

When one performs a Google search using the keywords “scholarship,” “radiology,” and “education” the results are quite surprising. For many people it appears, the term “scholarship” refers only to monetary support for the educational and training programs in radiology. For others, it refers to funding used to sponsor residents and fellows to attend professional conferences. When the same keywords were used for a PubMed search, 144 articles were identified. Most of the PubMed articles deal with residents and fellows training in radiology and its many subspecialties. This body of literature indicates the practice of educational scholarship within academic departments of radiology (i.e., the systematic documentation of teaching, learning, and assessment of learning outcomes). Only one article expresses the concept of scholarship in its full meaning within the community of academic radiologists. For the authors,

...the contributions of educators to the viability and growth of the specialty require equal legitimacy to research in academic recognition. Development of educators and documentation of educational activities are key elements in achieving academic status for scholarly activity (Wood and May 2006).

From these cursory observations, it appears that there is a principal need to first define the term “scholarship” in the sense that we are using it in this book, where the goal is to promote and enhance the concept and formal implementation of scholarship in the teaching and learning of radiology within academic departments of radiology. Once the concept of educational scholarship is clearly defined, like-minded radiologists (who are already practicing teaching under this paradigm) may find opportunities to engage with the ideas and experiences of others through this endeavor.

R.K. Chhem
Department of Medical Imaging, Schulich School of Medicine
and Dentistry, University of Western Ontario, London, ON, Canada N6A 5C1
E-mail: rethy.chhem@lhsc.on.ca

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2.1

What is Scholarship in Radiology Education?

According to Merriam-Webster's online dictionary, the term "scholarship" is defined in the following order: (1) a grant-in-aid to a student (as by a college or foundation); (2) the character, qualities, activity, or attainments of a scholar; (3) a fund of knowledge and learning (drawing on the *scholarship* of the ancients). In this book scholarship would refer to either the second or the third meaning as given above. For a more comprehensive understanding of the application of the term "scholarship" as it applies to academia, we draw upon Ernest Boyer's work. Boyer popularized the concept of scholarship as it applied to academic activities in the American higher education system, which has increasingly permeated into many medical schools' academic paradigms (Boyer 1990). According to Boyer, the work of the professoriate can be divided into four overlapping functions, namely, the scholarship of discovery, integration, application, and teaching (Boyer 1990) (Table 2.1. Boyer's work stimulated a surge of interest and growth in the body of knowledge on scholarship, and in 1997, Glassick et al. (1997) followed it up with another notable work on the topic, *Scholarship Assessed*, which builds on Boyer's foundation.

Notably, in Boyer's conceptual framework of scholarship, the equitable inclusion of the four areas does not in any way minimize the importance of discovery.

According to Beattie (2000), the scholarship of discovery "should not be minimized as new models of scholarship are recognized, described, evaluated and rewarded" (p. 873). There is no argument that the scholarship of discovery must be sustained as the advancement of specialized knowledge is constantly required. Discovery of knowledge plays a vital role as the "process, the outcomes and especially the passion of discovery enhance

Table 2.1 Boyer's four areas of scholarship

Discovery	To discover is a key element in scholarship. For scholarship to be sustained, the advancement of specialized knowledge is required. Discovery contributes not only to knowledge but also to the intellectual climate of a college, university or department
Integration	To interpret, to draw together and to bring new insights to bear on original research Integration advocates a capacity to look for new relationships between the parts and the whole
Application	To ask questions: How can knowledge be applied? How can it serve the interests of the department, university, community, the world? Application addresses the issue of the interaction between theory and practice
Teaching	To move teaching beyond a routine function to be viewed as an endeavour that not only transmits knowledge but also transforms and extends it

From Boyer (1990)

the meaning of the effort of the institution itself” (see p. 9 in Glassick 1997). Integration becomes true scholarship when novel insights, both interpretative and interdisciplinary, are discovered. According to Glassick et al. (1997), the scholarship of integration makes connections between the disciplines by “altering the contexts in which people view knowledge and offsetting the inclination to split knowledge into ever more esoteric bits and pieces....The scholarship of integration seeks to interpret, draw together and bring new insights to bear on original research” (p. 9). Integration advocates a capacity to synthesize and to look for new relationships between the parts and the whole. Application looks at how knowledge can be applied and how can it serve the interests of the larger community. Scholarship of application has to “prove its worth not on its own terms, but by the service to the nation and the world” (Hanlin, in Derek Bok 1990, p. 103). The common aspect of scholarship of application is the dissemination of useful, testable, and reproducible information to others. In terms of clinical expertise, what constitutes the scholarship of application? This could apply to patient-oriented research such as clinical trials, drug or physical therapy, or case-controlling studies such as the relationship between smoking and lung cancer. Application looks at how intervention works when applied to humans.

