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An international course on strategic information management for medical informatics students: international perspectives and evaluation

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Summary All over the world, countries more and more take part in the international society and economy. To meet the stringent requirements of this globalization asks for internationally oriented and well-educated graduates. A major challenge of academia thus lies in qualifying graduates for international positions in this new world. A crucial element in the training and education of tomorrow's medical informatics specialists is exposure to health care systems across national borders. In this contribution, we report on the international aspects of and experiences with an inter-university course for medical informatics students on hospital information systems, in particular on their strategic information management. From 2001 onwards, this course was offered jointly for students of the University of Amsterdam, the University of Heidelberg/University of Applied Sciences Heilbronn and the University of Health Informatics and Technology, Tyrol (UMIT). Based on our experiences, future establishment of international courses in the medical and health informatics field is recommended.

1. Introduction

All over the world, countries more and more take part in the international society and economy. New generations of graduates will experience the consequences of this; both in positive as in negative

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sense. To meet the stringent requirements of this globalization requires international-oriented and well-educated graduates. A major challenge of academia thus lies in qualifying graduates for international positions in this new world [1].

Modern information and communication technology (ICT) strongly influences our societies and health care. Consequently, ICT offers tremendous opportunities to improve the efficacy and efficiency of health care [2]. The rapid developments of ICT in health care even more highlight the importance of international approaches of educational activities as these may contribute in keeping up with new knowledge and trends occurring in this field across the world. In the medical informatics field, a variety of full-fledged educational programs to train the next generation of professionals are founded [3—6], of which some recently [7].

Moreover, universities have co-operated in joined projects to promote multidisciplinary and international approaches in their educational programs, see for example [8]. Yet, in these programs student learning for the most takes place within one educational institution. Learning needs of course no longer take place physically within a university. Today, university walls, whether internal or external, are no longer relevant to students' educational needs. The next generations will be more likely to travel abroad for employment than is common today. One of the main purposes of higher education is to provide the labor market with high level competencies and expertise necessary for the growth and prosperity of modern societies and to enhance students' marketability and employability by preparing them for international positions in their field. International experience of students across universities is now widely regarded as an essential and integral part of a student's learning process.

As it seems today, most universities strive for an international educational component as structural part of their M.Sc. programs. Three European universities, the University of Amsterdam, the University of Heidelberg/University of Applied Sciences-Heilbronn, the University for Health Informatics and Technology Tyrol, all offering medical informatics courses at B.Sc. and M.Sc. level [3,6,7] likewise felt that internationalization of their education should no longer be a byproduct of an external funding policy, but should constitute an integral part of their higher education activities.

A crucial element in the training and education of tomorrow's medical informatics specialists is exposure to health care systems across national borders. Governments, health authorities and academia in many countries have recognized the urgent need for highly educated professionals in information management and the need for international generic courses in this context [9,10]. More specifically, strategic information management of health care information systems is considered a precondition for high quality information processing [2]. Strategic information management deals with the enterprise's information processing as a whole and lays down strategies and principles for the evolution of the whole information system [11]. The operation and management of hospitals typically rely on highly intensive information processes. Historically, hospital information systems have contributed to support this processing. In this context, hospital information system architectures have evolved from the more traditional monolithic approaches towards interfaced approaches to effectively support medical and nursing processes too [12—14]. The basic idea is to use advanced technology to integrate heterogeneous system components and to add to these functionalities by building generic system components. Overall, medical informatics specialists envision the development of a multimedia electronic medical patient record within the hospital to be extended to other health care providers [15,16].

Despite their great potential and usefulness, the development, implementation and operation of hospital information systems is quite complex and asks for considerable organizational involvement and institutional resources [13—15]. The potential of hospital information systems to evolve and to be effectively adapted to changing needs becomes more and more important. As it seems, new methods and tools are required for quick and robust adaptation of hospital information systems to health care processes and the ever-changing requirements. Strategic IT planning in hospitals is therefore one of the main concerns to address the information processing problems of hospitals [16,17].

