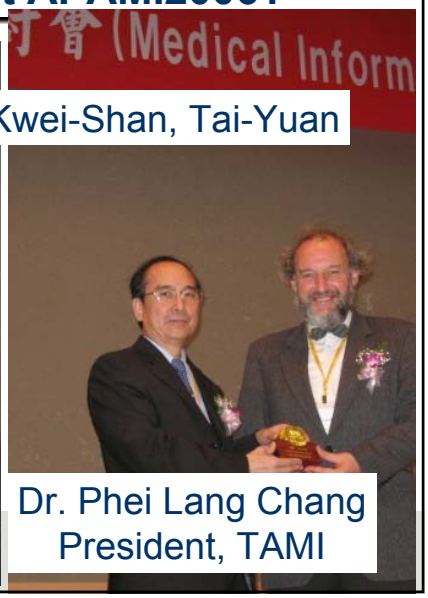
why giving a talk on education (and not on research) at APAMI2006?

Dr. Her-Kun Chang
Conference Chairman

MIST2005, Kwei-Shan, Tai-Yuan



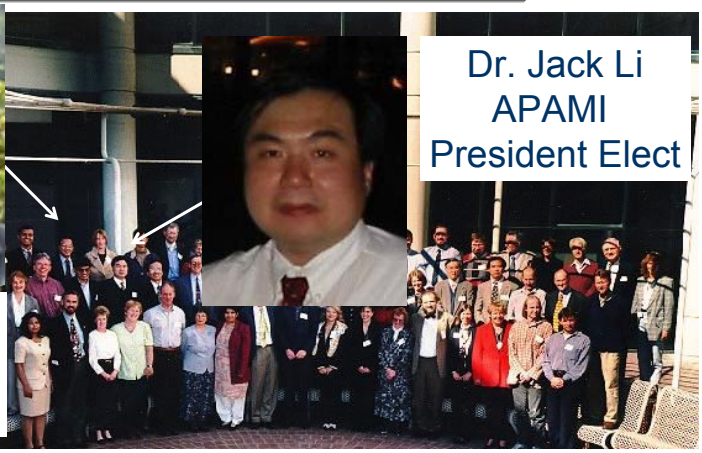
Dr. Phei Lang Chang
President, TAMI

why giving a talk on education (and not on research) at APAMI2006?

4th IMIA WC Education, after APAMI1997,
Newcastle, Australia

why giving a talk on education (and not on research) at APAMI2006?

Dr. KC Lun
IMIA Past President



Dr. Jack Li
APAMI
President Elect

4th IMIA WC Education, after APAMI1997, Newcastle, Australia

preliminary remarks

1. Progress in information processing and IT is changing our societies.
2. The amount of health and medical knowledge is increasing. We cannot hope to manage it without using new information processing methodology and IT.
3. There are significant economic benefits from the use of IT to support medicine and health care.
4. The quality of health care is enhanced by the systematic application of information processing and IT.

preliminary remarks

5 It is expected, that these developments will continue.

6 Health care professionals, who are well-educated in health informatics / medical informatics are needed to systematically process information in medicine and health care, and for the appropriate and responsible application of IT.

7 Through an increase in scope and the provision of high quality education in health informatics / medical informatics, well-educated health care professionals world-wide are expected to raise the quality and efficiency of health care.

aim of this talk

- to introduce approaches for specialized educational programs at universities, leading to a dedicated degree in health/medical informatics
- to give examples for specialized health/medical informatics programs
- to discuss health/medical informatics graduates' job perspectives

approaches

Methods of Information in Medicine
© F. K. Schattauer Verlagsgesellschaft mbH (2000)

International Medical Informatics Association, Working Group 1: Health and Medical Informatics Education

Recommendations of the International Medical Informatics Association (IMIA) on Education in Health and Medical Informatics

Abstract: The International Medical Informatics Association (IMIA) agreed on international recommendations in health informatics/medical informatics education. These should help to establish courses, course tracks or even complete programs in this field, to further develop existing educational activities in the various nations and to support international initiatives

Methods Inf Med 2000; 39: 267-77. www.IMIA.org
translated in Chinese, Czech, Italian, Spanish, Turkish, ...

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key principles: HEALTH

in order to provide good quality health care, health / medical informatics (HMI) education in HMI is needed:

H for various health care professions
E in different modes of education,
A with alternate types of specialisation in HMI
L at various levels of education, stages of career progression; there must be
T qualified teachers and
H recognised qualifications for HMI positions

