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Problem-based education of Nuclear Medicine Technologists as part of a four-year integrated Bachelor's degree in Diagnostic Imaging and Radiation Therapy in the Netherlands: report of a transition

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Abstract

This article outlines the significant changes that the education of Nuclear Medicine Technologists (NMTs) in the Netherlands has witnessed in the past decade and a half. The present education is described in some detail here. The choice for the pedagogical model is motivated and some educational activities are highlighted. Some facts and figures are shown. At the end the interested reader is shown the way to some additional sources of information.

Key words: education, problem-based learning, technologists

Introduction

In 1989 the Dutch started an integrated, university-based BSc curriculum in all diagnostic imaging modalities and radiation therapy. The programme takes the students on average 4 years to complete. Graduates are licensed to work as technologists in diagnostic radiography, including CT and MRI, and in Ultrasound, Nuclear Medicine and Radiation Therapy. The objective is to produce graduates who are trained in a wide variety of skills, at entry level. The programme is labelled 'MBRT', the Dutch abbreviation for 'Diagnostic Imaging and Radiation Therapy'.

The new programme was developed cooperatively in two universities of professional education. Since 1996 a third one has been participating. Before this new programme was developed, the Netherlands already had a long tradition of hospital-based separate programmes to train technologists in diagnostic radiology, radiation therapy and nuclear medicine. These programmes took 3 years for the first one and 1 or 2 years for each subsequent one.

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Problem-based learning

When the new curriculum of the university-based programme was designed, the profession was first analysed not only with regards to its contents, but also to the circumstances of practice and to some skills at meta-level that graduates need in order to be qualified professionals. As a result of that analysis it was decided to base the new programme upon the pedagogical concepts of "Problem-Based Learning" (PBL). The general concept of PBL was designed in McMasters University in Hamilton, Canada. It was introduced in the Netherlands by Maastricht University. A comparison of some of the main characteristics of both the profession and PBL clearly underpins the choice:

Profession	Problem-Based Learning
• Centred around the patient rather than around individual practitioners	• Centred around themes rather than around individual subjects
• Workers face a variety of situations in which problem-solving capabilities are often required.	• The programme consists among other things of problems out of the future profession as a platform for learning-activities
• Teamwork	• Student activities carried out in small groups
• Integrated (different skills and competencies come together in one professional practice)	• Integrated (a variety of knowledge and skills are trained nd examined a combined)
•Relatively independent, not always having direct supervision and/or instruction at hand	• Relatively few lectures and tutorials, a lot of self-study and group-study: teacher extensive
• A "do-profession" (one has to know a lot, but it is knowledge aimed at guiding one's acting in practice)	• A "do-system" (a lot of theory is mastered, but in relation to and aimed at guiding practical acting in skills lab and clinical placement)

In this system not only the basic theory is being taught at school, but also the basic skills are demonstrated, practised or simulated there. This means that the school has an extensive skills lab-facility available for the students. To give some idea: the school where I work has at present an annual inflow of roughly 100 students, resulting in an annual output of some 70 graduates 4 years later.

For that we have two complete X-ray rooms, including 6 computers for digital image-processing, two radiation therapy simulators (localisers) and 10 computers for treatment-planning, 7 ultrasound machines, an MRI and CT processing computer, a gamma camera and 7 nuclear medicine computer workstations. This amounted to a total investment of roughly euro 1.6 million (1.41 million US$, April 2002 exchange rate), thus counterbalancing the potential positive budget-effects of a teacher extensive programme (Fig. 1).

Figure 1. Lectures play only a minor role in PBL, if any role at all. In our system students have no more than 6 lectures a week.

