# The ‘Teaching - Research’ nexus in medical education

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Section 3

# Review article

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## THE «TEACHING – RESEARCH» NEXUS IN MEDICAL EDUCATION

Research forms an important part of the academic competencies attained during academic study. For medical students, this includes learning how to critically appraise and interpret medical and wider health care research, particularly – but not only – when relevant for one»s own current or future practice. It also includes understanding the core principles of different methods and research ethics and learning to participate in research. The teaching – research nexus: strategies to implement research education in the medical curriculum. In this paper, we offer reflections on how to do this on the basis of professional anecdotal experiences by a general educationalist with a particular interest in medical education; an undergraduate medical student with a research-focussed, stand-alone additional degree, and a medical academic.

Our paper initially explores the need for research education; tying in Healey»s theoretical framework in student research, and the nature of providing evidence-based patient care. The paper then presents a report on a student research programme at the University of Birmingham, England.

**Key words:** tteaching, research, medical education.

### Introduction

*«Research» as a competency for medical doctors.*

There are numerous national and international competency frameworks guiding both medical practice and medical education. Research competencies form an important part of the standard competencies described in these frameworks. An example of this includes the Canadian «CanMEDS 2015 Physician Competency Framework» [1], which defines the abilities physicians require to meet the healthcare needs of the people they serve. These abilities are grouped thematically under seven roles: the Medical Expert (an integrating, overarching role), Communicator, Collaborator, Leader, Health Advocate, Scholar and Professional. The role of the Scholar encompasses competencies concerning interpreting and conducting research, with a strong focus on «Evidence Based Medicine».

Universities globally have adapted these professional competency frameworks to their medical curricula. In these curricula, professional competencies are usually «translated» into student learning outcomes.

The «Subject Benchmark Statement Medicine», published by «The Quality Assurance Agency for Higher Education» [2] may be considered as a British educational translation of a medical competency framework. When addressing student-selected study, the statement states that this should aim to «stimulate critical thought» and «develop further generic graduate skills and intellectual attributes underpinning enquiry and critical thinking». Additionally, this should enable students to «acquire research methods and enhance their skills in collection, evaluation, synthesis and presentation of evidence».

In Britain, the «General Medical Council» publishes the «Generic professional capabilities framework». It states: «This framework sets out the essential generic capabilities needed for safe, effective and high-quality medical care in the UK. At its heart

are the principles and professional responsibilities of doctors, and we have translated these into educational outcomes so they can be incorporated into curricula» (our italics.) The framework of the document shows a strong resemblance with the CanMEDS framework. Educational outcomes are grouped in nine domains. Domain 9: «Capabilities in research and scholarship» states that «Doctors in training must demonstrate that they can:» Followed by 12 research related learning outcomes, including «demonstrate appropriate knowledge of research methods, including qualitative and quantitative approaches in scientific enquiry.» [3].

An example of a direct «translation» of the CanMEDS framework is the 2009 framework for undergraduate medical education in the Netherlands [4], in which the seven roles of the CanMEDS framework are explicitly retained, alongside a strong focus on the importance of research education. It states that «Student-selected study has the aim of stimulating critical thought and developing further generic graduate skills and intellectual attributes underpinning enquiry and critical thinking; it should allow students to acquire research methods and enhance their skills in collection, evaluation, synthesis and presentation of evidence».

*The teaching – research nexus: strategies to implement research education in the medical curriculum.*

The strategies medical schools employ globally to enable students to acquire research competencies are varied: ranging from optional, additional teaching in addition to core curriculums, to a mandatory, significant portion of undergraduate education. As an example, Maastricht University medical school in the Netherlands employs Problem Based Learning from the first day of their undergraduate degree course. Its principles and practice are explained in an excellent short cartoon style video [5]. In the video a student says: «with PBL we learn more than just facts» and: «we learn to conduct our own research», showing inspiration and enthusiasm.

The clinical context: Combining professional competencies in practice. PBL is not the only possible approach to research education in medical studies. A medical doctor must combine their professional competencies constantly in daily practice. The care for patients is central, not the separate medical knowledge and skills that are reflected in subject areas like anatomy, immunology, physiology, etc. and also research skills. CanMED: «As Medical Experts, physicians integrate all of the CanMEDS Roles, applying medical knowledge, clinical skills, and professional values in their provision of high-quality and safe patient-centred care». So, the integration of these competencies in medical education bachelor and master programs also should receive due attention. Often this integration was – and still is – confined to the final year of the programme in a series of clinical attachments in different medical specialties. However, the earlier in the curriculum this integration is pursued, like in PBL, the closer the educational development of students will be linked to their later professional practice.

