



A Revolution in its Own Right: How Maastricht University Reinvented Problem-Based Learning

Virginie F.C. Servant-Miklos^{a,b,*}

^aAalborg Centre for Problem-based Learning in Engineering Science and Sustainability, Aalborg University, Denmark

^bErasmus University College, Erasmus University, Rotterdam, the Netherlands

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1. Introduction

In 1974, the *Rijksuniversiteit Limburg*, now known as Maastricht University, opened its doors to 50 medical students entering a Faculty of Medicine that had not even been fully approved by the Ministry of

Education yet. Following in the footsteps of McMaster University Medical School in Canada, this was only the second medical school in the World to offer a radically new approach to medical education known as problem-based learning.¹ This approach was based on small-group, student-centred learning, at the starting point of which was a realistic biomedical or clinical problem. Group meetings guided by a tutor displaced lectures as the main format of learning, leaving students ample time for self-directed learning using the learning resources provided by the University. Over the past 45 years, Maastricht University has made a name for

*Correspondence address: Erasmus University College, 1A, 3011HP Rotterdam, the Netherlands.

E-mail address: servant@euc.eur.nl

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itself as a role-model in problem-based medical education; it has initiated PBL training programmes all over the World,² held the secretariat for the *Network of Community Oriented Network of Community-oriented Educational Institutions for Health Sciences*, a World Health Organization initiative regrouping PBL-practicing schools, for over 30 years,³ and dominates the scientific literature on PBL.⁴

It may seem like a curious twist of history that Maastricht, rather than McMaster, has led the way in the internationalization of PBL. After all, PBL was invented at McMaster University by Dr. Evans and his team, starting with preparations in 1965 and implementation in 1969, and only came to Maastricht through a fortuitous encounter at Michigan State University between Evans and the founding Dean of the Maastricht Faculty of Medicine, Dr. Harmen Tiddens.⁵ The choice of PBL as a methodology for the 8th Dutch medical school was initially made for political reasons rather than educational ones: the new medical school was a welcome gift to a region suffering economic decline as it underwent the closure of its last coalmines, but also ruffled feathers amongst the seven extant schools who felt there was no need for an addition to their numbers.⁵ The use of a new and different approach to medical education initially served to justify the opening of an 8th school in the eyes of the political powers in play. The pragmatic choice soon turned to a choice of conviction, leading Tiddens to strongly defend the idea a more progressive, problem-oriented and family medicine-driven medical curriculum into the so-called *Basisfilosofie* (Basic Philosophy) of the Faculty, which was published in the Dutch journal *Medisch Contact* in 1972.⁶ Despite this, Tiddens himself was not much involved in the development of PBL at the new faculty; instead he delegated this task to the education psychologist Dr. Wynand Wijnen. The appointment of Wijnen already marked a major point of departure from McMaster, whose educational team was exclusively made up of medical doctors. Wijnen, whose area of expertise was assessment, remains best known today for the inception of the Progress Test, a completely new approach to assessment in PBL.⁷ The majority of curriculum development at Maastricht was delegated to other members of staff, whose contributions will be discussed in this paper.

The purpose of this paper is to explore the transition of PBL from McMaster to Maastricht to identify the key transformations and additions that, while remaining faithful enough to the principles etched out by McMaster to still be fully part of the PBL family, allow us to consider Maastricht as a PBL pioneer in its

own right. A history of Maastricht University was written by Peter Knegtman in 1992, but focused on the political and institutional history rather than on PBL.⁵ This research is of special interest to the medical education community as PBL approaches its 50th anniversary and more schools than every are adopting the method across the globe. Maastricht sparked so many programmes in Asian and Africa through its consultancy efforts and the *Network* that many Maastricht innovations such as the seven-step method and the Skills Lab have become mainstream in PBL and medical education beyond. It is important to understand where these innovations came from, why they came from Maastricht rather than McMaster, and what they meant for the development of PBL, in order to avoid getting into time-consuming debates about what constitutes “pure” PBL or not. Instead, understanding the contributions of Maastricht to PBL will help us to get a broad picture of the development of PBL through education history, with its contingencies and path dependencies. Although this is not the purpose of this paper, this research may help educators to make decisions about the sort of PBL they wish to implement.