A theory session, how it is done

In straight PBL, the students, by means of analysing problems, which one way or another deal with aspects of their future profession, master all theoretical knowledge. Students are being confronted with several cases a week, which they analyse following a specific method. For instance, the students are offered a case of "a patient suffering from chest pain". Their method of analysing this case consists of 7 distinct steps. The first 5 steps are dealt with in one session; step 6 is worked on for some days and step 7 is performed in the next session. This session usually also houses step 1 through 5 of the next case. In the group meetings (10 students) that deal with these cases students are being guided by a teacher/tutor. The 7 steps are:

1. Read the text of the case, look up words that you do not know and clarify any language that you do not understand.
2. Formulate what you think is (are) the central problem(s) in the given case.
3. Brainstorm (Meaning: make an inventory of what you already know concerning a case like this and formulate hypotheses concerning causes, solutions, etc).
4. Make a logical and practical arrangement of the outcome of step 3.
5. Formulate learning objectives (meaning: make a list of items that you do not know, but you think you should know if you were the technologist who has to deal with that case in real life).
6. Work on the learning objectives of step 5. Look up information and references, in the school's library, in your books, on the internet, etc.
7. Report to your group and tutor what you have found, synthesise information and make an inventory of unanswered questions.

The way that PBL is adopted in this Dutch curriculum is a hybrid one, in the sense that the curriculum does not solely rely on analysing problem cases for the education of theory. The cases (one a week) are accompanied here by more directive assignments, instructing students to examine specific aspects of the theory, compare items, perform calculations, etc.

A practical training session: how it is done

Each skills lab-session of a practical training has a similar structure:

— First, the students master the relevant theory of a given subject, for instance myocardial SPECT-acquisition and reconstruction. They do so, guided by an occasional lecture and a variety of assignments, as mentioned above.
— Second, a teacher gives a demonstration of the required practical skills (1.5 hours).
— After that the students have two scheduled occasions for practising these skills, spread over one or two weeks, using a gamma camera and computers or sometimes a dummy hot lab. For this they have 2 × 1.5 hours per group of 10 students and they can book the nuclear medicine room in the evening if they feel they need more practice. These practice hours are without a teacher being present, though in general one is at hand for questions.
— Finally there is a feedback session of about 1.5 hours in which the students are given an old practical exam, including a list of scoring-items, and they get feedback on their performance.

Figure 2. Group of students practising in the school's skills lab facility.

The week after, a new subject starts. In the given example of cardiac SPECT, the students of course benefit from the fact that in the same period they also have cardiac ultrasound and cardiac angiography in their (integrated) programme (Fig. 2).

Clinical placements and research project

No matter how well equipped a school may be there is a lot of professional experience that a student can only get in the hospital, working with "real patients" instead of fellow-students or dummies, under real time pressure, with real radio pharmaceuticals, etc. Therefore the programme at school is supplemented with several periods of clinical placement, amounting to almost one year: 20 weeks for radio diagnostics & ultrasound, 10 weeks for radiotherapy and 10 weeks for nuclear medicine.

Students use the last 5 months of their study for a research--project. They have to work on a specific thesis, perform the necessary tests and calculations, write a report and an article and give a presentation to an audience.

Some facts and figures

— The Netherlands have roughly 16 million inhabitants and some 145 hospitals, varying from small rural clinics to large University centres.
— In the 3 schools that offer this university-based programme in Diagnostic Imaging and Radiation Therapy, there is at present an overall annual inflow of roughly 260 new students.
— This results in an output of approximately 180 graduates 4 years later.
— Around the country there are also roughly 95 students in several still-existing hospital based programmes for diagnostic radiology and some 20 for radiation therapy.
— Added up, this is not enough to fill every existing vacancy on the labour market.
— 75% of the new students are female and 25% are male.
— 85% of the graduates are female, so we lose more males than females along the way.
— Interviews with students leaving without a degree indicate that this has to do with the fact that female students overall manage to cope with the relatively large amount of freedom that goes along with the PBL-system better than their male colleagues do.
— Also the small chance for a fast rising career-perspective discourages some males.
— A disproportionally large percentage of the new students come from rural areas and small towns.
— It appears that Healthcare as a future employer (still) has more status in small communities than among those who live in 'the big city' in our country.

What do 'others' think of it all?

The university-based schools were analysed as part of an inspection programme by the Dutch Ministry of Education. Also the schools had a survey performed among the first cohorts of graduates and their employers.

The inspection team concluded among other things that:
— There is a mutually beneficial, open communication between students and staff.
— The chosen didactic model and the way it is embedded in the programme ensure a high student throughput and a thorough preparation for the future profession.
— The final theses delivered by the students are of outstanding quality.

The survey showed employers giving roughly equal or sometimes higher rating to the graduates than they did to themselves (especially in the area of factual knowledge and social skills). The employers indicated that, on average, the graduates took some 5 to 9 months to familiarise themselves with the department in such a way that they could be scheduled for every kind of work, including non-routine, complex tasks (Fig. 3).