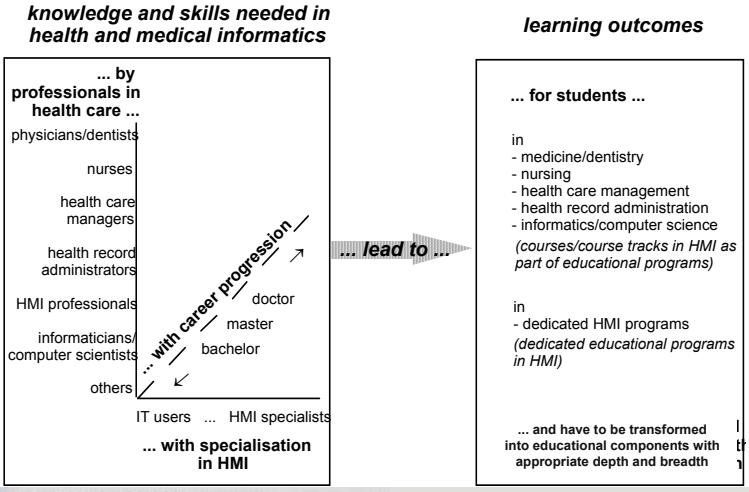
knowledge and skills needed in HMI

- by health care professionals
  physicians/dentists, nurses, HC managers, health records administrators, HMI professionals, informaticians/computer scientists
- with specialisation in HMI
  IT user ... HMI specialist
- with career progression
  ... bachelor, master, doctor, ...

lead to leaning outcomes for students in

- medicine/dentistry
  nursing
  health care management
  health record administration
  informatics/computer science
  courses/course tracks in HMI as
  part of educational programs
- ***dedicated*** HMI programs (degree in HMI)
- and have to be transformed into educational components with appropriate depth and breadth

structural outline



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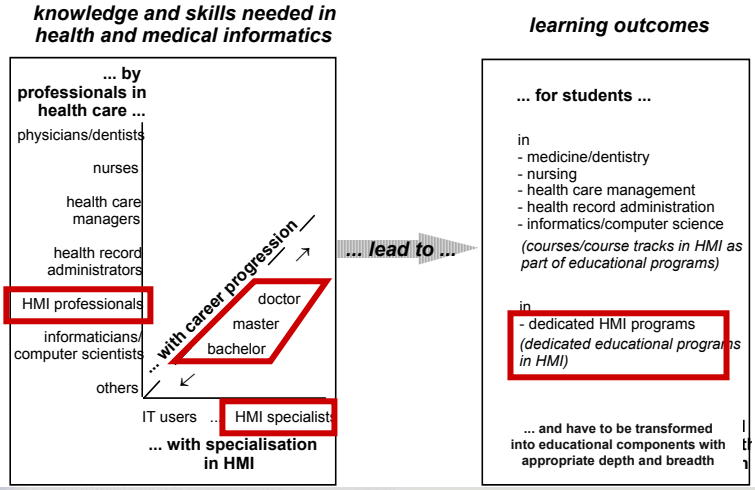
... for IT users

- aim: to efficiently and responsibly *use* information processing methodology and IT
- these need to be included in all undergraduate curricula, leading to a qualification for health care professionals

...for HMI specialists

- aim: preparing graduates for *HMI careers* in academic, health care (e.g. hospital) or industrial settings
- these need to be included in all curricula, leading to a qualification as specialist in HMI

structural outline



two approaches for HMI specialists

- *informatics-based approach* to HMI: To focus on the need for advanced knowledge and skills of health and medical informatics, of mathematics, as well as of theoretical, practical and technical informatics/computer science. Health care problems, however, can be treated cooperatively with physicians and other health care professionals.
- The objective of a *health care-based approach* to HMI is to focus, apart from knowledge in health and medical informatics, also on knowledge in medicine or of other health sciences to such an extent, which can only be imparted within the scope of a medical or health science education.

examples

examples for dedicated HMI programs

- these programs lead to a dedicated HMI degree in health informatics / (bio)medical informatics

two approaches for HMI specialists: mapping to curricula

- *informatics-based approach* to HMI:
  Bachelor (e.g. Victoria, Amsterdam, …)
  Master (e.g. Minnesota, Utah, Amsterdam, …)
  Ph.D. (most universities with HMI research)
- *health care-based approach* to HMI
  Master (e.g. Minnesota, Utah, …)
  Ph.D. / M.D. (most universities with HMI research)
- more programs e.g. at www.IMIA.org - IMIA's Institutional Academic Members (≥40) or at www.iPHIe.org

Bachelor programs (only informatics-based approach)

- Objective: to impart specialized knowledge in the field of HMI as well as skills in a practice-oriented application of the acquired knowledge. The intention is to provide a practice-related education to qualify for translating expertise gained in the field of HMI into practical activity.
- Graduates of this program are intended to have better professional opportunities in HMI than, e.g., informatics graduates at the B.Sc. level. On the other hand, they should also be able to compete with informatics graduates for informatics positions outside medicine and health care.
- Duration: ≥ 3 years, full-time

Master programs (both approaches)