As we raise the next generation of medical informatics specialists who have to deal with these problems, students in M.Sc. programs, besides other know how [18], would benefit from knowledge of the diverse ways European hospitals accomplish to manage their hospital information systems in order 'to appropriately and responsibly apply ICT to the complex information processing environment of hospitals' [11].

To contribute to these goals, we elaborated a course on hospital information systems originally developed and offered at the University of Heidelberg/University of Applied Sciences Heilbronn, into an international course within the International Partnership of Health Informatics Education (IΦE, http://www.iphie.org, [19]). In this contribution,

we report on the main aims of the international part of the course as well as on students' evaluations of the international course, organized in 2002 in Amsterdam and in 2003 in Innsbruck. We will show how the set-up of this international course encourages students to progress and share knowledge in an international environment and that students feel that this sharing of experiences as regards hospital information systems, and more specific the strategic information management of these systems in different European hospitals adds more to their training than in a normal lecture series at their home university.

2. The course and its international perspectives

Until recently, medical informatics students of the respective universities who were eager to explore the boundaries of their knowledge and pursued study in an international surrounding had limited possibilities to attend courses within a medical informatics program of another university. These students had a long way to go in fulfilling all formal university regulations and in seeking financial support to realize their ideas.

Consequently, international experience as part of their university education was reserved for small groups of students. We do, however, believe that international education should be integrated in our medical informatics university programs and as such we strive after international experience of all our students during their university education. Realizing this mere fact meant that in organizing our international classroom course we strived for a set-up with a focus on health care system information processing issues of which international exchange of knowledge and ideas would add to students' education at the home university to the maximum.

To offer all our students an international element as part of their medical informatics training, the European partners within IΦE decided to set-up this inter-university course as an integral part in their medical informatics programs. As such, all our students at the level of one year before graduating to a M.Sc. in medical informatics in one of the three university programs have to attend this course.

The course is organized into two main parts (see Fig. 1): while the first part of the inter-university course is offered locally, the international part of the course is organized in turn at one of the three European partners. The first-local-part consists of a theoretical introduction on hospital information systems and in particular their information

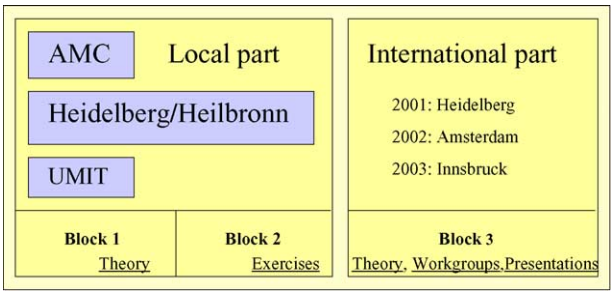

Fig. 1. Schematic overview of the set-up of the course.

management. This part introduces students to the enterprise functions of a hospital, the concern of systematic information management in hospitals and to (architectures of) hospital information systems. Moreover, this theoretical introduction covers strategic, tactical and operational information management, organizational structures for information management and strategic planning, monitoring and directing of hospital information systems.

After this theoretical lecture series, each student attends demonstrations of typical areas of information processing organized locally in each of the three hospitals, such as a ward, an outpatient unit, a medical record department, a service unit, or a patient admission unit. Subsequently, at each hospital site student groups are assigned to one of these departments or units in order to introduce them to the information processing structures at the workplace. To assure that in the inter-university part of the course student groups will be able to compare these information structures and the problems encountered in this context between the three hospitals, coverage of similar areas of the three academic hospitals is taken care of. In elaborating the exercises, student groups tackle the problems described in Table 1.

In producing their results, the students search and review literature, organize interviews or observational sessions with staff members and develop a business process model and a three layer graph meta model (3LGM model). This meta model can be used to model hospital information systems. It distinguishes three layers of information systems: the domain layer, the logical tool layer and the physical tool layer. The domain layer describes a hospital information system independent of its implementation as a set of enterprise functions. At the logical layer the application components (computerized and conventional) are described. Finally, the physical layer describes the physical data processing components. Between the different layers a variety of inter-layer relationships are described [11].