The research looks particularly at the period between 1970 and 1980, at the time where Maastricht was preparing, then implementing its PBL programme. To do this, we have accessed the archives of Maastricht University, held at the Regional Archives of Limburg, and the archives of the Faculty of Health Sciences held at McMaster University. We have also interviewed 11 former members of faculty, administrators and students from McMaster University Faculty of Medicine and 15 former members of faculty, administrators and students from Maastricht University. We had access to numerous published and unpublished reports from McMaster and Maastricht, either stored in the archives, or donated by interviewees. Although the author is versed in both English and Dutch, two research assistants helped to translate the archives from Dutch. In this paper, only the English translation has been given, for ease of reading. The material was analysed thematically using an inductive and hermeneutic approach, attempting to distill the meaning given to events by those who witnessed them, at the time through writing, and today through oral history.

The findings in this paper will be divided into six sections, looking at the process of building the new undergraduate curriculum, the re-inventing of the tutorial, the creation of the Skills Lab, the development of the Progress Test, and the inception of a PBL research programme. The implications of these findings will be discussed in the conclusion.

Table 1
The Maastricht Curriculum in 1977.

Year 1					
1.1. Studying in the MFM	1.2. Trauma	1.3. Infections & Inflammation	1.4. Psychosomatic reactions	1.5. Artheosclerosis	1.6. Cancer & Introduction to the clinic
Year 2					
2.1. Embryo & Foetus	2.2. The Child	2.3. The Teenager	2.4. The Adult	2.5. The Elderly	2.6. Experiencing a professional setting
Year 3					
3.1.Fatigue	3.2. Fever, infection & Inflammation	3.3. Breathlessness & Chest Pain	3.4. Lifestyles	3.5. Blood Loss	3.6. Electives
Year 4					
4.1. Stomach complaints	4.2. Menstruation complaints & complications in pregnancy	4.3. Headaches/loss of consciousness & neurological / psychiatric problems	4.4 & 4.5. Electives		4.6. Back ache & aches in legs and arms
Year 5 – Clinical Internships					
12 weeks internship in primary care / family practice		20 weeks clinical internship			8 weeks psychiatry
Year 6 – Clinical Internships					
8 weeks gynaecology	4 weeks neurology	6 weeks paediatrics	3 weeks dermatology	3 weeks otorhinolaryngology	3 weeks ophtalmology 12 weeks clinical elective

2. Building an undergraduate programme

The most striking differences between Maastricht and McMaster are the length of the programme and its intended students. Indeed, McMaster, like all North-American medical schools, offered medicine as a post-graduate programme which students would enroll in once they already had an undergraduate degree in something else. As a result, the students that attended McMaster graduated within three years, and they were expected to be somewhat older and more mature than high-school leavers. On the contrary, the Maastricht programme catered to students who were admitted straight out of high school and expected to spend six years studying at the Faculty of Medicine. This had two implications: firstly, the programme had to be adapted to a longer study period, and secondly, it had to be adapted to younger students.

2.1. A longer curriculum

Maastricht needed to conjure up a six year-long programme based on the same unit structure as McMaster – but they couldn't simply reproduce the McMaster structure since they were operating over a longer period and with a different target student-base. McMaster's 1969-72 programme was structured in four

thematic phases, primarily structured around interdisciplinary organ-systems problem-based units.^{8,9} It took a several trial-and-error attempts for Maastricht to come up with a suitable curricular structure, but it was clear from the beginning that they would *not* adopt the McMaster "phase" structure, or indeed its organ-systems approach. After three years of fumbling around with a haphazard "block" (unit) distribution, in 1977, the MFM developed a mixture of a life-cycle and a health complaints approach, with each block either representing a set of complaints, or a period in a person's life. This is a summarized overview of the curriculum as dating from 1977¹⁰:

The first block comprised an introduction to medical studies. This was intended to familiarize new students with both the content and educational process of the medical curriculum. The final two years were made up of various clinical internships, which meant that four full years were dedicated to the PBL blocks, twice as long as McMaster.