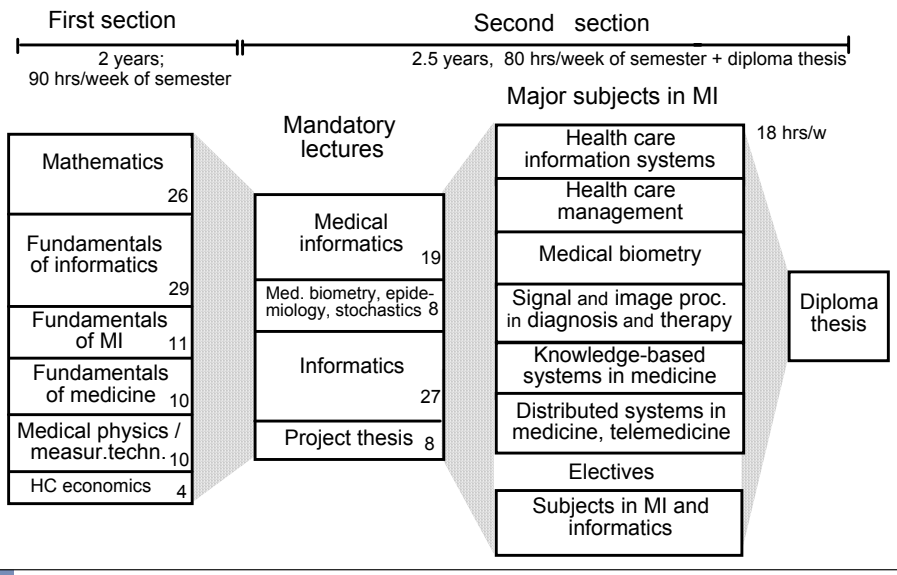
- Objective: to provide an education of scientific character that includes theory, specialized knowledge and practical skills. Graduates shall, apart from a practice-oriented application of methods and tools from medical informatics, be enabled to independently participate in research and in the methodical advancement within the field of HMI.
- Graduates of this program are intended to have better professional opportunities in medical informatics than, e.g., informatics graduates at the M.Sc. level or as physicians or other health care professionals without additional medical informatics education.
- Duration: ≥1 (2) year(s), mostly full-time

doctoral program (both approaches)

- usually research oriented, sometimes including courses
- independently and intensively participating in research and in the methodical advancement within the field of HMI
- duration: ≥2 (4) years, mostly full-time

Medical Informatics Heidelberg/Heilbronn

- University of Heidelberg / University of Applied Sciences Heilbronn, Germany
- since 1972
- informatics-based approach
- duration: 4.5 years as integrated Bachelor and Master program (optional: Ph.D)
- leading to a Diploma degree in Medical Informatics
- Int J Med Inform. 1998; 50: 31-42.
- www.uni-heidelberg.de and www.hs-heilbronn.de



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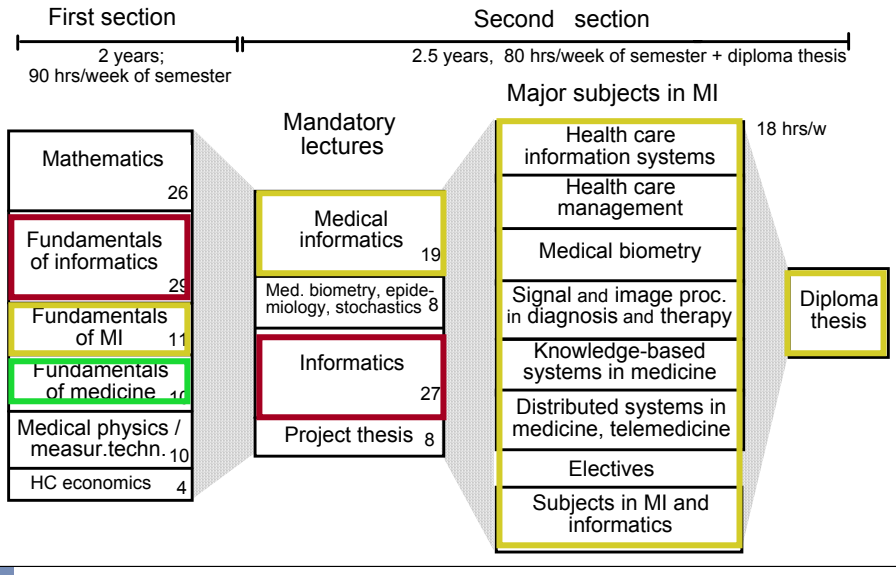

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Health Information Management Heidelberg/Heilbronn

- University of Heidelberg / University of Applied Sciences Heilbronn, Germany
- since 2000
- health care-based approach (primarily for physicians)
- duration: 15 months
- leading to a M.Sc. Degree in Medical Informatics (optional: Ph.D / M.D.)
- Int J Med Inform. 2002; 65: 31-9.
- www.uni-heidelberg.de and www.hs-heilbronn.de