So, research competencies should be part of this integration. In the remainder of this article we will concentrate on how these specific research competencies can be integrated in a medical curriculum.

*How can the teaching – research nexus be implemented in daily educational practice?*

There are many educational research papers published about the teaching – research nexus. For instance, using «teacher – research nexus in medical education» as a search term in Google Scholar gives an overwhelming number of hits. However, most of these publications do not provide accessible, practical and succinct support to medical teachers who are often, next to their teaching load, very busy with clinical and/or research work.

Professional development workshops can provide teachers with teaching – research models and examples in an effective way, especially when collegial exchange is a cornerstone of the workshop approach [6]. Also «teacher guides» and frameworks can provide (medical) teachers with practical support.

A first example of such a guide is published by the University of Portsmouth in Britain and Nagoya University in Japan and covers «Eight principles for linking research and teaching» [7]. These principles summarize what can be done in classroom practice. The guide states that teachers could (or should):

1. Communicate the excitement of doing research.
2. Draw on your own research experiences.
3. Emphasize the process of knowledge production.
4. Include current research findings and issues in your teaching.
5. Provide opportunities to acquire research methods and skills.
6. Involve students in various research activities in your institution.
7. Create showcases of undergraduate research.
8. Introduce students to the lives and values of researchers.

Each of these eight principles is subdivided in a number of practical tips. For example, the first

principle «Communicate the excitement of doing research» provides the following:

A. Talk about your motivation for doing research.

B. Communicate the enjoyment of doing research in your field.

C. Share the excitement of producing knowledge.

D. Explain why research skills are important for students.

E. Explain how research outcomes make a difference to students» daily lives.

F. Engage students through interesting demonstrations and examples.

Finally, each principle is linked to one or a few practical examples on research skills training from Portsmouth or Nagoya University. For instance, for the principle «Emphasise the process of knowledge production» it is described how diffraction is taught in a course on crystallography. Students do a very open experiment with diffraction patterns of light falling through pieces of cloth and learn to reason in a scientific way to explain what they see.

The second example is a framework on student research that was originally developed by the University of Adelaide in Australia. «The Research Skill Development (RSD) framework was devised in 2006 to articulate what educators do when they facilitate student learning through active exploration in ways that enable their skills to grow in sophistication and rigour». Since 2006 the RSD has been adapted and re-published by many scholars and educational practitioners. Please be advised to click the link below to the framework, to support the following brief explanation.

On the y-axis of the framework six consecutive research skills are described. On the x-axis there are seven divisions on student research, ranging from «predescribed research», which is very closed and supervisor instigated, to «enlarging research», in which students act as «fully fledged» independent researchers. Each resulting square has a concrete description of the development of a particular skill at a particular level. The framework can be used to design a research curriculum or to analyse an existing one. It can also be used as a rubric [8] to assess the student learning process by attainment levels.

In 2015 the journal «Nature» published the article «The Science of Teaching Science» [9]. In this article, an approach to learning about research is advocated that is based on active student participation, at bachelor and master level, in the sciences, and in medicine. The article starts with a medical example: the description of a first-year medical student group task to help «solve» the cause(s) of an outbreak of food poisoning among a number of people attending a particular event. The article describes many other examples of effective educational methods of active learning and concludes: «what the methods share is an outcome confirmed in hundreds of empirical studies: students gain a much deeper understanding of science when they actively grapple with questions than when they passively listen to answers».

*Mick Healey»s framework of research training*

Together with several colleagues, Mick Healey of the University of Gloucestershire in Britain has published widely about the teaching – research nexus. His publications are also quoted extensively in the educational literature about this nexus and includes research work and guidelines for teachers, departments and institutions [10-11].

The core of his approach is the «teaching – research framework», in which four types of student research can be distinguished [12]. This framework helps to understand, classify and balance the many different approaches that exist in student research training.

