

S.K. Andersen^{1,4},
S. Andreassen^{1,4},
A. Bygholm^{3,4},
O. Hejlesen^{1,4},
C. Nøhr^{2,4}

Departments of ¹ Medical Informatics and Image Analysis; ² Development and Planning; ³ Communication; and the ⁴ Virtual Center for Health Informatics (V-CHI), Aalborg University, Aalborg, Denmark

Education and Training

The Education in Medical Informatics at Aalborg University

Introduction

A description is given of the education in medical informatics at Aalborg University. The description includes a brief outline of the curriculum, together with a description of two aspects where the education differs in form from most other university educations: Similar to all other education programs offered at Aalborg University, this education requires the students to spend about half their time on projects. Furthermore, the education is offered as distance learning. The students are only present four times each year at the University and, in between, the communication between teachers and students take place over an electronic conferencing system, including examinations. Our experience with this type of education will be described.

The education is very new, the first courses were offered in 1994. This paper will, therefore, review the background for the education, and it will describe the educational background of the students: mainly nurses and physicians, and only a few engineers. It is probably fair to say that the present curriculum is based on the intuition and professional interests of the individuals who organized the education. The first students will graduate in the

summer of 1996 and it is, therefore, too early to give statistics on the type of employment for the graduated students. Nevertheless, revisions of the current curriculum should be based on information derived from the students and from employers (hospitals, industry and universities). Efforts are under way to achieve this in a systematic fashion.

Description of the Education

Duration and Entrance Criteria

The education has a duration of two years during which the students are supposed to spend a total of 1620 hours on their studies. This means that the students spend about half their time on their studies, making the study equivalent to one year of academic study for a full-time student. This choice was made because the education is only open to students who already have a professional degree. This degree may be:

- a master's degree (e.g., in medicine, pharmacology or engineering),
- a bachelor's degree in a health-care profession (e.g., nurse, midwife, physiotherapist or laboratory technician), or
- qualifications deemed to be equivalent.

For many of those students half-time studies are attractive, because that allows them to retain their jobs. This is also possible for students not living in Aalborg; distance learning is used with (almost) all communication taking place electronically (see section on Distance Learning).

Students who successfully complete their education receive a diploma. Eventually, the students should be able to earn a degree, either a bachelor's or a master's degree in Health Informatics. This will have to await revisions and possibly extensions of the education in view of the experience gained with the education presently offered.

In contrast to other university educations, which are free in Denmark, the students pay a modest tuition of about 1000 ECU (about 1,200 US\$) per year.

Goals of the Education

The declared goals of the education are [1]:

- To give the students a basic theoretical, methodological and practical insight in health-care informatics;
- To enable the student to critically appraise and assess the possibilities and limitations for application of information technology in health care;

- To qualify the student to take active part in the planning, development and implementation of information systems, and to organize the division of labor in relation to the practical use of such systems;
- To qualify the student to analyse and handle health-care information based on theories and methods from areas as biomedical engineering, computer science, organization, communication and cognition.

The Curriculum

The educational activities are measured in units of modules, one module being equivalent to 30 hours of study. The 1620 hours of study are thus equal to 48 modules, where 24 modules are being offered each year. The educational activities can be divided into two main types of activities: courses and projects. During the first year, 12 modules are used on courses and 12 modules on projects. In the second year, 6 modules are used on courses and 18 on projects. This emphasis on projects reflects the tradition for problem-oriented education at Aalborg University.

The courses offered are listed in Table 1.

The courses fall into three broad groups. The first and largest group comprises the courses Formalization and systems development, Signal cap-

turing and signal analysis, Databases, Medical decision support systems, and Human-computer interaction. This group of courses is organized from a data-lifecycle point of view, taking care of data items that are obtained from the patient, through processing, storage, analysis, and presentation.

The two courses on Quality assurance and Technology assessment provide methods for assessing the quality of health-care services as well as the quality of the technologies supporting these services.

Finally, the courses on Clinical applications of informatics and Administrative applications of informatics provide an opportunity for showing the students examples of information systems in current use. This is mainly done by invited lecturers at weekend seminars.

In addition to taking the courses, the students are required to complete two projects, one each year. The projects are usually done in small student groups with up to six participants, but they may also be completed on an individual basis if a student wishes to do so.