Table 1 Description of the exercise problems students had to tackle during their internship at a university department or unit

1.	Analyze and describe the information processing in the area you are assigned to:
	Which enterprise functions are essential in that area?
	What kind (computer-based and conventional) information processing systems are used?
	Which physical information and communication tools are used?
	Formalize the above results in a 3 LGM model.
	Formalize the business processing by using a Business Process Model technique.
2.	Analyze and describe the problems encountered by staff workers concerning the information processing:
	Describe at least three main problems of information processing.
	Think of and describe potential solutions for the problem, by making use of modeling techniques.
3.	Analyze and describe the similarities and differences of information processing at the department of the academic hospital in Amsterdam, Heidelberg and Innsbruck:
	Describe the similarities in information processing and information system support functions of sites.
	Describe the differences in information processing and information system support functions of sites.
	Prepare a mutual oral presentation on this subject matter.

If students experience difficulty in solving the problems, they may consult an expert of the department or unit they were assigned to or a medical informatics expert if required.

After this, in the second-international-part, students of each of the three participating programs meet during 3 days to work in international groups to jointly finalize exercises. In elaborating these exercises in different clinical settings, students learn to identify different solutions concerning architecture and infrastructure of the information systems to related or identical problems. The aim of these exercises is to have students understand the complexity of information management in hospitals and acknowledge the need of an appropriate theoretical background. Based on these exercises, students prepare presentations on their work in international student groups, of which the results are presented during a one-day seminar. A full description of the contents of the course is given in [20].

The main aims of the international part of the course were: (1) to offer students international experience as part of their training by mobility, (2) to introduce students the ways in which information management in diverse academic hospitals in three different European countries is dealt with, (3) to share the knowledge of experts in the field of hospital information systems their information management with an international audience, (4) to renew the educational training of students by introducing new learning materials and exercises, and (5) to offer students the opportunity to become more self-regulating, active learners with help of innovative instruction methods.

The instruction methods and exercises used focus on an active learning style of students and critical appraisal of the pros and cons of, and the manners in which problems encountered in information management at the respective hospital enterprises are or could be dealt with.

3. Evaluation of the international course part

To verify whether we succeeded in fulfilling the aims we set ourselves in developing the international classroom course, we conducted a systematic evaluation of the international part of the course, both in 2002 and 2003. A structured questionnaire with both open-ended and closed questions was developed and tested in a pre-test with three students. In 2002, a total of 30 students, and in 2003 a total of 59 students at M.Sc. level of the three different university programs on medical informatics participated in this course. The questionnaire both contained multi-choice questions and open questions and covered structure, contents, and organization of the course. Of all 30 students participating in the 2002 course, 28 returned the questionnaire. In 2003, 52 students out of 59 returned the questionnaire. Non response was due to students leaving the course somewhat earlier for logistic reasons. For the multi-choice part of the questionnaire, a rating scale of one to five was used with the following meaning: (1) totally disagree, (2) partly disagree, (3) agree/disagree, (4) partly agree, (5) totally agree.

3.1. Results of quantitative analysis

Part A of the evaluation was concerned with students' opinions with regard to the structure, contents and organization, beneficial outcomes and surplus-value of the international course as

Table 2 Students' personal opinions on the structure, contents, organization and value of the international course

Question	2002 Mean (S.D.)	2003 Mean (S.D.)
Sufficiently informed about structure and content of international part of module	4.11 (1.07)	3.63 (1.15)
Sufficiently informed about organizational issues	4.29 (0.69)	3.71 (1.34)
The first part of the lectures prepared me for the international exercises and presentations	4.07 (1.00)	3.59 (1.00)
Obtained sufficient feedback on the quality of the content of my exercises	3.75 (1.00)	3.30 (1.09)
Would have used a web-based communication tool to prepare exercises with other students	3.95 (1.17)	—

compared to a standard lecture and exercise series (see Table 2).