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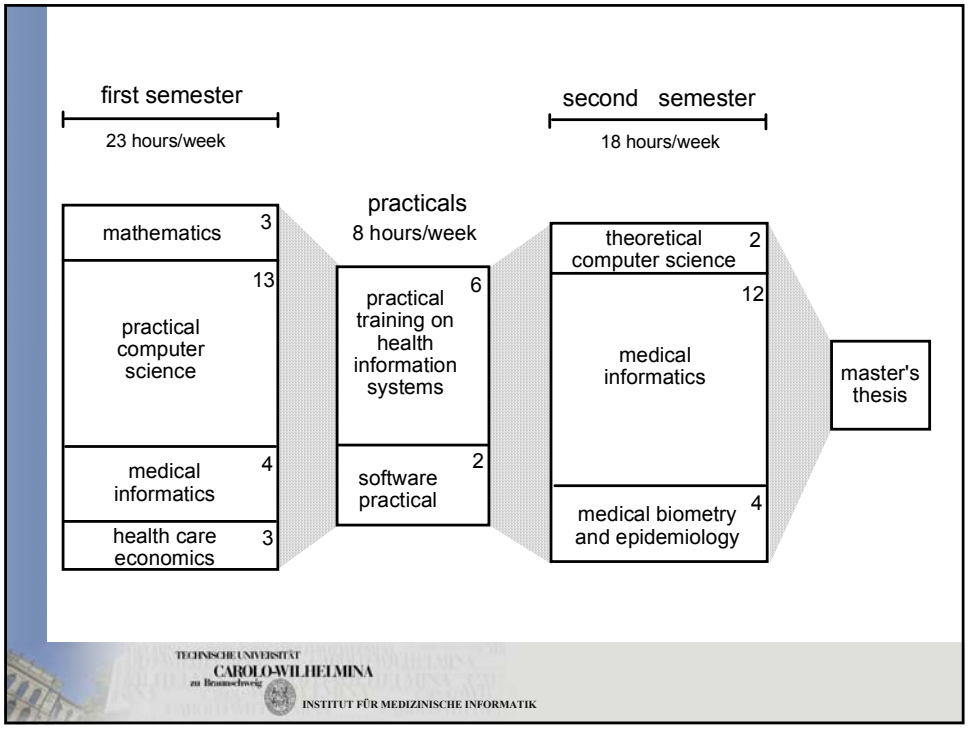
first semester
23 hours/week
second semester
18 hours/week
practicals
8 hours/week
mathematics 3
practical computer science 13
medical informatics 4
health care economics 3
practical training on health information systems 6
software practical 2
theoretical computer science 2
medical informatics 12
medical biometry and epidemiology 4
master's thesis
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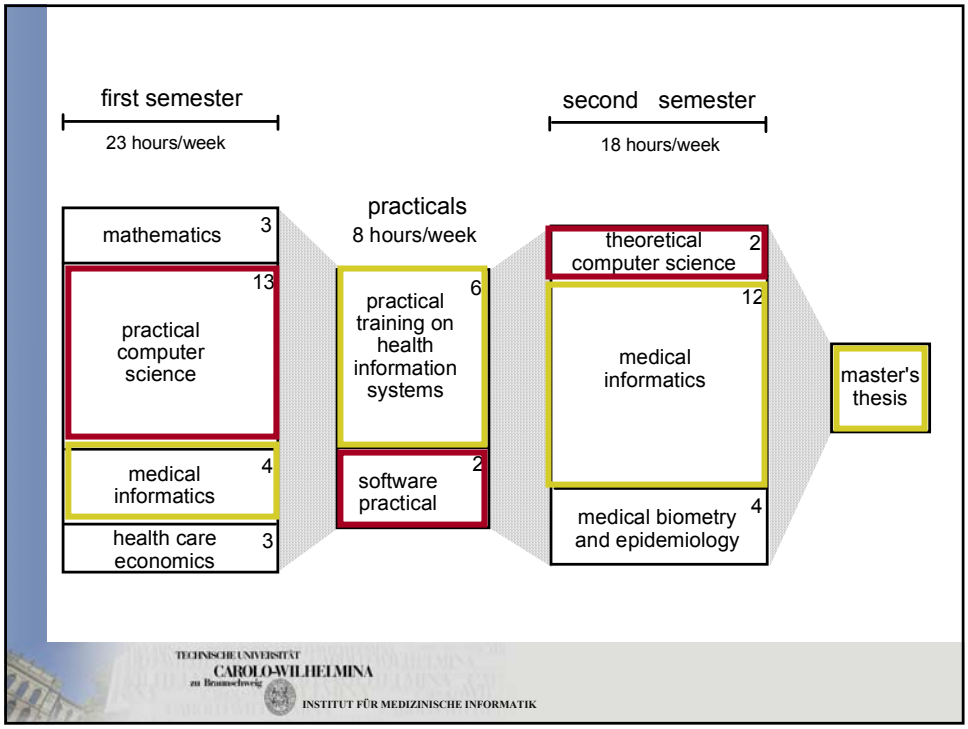
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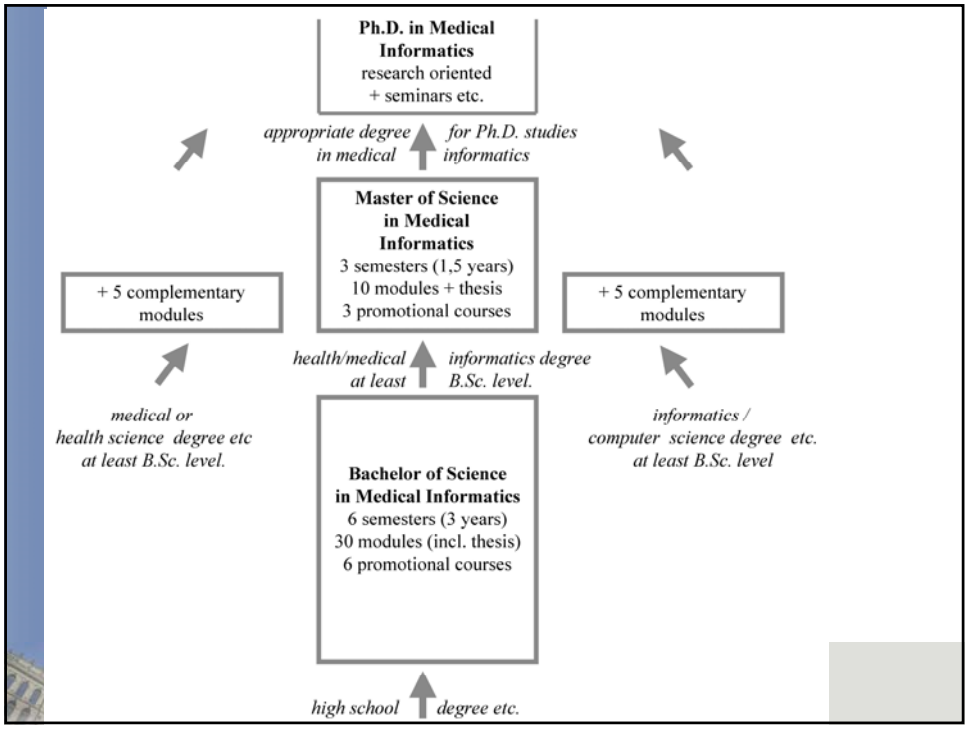
Heidelberg/Heilbronn medical informatics core modules