2.2. The problem of problems

One might think that given the abundance of time that Maastricht students had compared with their Canadian counterparts, they might be offered lengthier

problems – but according to several accounts, this was not the case. As explained by van der Vleuten:

I think that right from the start, we had major differences in the type of problems that we used. Which is.. the educational differences that arose from the original problems at McMaster that needed to be lengthy problems and that was not taken over in Maastricht. We made much smaller problems, which I think were less realistic but also didn't induce cognitive overload. I think it was more in line with educational theory.¹¹

Below is an example of what such a “shortened” problem looked like, extracted from a student training manual from 1976:

Running: You are awfully late this morning. When the bus stop comes into view you look behind and see the bus coming in the distance. You begin to run; the effort is no problem at first. After a hundred yards, however, your respiration quickens and when you have covered another hundred yards, you feel your heart starting to bump at a rapid rate. A moment later, you begin to sweat. As the bus passes by, you have a weak feeling in your arms and legs, almost as of pain. You stop running and walk slowly. In spite of the fact that you are no longer running you are still breathing quickly and deeply and you feel your heart thumping in your throat. These phenomena decline in a matter of two minutes.¹²

It seems that Maastricht started with a blank slate on problems, and decided to go its own way. As indicated by van der Vleuten, it is probable that they believed that shorter problems would be an easier cognitive load to handle for young and inexperienced students. This choice is a marker of the influence of education psychology on the curriculum, notably through the influence of Wijnen and his team.

Beyond the differing curriculum structure and problem-configurations, the other major implication of creating an undergraduate programme was that instead of mature adults with years of university experience, the founders of Maastricht found themselves confronted with teenagers straight out of high school when they opened the first classes in September 1974. This fact coloured the entire conception of the Maastricht programme: these students needed structure, training, and guidance, and since these were not built into the McMaster model, Maastricht created these from scratch. To do this, they first remodelled the PBL tutorial.

3. Re-inventing the tutorial process

In the process of re-inventing the tutorial process, at the practical level, Maastricht rapidly faced the need to implement a kind of learning structure that was almost anathema to the *ad hoc* tutorials run in the early days of McMaster.

3.1. From improvisation to structured training

Unlike McMaster, which had simply thrown students in the deep end of small-group self-directed learning, the *onderwijscommissie* recognized that some form of group training was necessary for the students coming in to the first cohort of the MFM. In February 1974, they enlisted Canadian psychiatrist Norman Bell to help them devise such a training. Bell proposed a training focused on the “self-analytic group” – a theme anchored in the traditions of sensitivity training and psychoanalysis, at the cross-roads between Rogers and Freud. The programme, set to begin in October 1974, read as follows:

1. A small (6-10) group, together with a trainer, explores the nature of processes confronting all groups, such as commitment, authority and leadership, closeness and distance, task and social activities and harmony and conflict.
2. The group uses as material for study the most detailed real-life available material, - its own interaction. To be useful and used, the interaction needs to be recorded.
3. Such groups almost always involve a struggle to find a workable solution to the issues confronting all groups. The trainer promotes these processes by functioning as a catalyst, a commentator, a resource person and a friend.
4. Such groups almost always evoke strong feelings - positive or negative, or both. If there is a readiness and ability to tolerate such feelings, the experience is compelling and revealing for most individuals.¹³

From the beginning, students expressed dissatisfaction and the programme was reviewed to comprise a looser structure after only one month. It was reviewed and refocused again in January 1975, but a letter exchange from February 1975 reveals that the *onderwijscommissie* considered the programme a failure.¹⁴ In April 1975, the “Sub-commission on the Evaluation and Training Groups” advocated a complete reform of the programme, replacing Bell with psychiatrist Lex van Bommel, but sticking with the “group dynamics” approach, hoping for better luck with a different trainer.¹⁵ But like its

predecessor, this programme was a failure. In 1976, a letter of rebellion was sent to the *onderwijscommissie* from a discontented group of students who took up arms against the van Bommel programme. They made their own suggestions for a new programme:

Regarding the training, it should have as a main goal to be able to use the learning materials in the framework of the medical faculty - including the four basic principles. We are thinking of the following general implementation:

- The training should, among other things, be aimed at the following skills: becoming aware of what takes place in such a group, learning to see the role that your own behaviour plays in this, seeing the functions that have to be fulfilled to reach the set goal, working with group work techniques with regards to the roles of chair, scribe and agenda-setting, learning the skills necessary to bring a group that has derailed back on track.
- (...) In the implementation of this whole, they should research what sort of capacity is available in the entire country for these trainings. They should also attract enough in-house content expertise in this field.¹⁶

Thus it was out with sensitivity training and group dynamics, and in with specific role-oriented, process-oriented training. Bell and van Bommel were duly disregarded, but to acquiesce to the students' demands, the *onderwijscommissie* needed to develop its in-house training expertise. This task fell to Henk Schmidt and

Peter Bouhuijs, then both junior education researchers at the MFM's Department of Education and Research.