Students indicated that they were sufficiently informed about the structure and content of the course (M = 4.11 and M = 3.63, respectively) and about organizational issues (M = 4.29 and M = 3.71, respectively). They felt well prepared by the first part of the course (offered at their home university) for the second lecture series on information management in hospitals and the international group work and exercises (M = 4.07 and M = 3.59, respectively) and that they obtained sufficient feedback on the quality of their exercise elaborations (M = 3.75 and M =3.30, respectively). Finally, the students in the 2002 course indicated that they would have used a web-based tool to prepare their exercises with the other international students (M = 3.95).

Part B of the questionnaire was concerned with their personal assessment of the international classroom course: the study burden of the course, the beneficial effect of the course as it came down to improving their professional knowledge and skills and English fluency, the surplus-value of the course with regard to the international exchange of knowledge and ideas on information management in hospitals, and the surplus-value of international group work (see Table 3).

Overall, students indicated that they learned more from having the second part of the course together with other nationalities compared to a similar lecture at home (M = 4.26 and M = 3.62, respectively), and rated the international group exercises as useful and interesting (M = 4.32 and M = 3.86, respectively). Our students benefited in exchanging their ideas as regards the exercises and presenting their work with other nationalities (M = 4.56 and M = 4.23, respectively), as well as from the international group discussions (M = 4.37 and M = 3.56, respectively). Students also stated that they made efficient use of their time in the joint discussion groups (M = 4.20 and M = 4.04, respectively), and that they improved their presentation skills (M = 4.32 and M = 3.67, respectively). Students indicated to have learned more about other hospital information systems and their management than in a normal lecture and exercise series at their home university (M = 4.15 and M = 3.81, respectively). They benefited from the exchange with other international students with regard to professional knowledge and skills (M = 4.33 and M = 3.83, respectively), highly enjoyed the exchange of ideas

Table 3 Students' personal assessment of the beneficial effect of the international course

Question	2002 Mean (S.D.)	2003 Mean (S.D.)
Learned more from joint HIS lectures in international context	4.26 (0.86)	3.62 (1.25)
International exercises interesting and useful	4.32 (0.98)	3.86 (1.00)
Benefited from exchanging ideas internationally	4.56 (0.64)	4.23 (0.90)
Benefited from international discussion/pres.	4.37 (0.63)	3.56 (1.30)
Made efficient use of time	4.20 (0.70)	4.04 (1.32)
Improved my presentation skills	4.32 (048)	3.67 (1.12)
Learned more about other HIS than normal lecture series at home university	4.15 (0.72)	3.81 (1.16)
Benefited as regards professional knowledge and skills	4.33 (0.73)	3.83 (1.00)
Enjoyed international exchange of ideas on hospital information management	4.42 (0.76)	3.88 (0.91)
More active in learning in international course than in normal lecture series	4.36 (0.60)	4.48 (0.78)
Improved my self-confidence as a result of international course part	4.39 (0.56)	4.58 (0.72)
Better insight into other health care systems	4.04 (0.76)	4.20 (0.70)

Table 4 Students' personal assessment of the overall beneficial effect of the international course

Question	2002 Mean (S.D.)	2003 Mean (S.D.)
Benefited overall	4.67 (0.48)	3.87 (0.97)
Recommend participation to other students	4.79 (0.42)	4.37 (0.94)

on hospital information management with other international students (M = 4.42 and M = 3.88, respectively). Students felt that they had been more active in their learning (M = 4.36 and M = 4.48, respectively) and improved their self-confidence as a result of the international course part (M = 4.39 and M = 4.58, respectively). Finally, they improved their insight into the various health care systems of the three nations (M = 4.04 and M = 4.20, respectively).

Part C of the inquiry was concerned with the overall assessment of the international course.

Students thought that they really benefited from the international exchange as compared to a purely national lecture and exercise series (M = 4.67 and M = 3.87, respectively). They would definitely recommend other students to participate in this international classroom course (M = 4.79 and M = 4.37, respectively) (Table 4).

3.2. Results of qualitative analysis

Part D was concerned with any additional comments that the students wanted to convey. The three questions asked were:

- What did you like best in the course?
- What did you like the least in the course?
- What is the most important thing you learned in the course?