- for both programs in the last year(s)
  - health information systems
  - knowledge processing in medicine
  - medical documentation
  - biomedical signal and image processing
  - (medical biometry and epidemiology)

UMIT

- University of Health Sciences, Medical Informatics and Technology, Innsbruck/Hall, Tyrol, Austria
- since 2001
- programs offered will lead to
  - a Bachelor's,
  - a Master's, and
  - a Ph.D. Degree
- in Medical Informatics
  (since 2004: Biomedical Informatics)
- Int J Med Inform. 2004; 73: 124-38.
- www.umit.at



semester / weeks	module					promotional courses
1 1-6	anatomy, physiology, biochem. MH		programming I	algorithms and data structures 1 I	mathe-matics 1 QM	scientific working 1
7-12		health care systems MG				
13-14		health care institutions MG				
2 1-6	clinical medicine MH	medical documen-tation MI		algorithms and data struct. 2 I	mathe-matics 2 QM	project management 1
7-12			software-engineering I	seminar on informatics I		
13-14						
3 1-6	health care economics MH		technical informatics I	practical informatics I	mathe-matics 3 QM	information literacy
7-12		health information systems 1 MI				
13-14						
4 1-6	knowledge processing in medicine MI	med. signal & image proc. MI		information systems I	biostatistics QM	presentation und communication
7-12		seminar med. informatics MI	software project I		medical physics QM	
13-14						
5 1-6	elective medical informatics MI		software project I (cont.)	communication systems I	elective informatics I	project management 2
7-12		health information systems 2 MI				
13-14						
6 1-6	elective medical informatics MI	project in medical informatics, including bachelor thesis and presentation		elective informatics I	elective informatics I	scientific working 2
7-12						
13-14						

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semester / weeks	module					promotional courses
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7-12		health care institutions MG				
13-14						
2 1-6	clinical medicine MH	medical documen-tation MI		algorithms and data struct. 2 I	mathe-matics 2 QM	project management 1
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7-12		seminar med. informatics MI	software project I		medical physics QM	
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7-12		health information systems 2 MI				
13-14						
6 1-6	elective medical informatics MI	project in medical informatics, including bachelor thesis and presentation		elective informatics I	elective informatics I	scientific working 2
7-12						
13-14						

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UMIT - Master program biomedical informatics

- tracks
  - health information management (part time)
  - medical informatics (full time)
  - bioinformatics (full time)
- the core modules are
  - health information management
  - AI in medicine
  - clinical documentation
  - biomedical signal and image processing
  - bioinformatics

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Medical Informatics Braunschweig

- Technical University of Braunschweig, Germany
- since 1970‘s minor and later specialization in medical informatics as part of computer science program
- since 2005, with the change to bachelor and master programs, dual degree in computer science and medical informatics on the
  - bachelor level (3 years, dual degree if 50 out of 180 ECTS credits are from medical informatics courses)
  - master level (2 years, dual degree if 50 out of 120 ECTS credits a from medical informatics courses)
- informatics-based approach
- optional: Ph.D
- www.mi.tu-bs.de