Distance Learning

To minimize the requirements for the students to be present at Aalborg University for extended periods of time, the major part of the communi-

cation is electronic. The students are required to be present at the university only at the weekend seminars, which take place four times every year. Distance learning was chosen to make it possible for students living outside Aalborg to attend the program. This has been accomplished in the sense that out of the 74 students currently enrolled, only 7 live in Aalborg and 3 live outside Denmark. The main concern of the Faculty is to make the best of the personal contact with the students and at the same time to exploit the advantages of electronic communication. The electronic communication is using a conference program as its backbone. Every student is required to have a personal computer, a modem, a telephone line and a licence to a communication program, called FirstClass. At Aalborg University there is a server, dedicated to FirstClass. The server is host for a number of conferences. A conference is a billboard, where all members of the conference can post messages and read the messages from other participants of the conference. Most of the communication required to run the courses and the projects as described below take place over FirstClass. In addition to this communication, the conferences typically also receive postings from students who transmit personal opinions on course-related topics, comments on the perceived relevance (or lack of it) of the exercises, or simply ask for help on some problem they have encountered. The students log on to FirstClass frequently enough to make this function a forum for discussion.

Courses by Distance Learning

A course is organized in the following way. It is started at one of the weekend seminars. Typically, a course may have a 4-hour slot at a seminar. The faculty member responsible for the course (the teacher) may, for example, choose to lecture for two hours

<u>First Year</u>	<u>Number of modules</u>
Formalization and systems development	3
Signal capturing and signal analysis	2
Databases	2
Medical decision-support systems	2
Clinical applications of informatics	2
Administrative applications of informatics	1
<u>Second Year</u>	
Human-computer interaction	2
Information systems for quality assessment and assurance	1
Technology assessment and evaluation of information systems	3

Table 1: Courses offered in health informatics at Aalborg University

and spend the other two hours on exercises and/or discussion of topics related to the course. In the months following the weekend seminar, the faculty member will use the electronic conference system to maintain the students' motivation, for example, by posting exercises on the conference dedicated to that course. The students return the completed exercises, also via FirstClass. Most courses stretch over at least two weekend seminars, so the faculty member will have another opportunity for personal contact with the students during the time slot allocated for that course at the seminar. Often, the faculty member takes the opportunity to bring in an invited speaker, who will speak for an hour or two at one of the seminars. At the end of the course, an examination is held: the faculty member posts a set of exercises on the course conference. The students have a certain time limit, from the moment they read the exercises and until the completed exercises must be returned via the conference system.

Projects and Problem-oriented Education by Distance Learning

The conference system is also used for the student projects. At a weekend seminar, the students are requested to form groups, according to personal preferences, geographical considerations and, of course, their agreement on a common topic for that year's project. The students are encouraged to form groups with 4-6 members, but groups with only two members are allowed and, occasionally, a student may prefer to work independently. The student groups thus formed are assigned faculty members, based again on the students' personal preferences and on the availability of the individual faculty members. At the end of the year the group must deliver a report and that report is defended at an oral examination, where the faculty member and an external examiner are present. During the project it is the task of the

faculty member to help the group focus their efforts and to provide guidance in scientific problem solving. This is a process with some difficulties, as discussed below. During the project, the conferencing system binds the project and the group members together. Of course, within the constraints of geography, the students can meet or discuss their project by telephone, but most of the communication goes through the conference system, in particular for groups where the members of the group live in different cities.

The student projects are an important part of the education. This is already evident from the large number of hours dedicated to project work. The projects are intended to counterbalance the courses. The purpose of a course is to teach the students certain skills within a certain discipline. The Medical Informatics courses are used to give the students a broad background in the topics that we currently deem as necessary for a medical informatician. It may be discussed whether medical informatics has matured to the point where it is possible to speak of it as a well-defined discipline - or profession [2,3]. Nevertheless, the courses serve the purpose of teaching the students skills in this emerging discipline. In contrast, the projects allow the students to acquire in-depth knowledge in a narrow area, defined by the topic of the project. The students choose their own topic, with the restriction that it must fall within the broad theme of information technology in the health-care sector, and the topic must reflect a real-world problem, i.e. a problem that is pertinent to the health-care sector [4].

The assumption is that problem-oriented education forces the students to adopt an interdisciplinary approach. Often, the student groups are multidisciplinary in the sense that the members of the group have different backgrounds. This allows them to apply knowledge from different disci-

plines. Usually, during the course of the project, the students will progress from multidisciplinary to interdisciplinarity [5,6], where knowledge and methods from different disciplines become truly integrated. Interdisciplinarity is probably a precondition for professional work in medical informatics. For example, to build a clinical database, it is necessary to understand the technical and medical details as well as the organizational and psychological factors that eventually will determine if the database will be used according to its design.

Staff

The distribution of the members of the faculty on different disciplines should reflect the opinion that medical informatics is interdisciplinary. The education was established by the joint efforts of the three faculties of Humanities, Social Science, and Engineering at Aalborg University, and most of the faculty was recruited from these faculties. The lack of a medical faculty at Aalborg University was compensated for by recruiting part-time academic staff with a medical background from other universities and institutions. The use of a conferencing system as a backbone in the education enables to recruit part-time staff from a wide geographic area.