Those free-text comments were analyzed using qualitative content analysis. A total of 358 student comments were analyzed.

Students liked best working in international groups and taking more responsibility for their own learning, and least the rather full and dense time schedule of the course.

They learned the most of the various ways in which hospitals strategically and systematically manage their hospital information system in the three European countries, to critically appraise the pros and cons of the diverse solutions and of how problems in this context could be handled.

The most striking comments of students in this context were:

'I learned how different hospital enterprises systematically manage their hospital information systems and how important it is to learn from other countries how they solved problems so that similar mistakes are not made in future'. 'I benefited most of the discussion sessions with other students and teachers. How important hospital information systems are in support of hospital enterprise functions. But even more from how European hospitals differ in the way they systematically manage their hospital information system and approach problems in this context'.

'The presentations and discussions on the different hospital information system architectures and the pros and cons of these architectures were highly illustrative in learning more about hospital information management'.

3.3. Use of the virtual learning environment in the 2003 course

Since students in the 2002 course indicated that they would have used a web-based communication tool if it had been available, we implemented a virtual learning environment, Blackboard, in the course of 2003. This learning environment has been introduced at the University of Amsterdam in 2001, and proved very successful as communication platform between students and faculty and students mutually.

With the introduction of Blackboard in the international course, we hoped to stimulate the dissemination of knowledge and experiences and discussion among students of different nationalities even before the international part of the classroom course would have started. Hence we thought that Blackboard could prove an economic means for distributing knowledge between students on a longer time scale than the inter-university part of the course allows. The Blackboard environment and all course materials were available to the students a month in advance of the course: course schedule, lecture series, reading assignments and student exercise materials. All students received written instructions on the set-up and use of Blackboard. Technical support was provided by the ICT Education team of the AMC that logged all transactions on Blackboard. A number of observations was made about the use of Blackboard during the course (see Fig. 2).

The total number of student accesses of Blackboard during the course was 29.737. A total of 9.219 of these transactions (31% of the total accesses in 'Course contents') were attributable to students reviewing information with regard to course information, such as course schedule, course lecture or exercise materials. In general, students less frequently made use of the 'Communication All' area

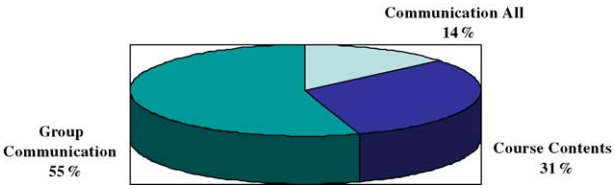

Fig. 2. Percentages of accesses per Blackboard area.

that Blackboard offers (4.163 Blackboard accesses: 14% of the total accesses). These were the areas in which general course announcements were provided for the total group of students. However, students frequently used the 'Group Communication' area (16.355 Blackboard accesses: 55% of the total accesses). They used this 'Group Communication' area to exchange their exercises results and to discuss their results among their (international) student group to prepare the international part of the course.

4. Discussion and conclusions

The evaluation results of our international classroom course surpass the expectations we had at the start of its development. Our course seems to meet all the objectives we set ourselves. One of our major aims was to train and educate medical informatics students on an international level with respect to the manner in which information management in different European hospital enterprises is realized. The results show that our course fulfilled this objective. In general, students stated that they learned more from the international exchange of ideas in group discussions and presentations with other nationalities compared to a standard lecture and exercise-series at their home university.

Another major challenge was to see whether we could help students to become more internationally orientated and to become more self-directed, active learners with the help of innovative instruction methods and exercises. The evaluation results show that our students improved their discussion and presentation skills and self-confidence as a result of the set-up of the course. They benefited from the internship at their home hospital and more particular from sharing and discussing their practical experiences during the group work in the international part of the course. Besides, they indicated to have been far more active and felt more responsible for their own learning than in a regular course. This international classroom course is unique insofar it (1) integrates theory on the information management in hospitals and practice by virtue of a hospital internship focused on information processing issues and its modeling at each local hospital site and (2) incorporates innovative instruction methods to stimulate an international exchange of ideas of how hospitals (could) manage and operate their hospital information system.