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TU Braunschweig - bachelor (medical) informatics

area	semester 1	semester 2	semester 3	semester 4	semester 5	semester 6	
informatics	programming 10 credits (4+6) techn. informatics I 4 credits theo. informatics 4 credits a & d 8 credits	techn. informatics II 4 credits theo. informatics 5 credits	SW engineering 10 credits (4+6) HW-/SW-Systeme 4 credits operating systems 4 credits Datenbanksysteme 4 credits informatics modules to the extent of 36 credits (e.g. 4+12+12+8)	computer networks 4 credits	team project 6 credits seminar 4 credits	Bachelo thesis 15 credits	122
mathematics	analysis I 4 credits linear algebra I 4 credits discr. mathematics 4 credits	analysis II 4 credits lineare algebra II 4 credits logic 4 credits	math. I 4 credits	mathe II 4 credits			32
minor			minor 16 credits (z.B. 4+4+4+4)				16
key qualific.		key qualific. 5 credits			key qualific. 5 credits		10
ECTS credits	32	32	28	30	31	27	180

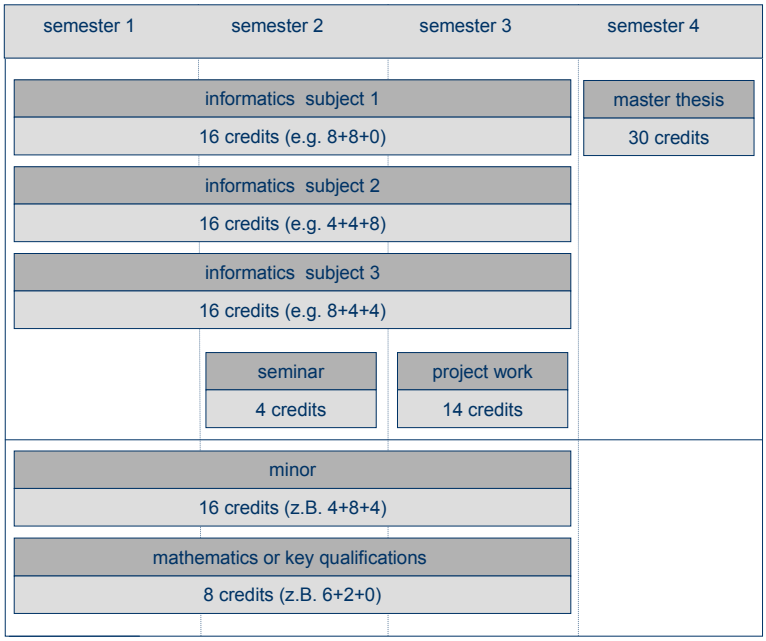
TU Braunschweig - bachelor (medical) informatics

area	semester 1	semester 2	semester 3	semester 4	semester 5	semester 6	
informatics	programming 10 credits (4+6) techn. informatics I 4 credits theo. informatics 4 credits a & d 8 credits	techn. informatics II 4 credits theo. informatics 5 credits	SW engineering 10 credits (4+6) HW-/SW-Systeme 4 credits operating systems 4 credits Datenbanksysteme 4 credits	computer networks 4 credits	team project 6 credits seminar 4 credits	Bachelo thesis 15 credits	122
			medical informatics 16 credits modules to the extent of 36 credits (e.g. 4+12+12+8)				
mathematics	analysis I 4 credits linear algebra I 4 credits discr. mathematics 4 credits	analysis II 4 credits lineare algebra II 4 credits logic 4 credits	math. I 4 credits	mathe II 4 credits			32
minor			minor 16 credits (z.B. 4+4+4+4)				16
key qualific.		key qualific. 5 credits			key qualific. 5 credits		10
ECTS credits	32	32	28	30	31	27	180