Peter Bouhuijs indicated that at first, the pair had little idea how to go about this training – they began with one-day trainings in which groups of six to eight students would tackle a series of problems, and would be tape-recorded in order to critically evaluate their performance afterwards. After a year of experimentation, the in-house training had progressed towards a more sophisticated assortment of techniques:

In September there will be a training for the first year students, that contains elements of the tutor training like the booklet, the video tapes and the group simulation. [...] During this group simulation, there will be several rounds in direct feedback techniques in which the students can only take part in the discussion if he gives an elaborate summary of what the student before him has said.¹⁷

In addition, the training load was also shared over more faculty, making the training less of an *ad hoc* and more of an institutionalised process. Complaints stopped, and the training programme essentially moved forward in this format from hereon.

3.2. Introducing the Seven-Jump Method

As remarked by Evert Reerink, one of the key members of the original Maastricht team, there was quite some difference between the McMaster and the Maastricht tutorial. He noticed this when he visited McMaster in 1975:

Table 2
The Seven Jump Method as Described in Schmidt²⁰.

The Seven-Jump Method	
Step 1	Clarify terms and concepts not readily comprehensible : this could be done either with the group members' prior knowledge or by using a dictionary. It appears very clearly that the purpose of this first step was not to produce a list of definitions, but to ensure that the whole group attuned their interpretation of the problem.
Step 2	Define the problem : the second step covers the exact definition of the problem. This does not mean that the students should propose a precisely defined list of questions, but instead should agree on which phenomena in the problem trigger need to be explained.
Step 3	Analyse the problem: attention subsequently centres on problem analysis. In this phase of the problem study, the students recapitulate their opinions, thoughts, ideas and actual knowledge on the problem based on their prior knowledge. Also called "brainstorming".
Step 4	Make an inventory of the explanations inferred from step no 3, proceeding systematically: in the fourth step an inventory is made of the various explanations of the problem brought forward. Make a schematic depiction of this analysis on a blackboard. The purpose is to 'marshal' and 'summarize' the contributions of the problem analysis.
Step 5	Formulate learning-objectives : these should answer the unknowns left open after the first four steps.
Step 6	Collect additional information outside the group : not only were students expected to make use of books and audio-visual aids, but they should also reach out to content experts within the Faculty.
Step 7	Synthesize and check the newly acquired information: This meant that students should inform each other about their findings, attempting to describe precisely the processes at play in the problem.

Another topic of the E.C. [Education Committee of McMaster] was the tutor role - and the tutor training that Vic Neufeld wants to organize. Howard Barrows has given a rather complete description of the capacities of a tutor. I think we would be quite surprised if this were announced as the standard description of a tutor in Maastricht!¹⁸

Vic Neufeld and Howard Barrows were running the curriculum at McMaster at the time, and, according to Schmidt, had a rather tutor-centred idea of the PBL tutorial:

I have seen videos of tutorials at McMaster, somewhat later. And they were totally tutor-driven. So the tutor was in the middle, they were looking at the tutor and they were talking to the tutor. But I must say these were the videos with Howard Barrows.¹⁹

The puzzle faced by the Department of Education Research and Development was how to achieve a problem-based education with students straight out of high school that would not be so heavily dependent on tutors. A free-for all discussion would be manageable with a tutor as moderator, but if the tutor was to take a step back, how would the students handle the problems? After a couple of years of muddling with sensitivity-oriented techniques, which amounted to letting the students deal with the problems on their own, a solution was introduced by Henk Schmidt in 1976 – the so-called “Seven Jump method” (also translated as Seven-Step).¹²

By 1981, the seven-steps had become something of an institution in Maastricht PBL education, with its own “how-to” manuals for students and tutors. With such a structure, the students could theoretically handle any problem systematically – such a detailed description of the learning process did not exist at McMaster, but became the hallmark of the Maastricht PBL tutorial, still taught there to this day.