Discussion and addition

There is some discussion going on in my country whether a hospital-based or a university-based system is the most adequate way to educate diagnostic imaging technologists. One might

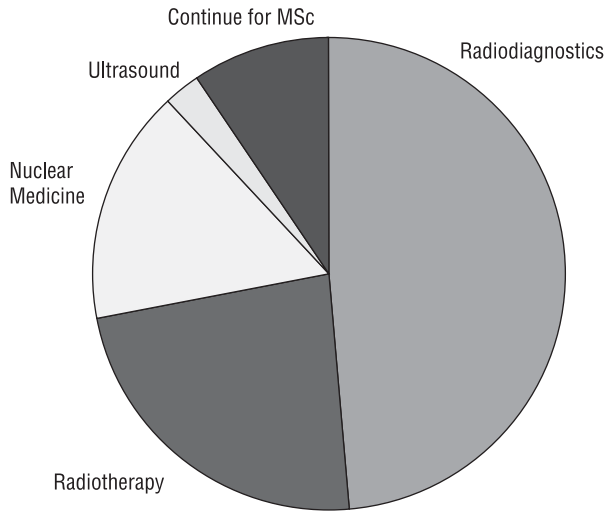

Figure 3. First jobs after graduation of the MBRT school in Endhoven as reported by students 1994–1999 (n = 211).

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argue that a graduate from a hospital-based curriculum is a 'dedicated' employee, who at the time of graduation is already perfectly adapted to the specific needs of his or her department and to the pluses and minuses of the local culture. A graduate of a university-based programme on the other hand can be seen as a 'general purpose' employee, equipped with the tools to familiarise himself or herself relatively quickly with a wide variety of departments and circumstances, with a potentially 'fresh look' at things. Arguably one can state that both methods are in themselves valid to deliver qualified new staff to the departments that need them so badly.

It must be added here that there is at present no hospital-based training for NMTs running in the Netherlands, due to a lack of trainees referred by hospitals. Furthermore the number of students in hospital-based training programmes for Diagnostic Radiology and for Radiation Therapy has dropped dramatically since the first graduates of the university-based programme came onto the labour market. I suspect that financial motives play an important role here. A student in a hospital-based programme is employed by a hospital, and hence paid a salary, and the costs of the school, books, travelling, etc. have to be paid by the hospital. In contrast, the Dutch Ministry of Education largely pays for a student in a university-based programme. The student must pay the remaining costs.

Partly, but not wholly due to this, the 3 schools that offer the university-based programme find themselves continuously unable to attract enough students to satisfy the labour market. Therefore they made the decision to start a second curriculum. This programme will also take 4 years to complete and aims at combining the 'on the job characteristics' of the previous system and the Bachelor level of the present. It is hoped that this new programme will be attractive to potential students who, for one reason or another, do not find themselves in a position to enter a four-year full-time study course.

In order to be admitted to this new programme, the potential students have to apply for a student job at a hospital department. Once hired (and paid a modest salary) they are admitted to the school. The hospital will supply the practical component of the training and the school will take care of the theoretical component. Since these students/employees come from all over the country, distance learning, supported over the Internet by means of the school's Virtual Learning Environment, will play an important part in the design of this new curriculum.

The benefit for the hospital is that in this construction the Ministry of Education is paying the costs of the school. The benefit for the students is that they receive a small salary and are being refunded for their books, etc. The main questions that have to be answered concern the organisational aspects on the one hand and the potentially large study load of combining a job and studying at Bachelor's level on the other.

The schools in the cities of Eindhoven and Groningen will start this so-called 'dual mode' programme in September 2002. Their colleagues in the city of Haarlem started last year. Although the first results do not seem discouraging at all, it is at this time too early to draw any statistically underpinned conclusions about this new development.

More information

More information about the 'MBRT' programme is available at the website of the school for MBRT in the city of Eindhoven. The web address is: www.fontys.nl/mbrt/english

Maastricht University has a dedicated website about PBL at www.unimaas.nl/pbl

Information about the Netherlands, in a variety of languages including some Eastern European ones, can be found at www.holland.com