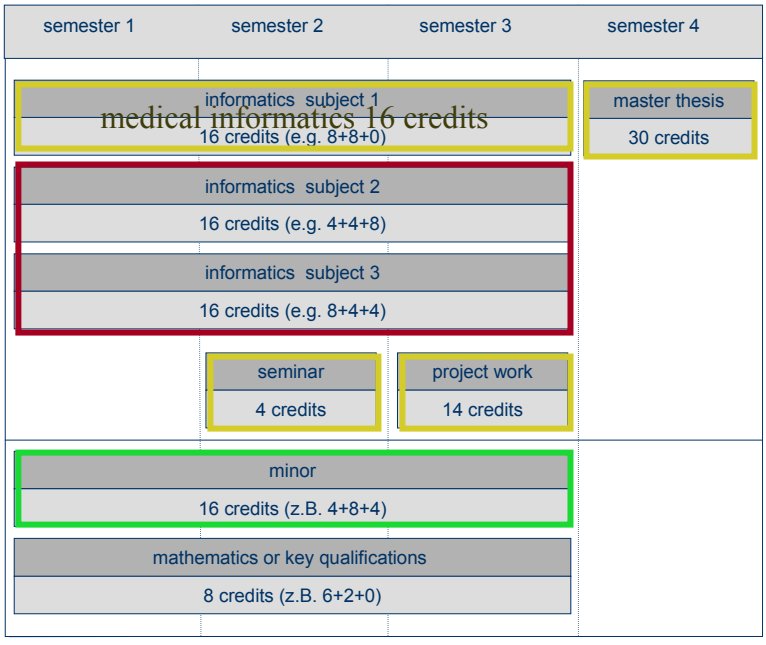
TU Braunschweig - Bachelor program

- medical informatics modules (4 ECTS each)
  - introduction to medical informatics
  - health information systems (tactical information management + project)
  - introduction to medical documentation and knowledge representation
  - biomedical signal and image processing
- modules in minor medicine (4 ECTS each)
  - medicine 1 (morphological, functional and mental foundations of the healthy human)
  - medicine 2 (morphological, functional and mental foundations of the diseased human)
  - health care systems - an international comparison
  - selected topics in medicine

TU Braunschweig - master (medical) informatics



TU Braunschweig - master (medical) informatics



medical informatics 16 credits

TU Braunschweig - Master program

- medical informatics tracks (4 ECTS per module)
  - health information systems track (modules: strategic information management, Frank van Swieten lectures, medical documentation, knowledge representation and study design …)
  - health enabling technologies track (health enabling technologies A, B, …)
  - selected topics in medical informatics
- modules in minor medicine (4 ECTS each)
  - selected topics in medical methodology I, II
  - selected topics in clinical medicine, I, II

graduates‘ job perspectives

578

Medical Informatics Specialists: What Are their Job Profiles?

Results of a Study on the First 1024 Medical Informatics Graduates of the Universities of Heidelberg and Heilbronn

P Knaup et al. Methods Inf Med 2003; 42: 578-87.

Study Design

- Study among Heidelberg/Heilbronn Medical Informatics graduates - aims:
  - to get an updated overview of the job situation and
  - to get their evaluation on the curriculum
- Method:
  - Observational study among the entirety of our graduates which had finished their studies before March 31, 2001 (1024 graduates).
  - In July 2001 standardized questionnaires were sent. An additional questionnaire was sent as reminder to all graduates that did not answer until September 20, 2001. A second reminder was sent to all graduates that did not answer till October 24.

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Questions

- In which kinds of institutions are the graduates employed?
- In which fields are the graduates working?
- How many graduates received a Ph.D.?
- What is their professional position?
- What are typical career profiles?
- How do graduates assess their education?
- How do graduates judge their job situation?
- ...

Results

- questionnaires sent: 1024
- received by: 981
- responses: 446

- response rate: 43,6%
- compliance: 45,5%

In which kinds of institutions are graduates employed? (n=441)

– hard-/software enterprise	32,7%
– other enterprise (industry)	19,3%
– university hospitals	12,9%
– self-employed	5,7%
– other hospitals (not university)	5,2%
– pharmaceutical enterprise	5,0%
– other public services	4,3%
– other institution of a university	3,9%
– other research institution	2,5%
– other institutions	2,0%
– unemployed	0,7%
– not working due to other reasons	5,9%

In which fields are the graduates working? (n=446)

– within medical informatics:	178 (42,9%)
– outside MI, but in informatics:	213 (51,3%)
– in other fields:	24 (5,8%)
– no answer	31 (17,4%)

Within MI graduates (n=178) are working in the branches (≥10% of working hours, multiple choice, % of cases):

– information systems in HC	108	(59,6%)
– *with focus hospital*	*102*	*(56,0%)*
– *with focus GPs*	*8*	*(4,4%)*
– *withfocus public health*	*8*	*(4,4%)*
– *with other focus*	*17*	*(9,3%)*
– medical documentation	65	(35,7%)
– quality management	39	(21,4%)
– medical imaging	30	(16,5%)
– multimedia, Internet	24	(13,2%)
– telematics	10	(5,5%)
– bioinformatics	10	(5,5%)
– biosignal processing	8	(4,4%)
– knowledge based methods	8	(4,4%)
– other branches of MI	30	(16,5%)

Within MI graduates (n=178) regard their jobs focussed on (multiple choice, % are of cases):

– health/patient care	135	(74,2%)
– research	77	(42,3%)
– education	30	(16,5%)
– other	24	(13,2%)

Within informatics graduates (n=213) work in the branches (≥10% of working hours, multiple choice, % of cases):

– software engineering	143	(60,9%)
– databases, information systems	141	(60,0%)
– telematics, distributed systems	56	(23,8%)
– informatics in economy	56	(23,8%)
– multimedia, Internet	37	(15,7%)
– informatics in technology	33	(14,0%)
– fundamendals of informatics	26	(11,1%)
– technical informatics	13	(5,5%)
– signal-, image-processing	12	(5,1%)
– informatics in law & public service	10	(4,3%)
– knowledge based systems	6	(2,6%)
– other fields	35	(14,9%)

–How many graduates received a Ph.D.? (n=446)

- 108 graduates (24,2%)
  - received (67, 15,0%) or
  - are striving (41, 9,2%)
- for a doctor's degree.
- More than the half of them is or is going to be confered by the University of Heidelberg (58).