The mere introduction of the Seven-Jump still did not resolve the role of the tutor in the tutorial – indeed, a tutor could very well lead the discussion, even with the new structure. This is why Schmidt also introduced the role of the “Student Chair”. The earliest record of this role can be found in the presentation of the Tutorensysteem (Tutor System) in 1976. Schmidt elaborates on the functions associated with chairing:

The Chair:

1. Before the meetings, he will look at which points need to be added to the agenda of the meeting.

2. At the beginning of the meeting he will look at whether the agenda is complete according to the students.
3. He will keep an eye on the time.
4. Will assign speaking time and restrict it.
5. Will not interfere with the content of the discussion.
6. Time and again, will give a short summary of what has been said.²⁰

Point five is strongly emphasized in the document – not only should the Chair not interfere with the content of the discussion, but he is literally *verboden* (forbidden) from doing so! His role is merely procedural – he keeps order in the meeting – and recapitulating – he summarizes in between other members’ contributions.

3.3. Framing the tutor role

Several reliable historical records from the Faculty detail the sort of person who might be hired to be a tutor. In 1977, the topic of tutor qualifications was discussed during an internal conference:

Tutor

- A yearly group of set tutors is desirable. See proposal of year coordinator for 4th study year.
- A tutor should have a certain content expertise
- A tutor has to be more and better connected to the education
- Tutors can be all staff employees (scientific employees), students, and technical administrative employees that are proposed by the capacity group.
- The fourth study year should be preferably taught by medical doctors.
- A tutor has to have an integral insight into the problems of the offered curriculum of a block. He has to recognise sub-problems of the problem, the expertise of the tutor is clearly of a different level than that of the real content expert.
- Feedback has to be given regarding the functioning of the tutor.²¹

These notes are somewhat self-contradicting. On the one hand, they call for tutors to possess a certain content expertise, but on the other hand, they propose that all “scientific employees” but also students and technical administrative employees be eligible to tutor! By 1979, matters had settled against students and technical staff, and in favour of “scientific staff”. A letter from the “Tutor-system Project Group” from 1979 stated the following:

The tutor role can, in principle, be fulfilled by any staff member coming from the scientific department of the faculty of medicine, whom is sufficiently trained for this educational role. One will have to have followed the so-called tutor training.²²

The wording is very clear with regards to the fact that the staff member should come from the scientific department of the Faculty of Medicine – while it is not clear whether this included lab assistants, it ruled out students and secretaries. However, the rules were different for skills trainers, allocated to Skills lab sessions (more will be said on this later), who could be people from the paramedical professions, such as physiotherapists and nurses.

One of the peculiarities of the MFM, as compared with McMaster, is that in practice, many of the new tutors ended up being basic scientists, whilst McMaster tutors were mostly clinicians. Perhaps this is what encouraged Maastricht to develop a tutor training programme, where McMaster had none in its first few years. The job of developing this training was given to a special project group directed by Henk Schmidt, who wrote in 1976:

The project group has decided that the tutor training to be developed will be set up in a way that is comparable to the social skills training that is given in the skills lab. This means that important parts of the training will be individualised and matched to the specific tutor. The up side of a training set up in this way is clear: the aspiring tutors can train at moments that are best suited for them and there is no need for an on-going work on part of trainers.²⁰

The idea was a combination of group simulations, self-evaluation (where tutors would record their tutorials and then reflect on their performance), and reacting to pre-taped tutorials. It seems that this training programme was not very successful, suffering from poor attendance, from being too general rather than specifically tailored to the blocks that were being taught, and a lack of human resources allocated to the project by the management. Schmidt was given the task of reforming the training, which he did under the name *Tutorensysteem* (Tutor System). This new system was strongly focused on identifying and coping with different types of student behaviours. Trainee tutors were asked to codify student behaviours into given categories, based on the transcript of a PBL meeting. They were also asked to reflect on a number of statements, such as “silent students have a negative impact on a group, yes or no”? This approach

crystallised into a book called “*Onderwijs in taakgerichte groepen*” (Education in Task-oriented Groups), which was published in 1980 and helped to popularise PBL in the Netherlands.²³