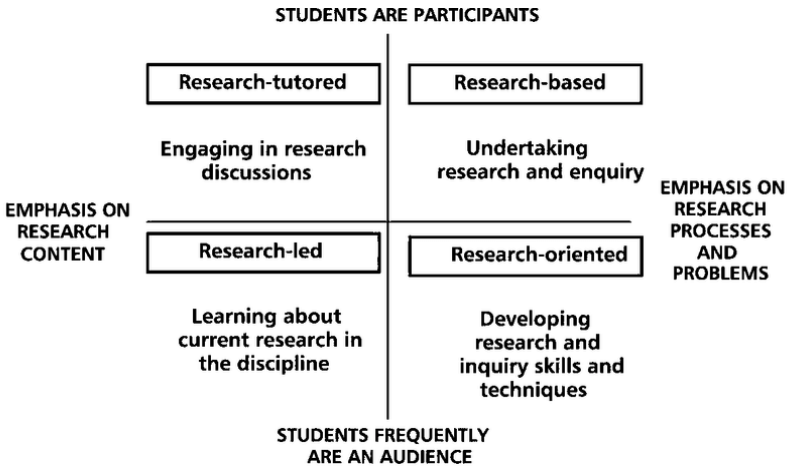


**Figure 1 –** Mick Healey»s framework of research training

The framework has two axes. The X-axis is a continuum between emphasis on research content» to emphasis on research processes and problems. The Y-axis ranges from students as audience to students as participants. This leads to four different approaches to student research education. Student research education can be:

Research-led: where students learn about research findings, curriculum content is dominated by staff or current disciplinary research interests, and some or much of the teaching may emphasise information transmission.

An example pertaining to an endocrinology or virology course: in a lecture student are taught about the medical implications of a covid infection, using a current scientific article as the basis for the lecture.

Research-tutored: where students learn in small group discussions with a teacher about research findings.

Students compare and discuss two recent medical articles with diverging viewpoints about the transmission vectors of the covid-19 virus.

Research-oriented: where students learn about research processes, the curriculum emphasises as much the processes by which knowledge is produced as knowledge that has been achieved, and staff try to engender a research ethos through their teaching.

In a series of lectures and practicals students study different research articles from the methodology point of view: their set up, the format, the type of research (qualitative – quantitative), the statistics utilized, the ethical implications, etc. Furthermore, students train with the formulation of research questions, hypotheses, selecting appropriate research methods, etc.

Research-based: where students learn as researchers, the curriculum is largely designed around inquiry-based activities, and the division of roles between teacher and student is minimised.

For example, students do a complete research project, from the formulation of a research question up to the publication of the results. The lecturer acts as a research coach, helping where necessary but leaving the ownership of the research very much with the students (see below for an extended example from the medical school of the University of Birmingham.)

*Some remarks about Healey's framework*

Healey emphasises that all four forms of research education have their own value. In education practice, there is no preference for one of them, nor a preferred sequence in time. In a balanced medical curriculum, all four forms will have their place!

Each of the four forms of research education can be realised in many different ways and at all levels of (medical) education. Unfortunately, it is still a common misconception that «research-based learning», where students are in charge of the whole research process, only can take place at the end of a bachelor or even master program, after they have «mastered» all research tools and techniques necessary for «proper» research. In the medical educational literature there are many examples that medical students can engage in full research even from the beginning of their first year.

An example of «research-based learning in the first year of medical education is given by Prof. Friedo Dekker of the Medical Center of Leiden University in the Netherlands [13]. He (quote) «asked all 1st year Bachelor of Medicine students to do a 2-week clinical attachment in a nursing home in September, to collect data on 3 selected patients (comorbidities, laboratory results, medication, ADL, cognition), to create a SPSS database, to go back to the nursing home in December, to collect same data (on same patients they collected data from in September?), to formulate a research question, to participate in a course with 5 days of lectures, assignments, practical and small working group sessions, to present a research question, to present a research project, and to write a short report.» Of course, this type of student research does not necessarily lead to publications in peer reviewed medical journals. It is often published in «student research journals» and/or presented at student research conferences.

Individual teachers can use the framework to assess their own teaching practice. Which forms of research education are part of my repertoire? How could I engage in different forms of research education? Is my research teaching «implicit» or do I make my students aware of its research components? How do I use my own research as part of my teaching? Etc.

The framework also can be very useful at the level of a department or institution. A curriculum evaluation analysis can be performed on the basis of the framework to find out which forms of implicit and explicit research education take place across the different disciplines of the curriculum, how they overlap or interfere and which omissions come to the fore.

Finally, the framework can also be an important cornerstone in medical curriculum design.

A case study: the BMedSc programme course «Global Health» of Birmingham University, UK. The University of Birmingham (UK) offers a research-oriented Intercalated BMedSc Degree

Course Global Health, where medical students take 10 months out of their standard programme after their 3rd or 4th year of study [14]. This program is for those students who wish to explore global health as potential future health professionals and/or academics, carry out original field research or literature study, share the results of their work with host communities and get their research published.