We hoped to foster an in-depth understanding of students of the information management in European hospitals through comparative analysis of each participant's own hospital information management strategy with those in other European hospitals so as to develop new insights into ways of addressing common concerns in this respect.

This integration of theory and practice in a hospital environment, and international exchange of knowledge and ideas in discussion groups and presentations led to a deeper understanding and critical appraisal of this subject matter and to a highly appreciated course by students and faculty.

An aspect of the course that may require improvement is a less dense time schedule in favor of lengthening the time for international group work.

The Internet is promoting active exchange and development of teaching materials with other, mostly geographically distant collaborators. International courses, developed in a collaborative effort of institutions residing in different countries, using the Internet as the distance delivery medium are already in existence or underway [21—27]. Experiences with distance learning have shown that a mixture of different media and instruction methods is required, not only allowing students and faculty to communicate through electronic resources, but also through personal contact [24,27]. We, therefore, combined online communication with onsite teaching on information management in hospitals and discussion of ideas through international group face-to-face work.

In their online communication, our students indeed made frequent use of the 'Group Communication' area to exchange their exercises results and to discuss these results among their (international) student group to prepare themselves for the international part of the course.

Nevertheless, the question is how we might optimize students' use of the functionalities offered by the virtual learning environment Blackboard even more. Experiences of others show that real time sessions using the 'virtual classroom' of Blackboard, which provides a chat room capability are difficult to organize, mainly for logistic reasons. Moreover, as it seems, these kinds of sessions offer no advantages over asynchronous discussions in Blackboard [28]. In stimulating the next group of students participating in our course in 2004 to actively communicate and discuss their results not only in their

own (international) group but with the other students as well, we will more proactively stimulate the use of the 'discussion board' functionalities that Blackboard offers. Discussion boards in Blackboard offer options for asynchronous communication and forum discussions among all students participating in the course. Such student co-operation, communication and consulting may help in changing from a teacher-centered to a more learner-centered approach in our higher education practice. Taken together, these aspects are perhaps the most essential for successful learning. Though this course in its present set-up already noticeably adds to medical informatics students' education and learning style, the investments, both financial and of the persons involved in organizing and coordinating the course were high.

As described, the course has been formally integrated and acknowledged in the three medical informatics university programs of the participating sites. In the long term, the course may be opened for students in other medical informatics programs in (West and Eastern) Europe, United States, or even China. Collaboration initiatives with universities in these nations are in a pilot-phase (e.g. teacher exchange). Likewise, the course may develop into a European post M.Sc. course on strategic information management in hospitals for other professionals in the health and medical field, such as medical information scientists or medical practitioners heading for a management position or hospital managers.

The final aim of the European partners contributing to this course is, in parallel with IΦE, to consolidate education and innovation in the medical informatics field on an international scale by establishing a network of expertise centers to develop other medical informatics courses suitable for all kinds of students. In this context all kinds of medical and health informatics courses may be developed to enhance students' and professionals' knowledge, ranging from B.Sc. students in the medical or health informatics field, computer science, to health care professionals and computer experts. These students and professionals are the next generation experts who will be responsible for the application of information and communication technology in such a way as to optimize the complex information processing in health care enterprises throughout the world. They need to and must be apt to share and communicate their knowledge and experiences in the field to raise the quality and efficiency of health care throughout the world. We embrace the initiative of a consortium of universities in the United Kingdom to develop an international master's qualification in health informatics [9] and hope to see many more examples of international collaborations in the medical and health informatics field in the future.

As mentioned in [29] we are convinced that: "However, we should not only try to enhance medical and health informatics education in our own countries, but to make our own experiences available and, where possible, applicable for other students and teachers throughout the whole world". Medical informatics is a rapidly growing and expanding field; internationally trained professionals can play a useful role in addressing world wide issues that ask for innovative information and communication technology solutions in the medical field. In this context, further establishment of international courses is highly recommended.

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