4. Developing medical skills training

The training of medical skills was assumed to flow naturally from the problems at McMaster – in the early years, no special provision was made to teach them separately. In practice, most of the training was done in the clinical year. Maastricht took a different road: the Skills Lab was a core component of medical education at the MFM from Day 1. According to Pie Bartholomeus, who coordinated the Skillslab for many years, the idea came from Reerink, who had visited several institutions in North America for inspiration. The Skillslab was also inspired by Barrows and his integration of clinical practice in the problem-solving process with simulated patients. But Reerink’s plan went one step further by consolidating all of these medical skills practices into one laboratory area:

Howard Barrows and his staff were helping us in getting over that [clinical skills] line, so it’s perfectly [possible] to not only have simulated patients who act really as patients in physical pain, and have physical problems, but also that your students can act as patients and helping your colleague student in understanding abdominal pain or problems with walking, you name it. And that was another factor that led to the idea that you could in an organizational way put all these things together in the 10-15 domains in medicine like surgery, medicine, paediatrics and then build a structure around it, isolate it, develop it, organize it in such a way that it is accessible to students 24/7, another wild idea we had! And you can build evaluation systems, self-evaluation systems, all based on what the, especially what the anaesthesiology mannequins had taught us. So there came the basic idea of a Skills lab.²⁴

The Skillslab was organized in a haphazard manner in the first few years of its existence. This prompted students to request more structure, qualified trainers, theoretical background knowledge, and more hands-on practicals in the evaluation of the year 1976-77.²⁵ In response, the MFM appointed Pie Bartholomeus to get the Skillslab on track. As part of this effort, the Skillslab was re-shaped into a new co-curricular programme to start in September 1977 and last through the six years of the medical study. The new version of the Skillslab was a place where students could go, with

or without the supervision of a trainer, to practice the clinical skills relevant to a block on mannequins and other available simulation tools throughout their six-year education at Maastricht. As part of the Skillslab revamp plan, the students were confronted with five levels of skills mastery:

1. Having knowledge of the procedure of a certain skill: this was a required basic level for all skills. In this instance, the student was expected to know of the procedure and its potential uses and effects on the patient, without necessarily being able to perform it himself.
2. Having seen how a procedure is done. In this case, while he may not have performed it himself, the future doctor would have witness the skill in question being applied by senior colleagues.
3. Having practiced a certain skill multiple times himself.
4. Total ownership of a skill. The idea behind this was that every basic doctor should have to master a certain number of skills at this level, which would be required for his direction of specialization.
5. The integration of a skill in the entire diagnostic and therapeutic process. This last level of mastery would only be expected of 5th and 6th year students.²⁶

The integration of the skills with the PBL blocks was not always practical or feasible, but it remained a strong ideal that has pervaded in medical PBL to this day. In fact, the *Skillslab* proved so popular an idea that PBL-practicing faculties and even traditional schools of medicine across many parts of the world and in particular Indonesia, can be seen to use the typically Dutch contraction of two English words to describe this practice – a testimony to the lasting influence of this invention!

5. A breakthrough in assessing PBL

Summative assessment was anathema to the early McMaster philosophy. Indeed, in its first few years of existence, there were no examinations to speak of, and only formative evaluation provided by the tutor and other self-evaluation mechanisms such as “Problem Boxes” (a type of do-it-yourself question-and-answers deck of cards) were available to help students estimate their level. But for the Canadian school, the national exam that all medical students had to take at the end of their studies provided an external benchmark to vindicate three years of medical study. Maastricht was deprived of such a national validation tool, but Wynand

Wijnen endowed it with arguably the most enduring innovation in medical assessment in the Netherlands over the past 50 years, the “Progress Test” – so enduring that it now serves as a quasi-national medical examination in the country, even among non-PBL medical faculties!²⁷ The concept behind this exam is a list of 250 multiple-choice questions drawn from a bank covering the entirety of the medical programme, which is administered four times a year to all medical students irrespective of their year of study. The idea is that students will score poorly in their first year but progressively build their way up to a good score, whilst avoiding exam-oriented studying behaviour.