During their research year, students engage in a number of different activities, covering all four quadrants of the Healey framework, with an emphasis on research oriented and research-based approaches. Students receive a firm grounding in health policy, social determinants of health, communicable and non-communicable disease control, and rigorous qualitative and quantitative research methods. Furthermore, research ethics are taught as well as challenges in research of pharmaceuticals, medical appliances and large health/ health care data source, the direction of RD, Intellectual property rights and global social justice. Principles of advocacy, innovation and fundraising are also taught. There is a strong focus on experiential learning, where students, through their group work, presentations and debates, «own» and create, rather than receive their learning. Overseas field studies are typically carried out in collaboration with clinicians/academics/students in the host country over an 8-12-week period early in the calendar year. Ethical approval processes are rigorous and in full compliance with the hosts» requirements.

Research topics are often proposed by health professionals in overseas settings and include a variety of topic such as:

Qualitative research on perceptions around obstacles to trachoma control in West Africa.

Perceptions of men of their health care seeking behaviour in East Africa.

Vectors of Chagas disease in Bolivia.

Quantifying the need for surgical and anaesthetic training in Sierra Leone.

Knowledge and attitudes around postnatal depression in a hospital setting in SE Asia.

Access to health care and perceptions of women admitted to hospital for miscarriage in Southern Africa.

And more…

Research can be one-off, or year-on year, adding further value by building on previous studies, as in the Loreto region in Peru, where our students respond to local health research priorities. Results are fed back to the health services in the host setting.

During 2020-21, due to corona restrictions, studies by remote interviewing were carried out, mainly in the UK. The main focus was on perceptions of corona control responses by selected groups in different countries, with the aim of learning from each other»s experiences and informing the development of better preparedness for future, unknown, large-scale and severe global health and health care challenges at local, national and global levels.

While prior academic achievements may be predictive of success, students are warned that this is not always the case for this programme, which is «outside the box» of customary medical education.

A large proportion of studies is published in mostly open access peer reviewed academic journals. For example, see references [15,16,17]. Please note that almost all first authors are the students, who were the «Principal Investigators». Apart from fulfilling the duty of making research findings easily available to researchers, practitioners and populations, it adds to the student»s credentials as an accomplished researcher in their CV.

While student satisfaction during and immediately after the course was generally high, a weakness of the programme is that it does not yet have a system to capture feedback from alumni who now practice medicine.

*Student perceptions of research training.*

During their studies, students take many different courses. Some students find some courses less inspiring, other students find the same or other courses inspirational or even «life changing», as is anecdotally the case for students in the above case study from Birmingham University. In addition to the question of what students feel about a course it is also important to ask what they learn from it. It is safe to assume (and research shows) that students learn more from courses that employ active learning methods, during which students feel intellectually and emotionally engaged, than from courses based solely on book knowledge and rote learning.

To appraise and improve the quality of research education it is important to evaluate the learning outcomes of the students. That can be done by grading tests, assessing practical skills, benchmarking student research papers, etc. An important aspect of such evaluations is to determine the perceptions students have regarding their learning processes & learning outcomes and their perceived development towards professional medical practitioners.

An example of this type of educational research is reported in the publication What Do Medical Students Understand by Research and Research Skills? Identifying Research Opportunities Within Undergraduate Projects [18]. A mixed methods approach was used to answer this question for five medical

schools in the UK. The approach included documentary analysis, student focus groups and, interestingly, a «student study day», during which the outcomes of the research were intensively discussed with the student target group. The article summarizes its outcomes in three «Practice Points»:

«Students and academic staff have different perceptions of what constitutes research and the research skills that will be acquired from specific projects.

To fully benefit from research opportunities and develop essential skills, undergraduate students must be given training in «what research is» and project descriptors should be explicit about the research skill development opportunities provided.

Medical students should engage with research from the initial stages of their undergraduate education, and medical educators must facilitate significant student engagement with research and associated skills.»

## Conclusion

In this article an overview has been given of the important position of «research competencies» as part of a much wider array of medical competencies that a medical doctor must be able to employ in an integrative way in his or her professional practice. Therefore, research competencies are part of medical curricula all over the world. The educational approaches and methods that can be employed to enable students to achieve these competencies vary very much. Healey»s framework of research education offers a strong tool to analyse these different methods and make appropriate curriculum choices. Finally, the importance of evaluation of research education is stressed. Student perceptions play a key role in these evaluation efforts.

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