Experience from the First Two Years

In 1994, the first 49 students were admitted to the program, and out of these, 34 students will complete the program in June 1996. In 1995, 48 students were admitted, and out of these 40 are still in the program. The drop-out rate (20-30%) might at first be considered quite high but is in fact low if compared to other open-university programs: most of the students have full-time jobs in the health-care

sector, and joining the program is equal to an extra half-time job. Some may not be able to cope with this extra workload for two years and, as a consequence, they drop out of the program.

To be admitted to the program, the students must, as previously mentioned, at least hold a bachelor's degree in health science, or a master's degree (non specific). The rationale of this is that most of the studying is done independently, out of the classroom. Therefore, the students must have proven their ability to study on their own.

One third of the students are MDs, and are mostly at the starting point of their carrier, or they have been engaged in the informatics arena for a while, without any formal training. Another third of the students are nurses, and a few of them have other university bachelor's degrees (law, language), and several have taken a number of university courses. The remaining third have various backgrounds as, e.g., laboratory technicians, engineers, midwives or have university degrees in social science or economics.

Revision of the Curriculum

It is our intention to make a first revision of the curriculum, beginning summer of 1996. In order to ensure that the university curriculum deals with real world problems we have initiated a number of activities:

1. In the first year of their study we interviewed all students about their job profile, and their wishes for their future job profile. This will be repeated when they have completed the program, to get an indication of the rate of change in their job profiles.
2. During a two-month period we have scanned relevant sources for job advertisements, which indicates that there is a substantial job mar-

ket for health-care informaticians. During the period we found enough advertisements to employ the majority of our students. The advertisements are a good source of information on the market demand for health-care informaticians, job profiles, required qualifications, etc.

3. As a more systematic approach we have designed a three-step activity:
 - Step one was to interview a number of opinion leaders on their view on the future qualifications and job profile for health-care informaticians.
 - These interviews were used to draw up three different future scenarios for the health-care sector with specific focus on health-care informatics. In the first scenario the public health-care sector focuses on reducing cost by increasing efficiency. In the second scenario the importance of a service-oriented, publicly financed health-care sector is stressed, and in the last scenario the health-care sector is partially privatized.
 - In step two the scenarios were used in a workshop: 50 people representing hospitals, the primary-care sector, the health-care industry, universities, and the labor unions participated. The discussion at the workshop was focused on the changes in the job functions of the health-care professionals over the next ten years: It was said that the division of labour will be affected by the introduction of information systems and, in order to cope with the changes, new qualifications are required of the people in the work force. Areas such as technology management and implementation theory should be stressed in the educational program. Furthermore, the importance of mastering the development and applica-

tion of data- and information models in health-care informatics was emphasized. Modelling of data and information are areas which make health-care informatics a specific and independent domain [7].

- Step three is a questionnaire survey aimed at getting quantitative indicators of the demand for university-level education in health-care informatics. This step has not been completed yet.

Conclusion

The experience with the open education in medical informatics at Aalborg University has revealed that there is a clear demand for such an education with a duration of two years. Although the education is not placed in connection with a medical faculty, the overwhelming majority of the students have a background in the medical professions. The annual enrollment of about 50 students per year is also above expectations. So far, the education has been well received, judging from the drop-out rate of 20-30%, which is low as compared to other open educations. Apparently, the study load, corresponding to about half a normal academic study load, is acceptable to the students, allowing them to maintain their connection to the labour market. The use of distance education has made it possible to recruit students and faculty from all over Denmark, and even a few students from outside Denmark.

The education is based on a balance between discipline-oriented education, based on courses and problem-oriented education in the student projects. We believe that this is conducive to the development of the true interdisciplinarity required from a medical informatician who is likely to work in an environment with people with technical, medical and administrative back-

grounds.

Currently, the students get a diploma, not a degree, when they successfully complete the education. In the years to come, it will be considered how the education can be consolidated and expanded, allowing the students to earn either bachelor's or master's degrees in medical informatics. This will be done, keeping the current and anticipated future job profiles of the students in mind, and in a dialogue with future employers of the students.

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Address of the authors:

S.K. Andersen,
S. Andreassen,
O.K. Hejlesen,

Department of Medical Informatics and Image Analysis,
Aalborg University,
Fredrik Bajersvej 7,
9220 Aalborg,
Denmark.
E-mail: ska@miba.auc.dk, sa@miba.auc.dk, okh@miba.auc.dk

C. Nøhr,
Department of Development and Planning,
Aalborg University,
Fibigerstrade 13,
9220 Aalborg,
Denmark.
E-mail: cn@i4.auc.dk

A. Bygholm,
Department of Communication,
Aalborg University,
Langagervej 8,
9220 Aalborg,
Denmark.
E-mail: ann@hum.auc.dk