Although the idea of *voortgangsevaluatie* (progress testing) was included as one of the four pillars of education in *Basisfilosofie* of 1972, there was no specific plan as to how that would look in practice. Initial attempts to translate this into standard end-of-unit exams were not very successful, as Maastricht researcher Erik de Graaff explained:

At the end of each thematic block, there was a block test, and the students were expected to define their own learning goals during working on the block. When the result was to be determined by the block test, several students tried to figure out what they needed to do to get a pass grade on the block test. So rather than defining their own learning goals with all freedom, they were trying to figure out: “What is the minimum we need to know to get a passing grade”. And then they decided, and I think Wynand had a crucial role in that: “Then you need to take away the decision part from the block test. You need to take the summative aspect of the evaluation away from the block test, use it only for formative purposes and create some other tool to make decisions on student progress”. So that’s why they invented the progress test.²⁸

Wijnen proposed dividing assessment at Maastricht into two categories: formative and summative. The former should be specific, qualitative, intermediary, non-binding and connected to the educational activities with which the student was presently engaged. The latter should be more general, quantitative, concerned with the end goal of the study rather than the specific educational activities of the moment. This is how Wijnen proposed the “Screening Test”: a series of “tests consisting of multiple choice questions (4 × per year yes / no questions). One could think of taking these screening tests as sample questions from a pool that represents the knowledge base of a GP.”²⁹ The proposal suggested that the screening / progress test be

Table 3
Extract from a Screening Test of March 1977³⁰.

Screening Test of 11 March 1977

1. corynebacterium pseudodiphtheriae is normally found in the pharynx
2. Gram-positive bacteria are more sensitive to (benzyl) penicillin than gram-negative bacteria.

To which of the following diseases can staphylococcus lead?

1. Wound infection
2. Osteomyelitis
3. Pneumonia
4. Enteritis
5. Furuncle

3. "Pelvic Congestion" is a syndrome of which menorrhagia, dysmenorrhea, stomach pain and back pain are the most important symptoms. Spontaneous abortion is characterised by:

1. Vaginal blood loss
2. The cessation of morning sickness

administered six times a year, and attempt to assess, in particular, problem-solving skills, attitudes and other skills from the domain of the skills lab, and the necessary medical knowledge.

However, it seems that while the test succeeded in achieving this last goal, the other two were somewhat lacking. The results of the study evaluation of 1976–77, after the first year of the "Screening Tests", are telling in this regard: the majority of students thought that the test did not cover problem-solving skills and attitude-development enough on the one hand, and that formative evaluations did not give an adequate overview of the students' input during a block on the other.²⁵ It seems that this problem was never really tackled, and by 1977, the Screening Test essentially had the format that we know now, with Yes/No questions and a "paper problem" at the end (Tables 1–3).

6. Setting the foundations of PBL research

When McMaster began its PBL curriculum, it concerned itself principally with defining the parameters under which this new problem-based model of education would operate and not so much on *why* or *how* the model might be more effective. The Education Committee of McMaster produced a few scattered publications, all of which were descriptive or conceptual and none of which were empirical in nature. In fact, the first empirical studies to come out of McMaster were done in the late 1970s by the Programme for

Education Development and Research under the leadership of Vic Neufeld.

The importance of educational research at Maastricht was embedded in the programme from the start, given Wijnen's background as an educational researcher. The *basisfilosofie* called for a "build-up of the curriculum in close connection with the educational experts"⁶ – something that McMaster never did – and from its inception, the MFM possessed a department specifically dedicated to *Onderwijs en Onderzoek* (Education and Research). Wijnen himself did very little in terms of empirical research, however, his employees Peter Bouhuijs and Henk Schmidt took on a prominent role in that regard as early as 1977.

The pair conducted their first dual study on the subject of "The Effect of Task Division on an Educational Group"³¹ and "The Effect of the Structuring of Patient Problems on the Study Results and Learning Satisfaction of Students"³². The former looked at whether learning goals within a problem were best divided among student group members or done by all group members simultaneously during the self-study period of PBL. The latter assessed whether students would perform better and find their learning to be more satisfying if they were handed a problem with structuring questions to assist their self-study. Neither study showed a statistically significant difference in learning outcomes measured by a knowledge retention test, but both studies suggested some differences in study satisfaction. The research was published internally in a report format, and was not entirely well received by some of those amongst whom it was circulated. In April 1977, Frans Verstappen, a physiologist working at the MFM, issued a virulent critique of Bouhuijs and Schmidt's work, calling it "tendentious" and scientifically unacceptable.³³