Professional positions of the graduates? (n=446)

- The mostly mentioned answers on positions are
  - researcher, scientific assistent 38
  - software-developer 35
  - consultant 23
  - project manager 16
  - software engineer 12
  - manager 9
- Number of subordinated staff members:
  - none 282 (63,2%)
  - 1 to 5 80 (17,9%)
  - 6 to 10 26 (5,8%)
  - more than 10 33 (7,4%)
  - missing answers 25 (5,6%)

Income of the graduates? (n=446)

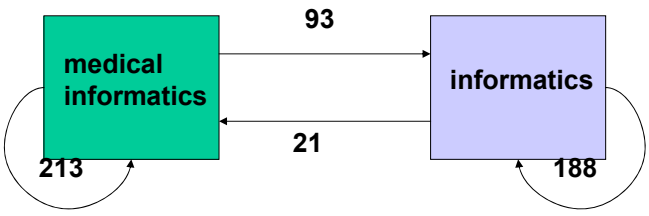
- The gross annual income of the graduates is
  - below 5.000 Euro 10 (2,4%)
  - 5.500 to 25.000 Euro 35 (8,4%)
  - 25.500 to 50.000 Euro 140 (33,7%)
  - 50.500 to 75.000 Euro 151 (36,4%)
  - 75.500 to 100.000 Euro 50 (12,0%)
  - more than 100.000 Euro 29 (7,0%)

What are typical career profiles? (n=446)

- When the graduates began working after the exam they start in the field of
  - medical informatics 255 (66,0%)
  - informatics 123 (31,9%)
  - neither medical informatics nor informatics 8 (2,1%)
- After the third change of position the graduates hardly change the field.

What are typical career profiles? (n=446)

- immigration to (medical) informatics (555 changes in position)



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How do the graduates assess their education? (n=446)

- Regarding their job situation graduates assess the medical informatics programme as
  - very satisfactory 108 (24,2%)
  - just satisfactory 246 (55,2%)
  - less satisfactory 40 (9,0%)
  - not satisfactory 5 (1,1%)

How do the graduates judge their job situation? (n=446)

	so far	in future
very satisfactory	192 (43,0%)	140 (31,4%)
just satisfactory	179 (40,1%)	169 (37,9%)
less satisfactory	34 (7,6%)	46 (10,3%)
not satisfactory	5 (1,1%)	7 (1,6%)
no indication	30 (6,7%)	71 (15,9%)
missing	6 (1,3%)	13 (2,9%)

Other results (n=446)

– female graduates	168	(37,7%)
– male graduates	272	(61,0%)
– no answer	6	(1,3%)

final remarks

TECHNISCHE UNIVERSITÄT
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achievements

- first dedicated programs started in the late 1960ies, early 1970ies
- today more than 40 academic members in IMIA („tip of the iceberg“)
- approved int. recommendations on health/medical informatics education (www.imia.org)
- there exist several approaches for educating HMI specialists

achievements international education, e.g.

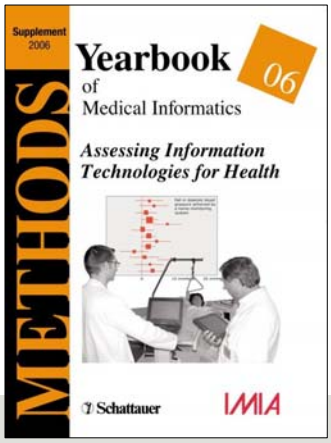
Frank-van Swieten Lectures on strategic information management in hospitals (Methods 2005, IJMI 2004)

lessons learned

- in contrast to other fields there is no 1/3 health / 1/3 health informatics / 1/3 informatics approach for dedicated HMI curricula
- there are however either informatics-based or health care-based approaches
- 2 years at minimum is recommended for a program leading to a health/medical informatics degree
- part-time is necessary, but full-time should be preferred
- the need for HMI specialists is still obvious, but graduates should have the opportunity to also find a job outside HMI
- the number of dedication programs is steadily (but slowly?) increasing world-wide

further information

- www.imia.org
  - WG1 on education
  - IMIA Yearbooks of Medical Informatics



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from the first chairman of IMIA's WG on Education

from the first chairman of IMIA's WG on Education

"Any technology sets a relationship between human beings and their environment, both physical and human. No technology can be seen as merely instrumental. …"

(JM Fessler, F Grémy, Methods Inf Med 2001; 40: 359-61)

Prof. Francois Grémy, recipient of the 2004 IMIA Medical Informatics Award of Excellence

Hardware, Software, Peopleware, Subjectivity*

A Philosophical Promenade

(F Grémy, Methods Inf Med 2005; 44: 352-58)

Francois Grémy
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