These early criticisms did not deter the researchers, and that same year, Schmidt outlined a proposal for a comprehensive education research programme, which centred on the four educational pillars of the *basisfilosofie*, namely – problem-orientation, self-directedness, progress-evaluation and attitude development. It is clear from this memorandum that problem-orientation and self-direction were his preferred direction of research.³⁴

Schmidt and Bouhuijs went on to publish the successful book *Onderwijs in Taakgerichte Groepen* in 1980.²³ While this was not strictly an empirical piece of work, it did reflect a willingness to move beyond the sort of descriptive and specifically programme-bound reflections offered by Barrows and Neufeld at McMaster. Indeed, while the book contained some references to Maastricht, it was intended as a sort of educational manual usable by all.

In 1982, Schmidt received his doctoral degree on the basis of conceptual and empirical studies on the role of the activation of prior knowledge in furthering knowledge retention in a problem-based environment – a line of enquiry which propelled him into the field of cognitive- psychology research and made him the most published author in problem-based learning research at the time of writing.³⁵ It is fair to say that the department of *Onderwijsontwikkeling & Onderzoek* of the Faculty of Medicine of Maastricht University has been the most prolific producer of empirical research on PBL in the method's 50 year history. Of the ten most published authors in the field at the time of writing, six were from Maastricht.⁴

7. Conclusion

We can conclude from the findings of this paper that Maastricht was emphatically not a carbon copy of the McMaster programme. In fact, some of the innovations born at Maastricht, such as the skills lab, the tutor training and the progress test were imported into McMaster in later years, and incorporated into medical curricula all over the world. Even though PBL was first conceived at McMaster, the innovations in PBL developed at Maastricht are sufficiently radical and sufficiently influential to consider the development of PBL at Maastricht as an educational revolution in its own right.

This finding makes the boundaries of PBL difficult to define: by the time Maastricht developed its own variation on the McMaster theme, McMaster was already reforming its own curriculum, replacing the original “biomedical problems” approach with a “priority healthcare problems” curriculum centred on teaching clinical reasoning skills, under the leadership of Barrows and Neufeld.³⁶ Therefore, by 1980, McMaster and Maastricht had practiced three possible approaches to PBL in medical education between them, as a heated intellectual dispute emerged on the nature of PBL between leading education researchers in both institutions. This dispute has been written about extensively elsewhere, but it firmly established within the medical education community that PBL was not a method that came with a single user manual. The picture was further complicated when PBL began spreading like a wildfire in community-oriented medical schools in the developing world. Meanwhile, Harvard Medical School developed its own interpretation based on a “learning to learn” philosophy, which tallied neither with the McMaster nor the Maastricht approach.³⁷ At the turn of the century, PBL seemingly became a free-for-all of

hybrid contraptions, ranging from traditional curricula with a smattering of patient cases, to fully fledged project-based curricula claiming the name “PBL” for themselves.³⁸ And who is to criticize this trend, since PBL has been reinvented almost from the moment it was born? PBL was not a patented method: anyone could take inspiration and make adaptations, as Maastricht did. On what basis could one argue that the innovations developed in Maastricht improved PBL whilst “innovations” like hybrid curricula (or other adaptations) do not? Why should the process of adaptation described in this paper be lauded in Maastricht but not be equally applauded in all other institutions? The danger in this approach is that PBL could end up meaning everything and anything, a hold-all name for (more or less) student-centred learning in (more or less) small groups.

To conclude this paper, the author would therefore like to argue that the Maastricht innovation which possibly had the most significant influence on the development of PBL is establishing a culture of thorough scientific research on PBL in the field of medical education. This research, as described in the paper, has allowed a group of global medical education scholars, principally in the field of cognitive psychology, and principally from Maastricht, but also from the USA and Canada among others, has set some guidelines for good practice in PBL, based on empirical research, grounded in the science of learning. One of the key challenges for the coming decade, as PBL crosses the 50 year mark, is to extent that research effort into other disciplines, such as engineering education, economics and business education and other fields that are rapidly developing interest in PBL.

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Virginie F.C. Servant-Miklos is a senior lecturer at Erasmus University College in Rotterdam, the Netherlands, and a postdoc researcher at the Aalborg Centre for PBL in Engineering Science in Denmark.