According to Shapiro and Coleman (2000), in the case of clinicians who see many patients and become experts in clinical evaluation, their experiences constitute expertise but not necessarily scholarship. The authors add, however, that if clinicians “systematically assess the effectiveness of different techniques and communicate these findings in a way that allows others to benefit from that expertise” (p. 896) then that is scholarship. The dominant view of scholarship appears to place research and theory as hierarchically superior relative to practice; practice has been predominantly viewed as the passive recipient of knowledge. The scholarship of application dictates that theory and practice are complementary and mutually enriching. Teaching is often viewed as “a routine function, tacked on, something almost anyone can do” (see p. 23 in Boyer 1990). Boyer argues that teaching needs to be viewed as a dynamic endeavor that goes beyond the transmission of knowledge to transform and extend knowledge. Glassick et al. (1997) contend that scholarly teaching “initiates students into the best values of the academy, enabling them to comprehend better and participate more fully in the larger culture” (p. 9).

While there is a strong and well-established infrastructure to assess and reward the scholarship of discovery, there is an urgent need for mechanisms to review and advance the scholarship of teaching. There is a need to develop a strong infrastructure that can provide a systematic examination of the degree to which there is support and recognition for faculty as educators. Glassick proposes six standards for judging excellence of scholarship that include clear goals, adequate preparation, appropriate methods, significant results, effective presentation, and reflective critique (Glassick 2000) (Table 2.2).

For most faculty members, the scholarship of discovery is not only the most prestigious and “noble” function, but practically speaking it is the kind of scholarship that is rewarding during the promotion and tenure process. The scholarship of discovery is highly regarded because it “contributes to the intellectual climate of a college or university, not to mention its role in enhancing the track record of scholars, further increasing the likelihood that

Table 2.2 Glassick et al.'s six standards of assessment of scholarly work

Standard	Does the scholar
Clear goals	<ul style="list-style-type: none"> – State basic purpose of work? – Define objectives that are realistic? Achievable? – Identify the important questions in the field?
Adequate preparation	<ul style="list-style-type: none"> – Show an understanding of existing scholarship within the field? (ex: literature review) – Bring skills to the body of work? – Bring resources that allow the project to move forward?
Appropriate methods	<ul style="list-style-type: none"> – Utilize a methodology that is appropriate to goals? – Apply methods effectively? – Modify procedures in response to changing circumstances?
Significant results	<ul style="list-style-type: none"> – Achieve the goal? – Does the work add consequentially to the field? – Address areas for further exploration?
Effective presentation	<ul style="list-style-type: none"> – Utilize a suitable style and organization to present the work? – Utilize a suitable forum to communicate and share findings with an audience? – Present the findings with clarity and integrity?
Reflective critique	<ul style="list-style-type: none"> – Critically evaluate the work? – Bring appropriate breadth of evidence to the critique? – Use evaluation to improve quality of the work?

From Glassick et al. (1997)

they would secure a research grant. In medicine and radiology, scholarship of discovery activities includes an original research project, followed by publication in a high-impact peer-reviewed journal. An example of scholarship of integration is the use of specialized knowledge across the medical discipline with the goal of educating the nonspecialist. This includes the organization of imaging rounds for cancer specialists and the publication of a critical review of the indication of computed tomography angiography in cardiac diseases or a book chapter on musculoskeletal ultrasound in sports injuries. Scholarship of application consists in using knowledge for the benefit of individuals, institutions, and society. This includes the validation of a new test in disease detection or the use of an image-guided interventional procedure to extract a ureteral stone. The last but not the least of these four types of scholarship is the scholarship of teaching, which is the focus of this book. It is important to emphasize that although we are focusing on teaching because it has been seriously neglected, it remains one component of the whole and we are promoting a program that synthesizes all four elements equally. Our efforts are directed at helping radiology departments understand the scholarship of teaching and learning as an integral part of the larger picture of academic scholarship.

The scholarship of teaching is curiously the least understood and practiced in academic radiology departments. It is worth remembering that the word doctor, as Gunderman

et al. (2003) point out, comes from the Latin *doctoris*, which means “teacher.” Indeed, we all teach radiology to medical students both informally and formally. We train and supervise residents in radiology and nuclear medicine, and fellows as well. Sometimes we participate in the assessment process during the examinations organized by the school of medicine or professional licensing bodies, submit multiple-choice questions to examination databases participating in objective structured clinical examination or objective structured practical examination, or rarely serve on curriculum committees. Exceptionally, a very few of us would publish a research paper on the process of teaching and learning itself. Finally, while we often consult PubMed to enlighten our daily radiology practice, few would consult a book on educational theories or strategies or learning objectives established by the curriculum office before lecturing an auditorium full of medical students. The difference between the very professional, scientifically rigorous way in which we embrace our clinical practice and the “amateurish” way we approach teaching is remarkable. An expanded body of medical imaging knowledge and medical sciences has led to a crowded curriculum for the 5-year residency that cannot be sustained without attention to the scholarship of teaching and learning.

This situation calls for a reassessment of the way we teach and learn radiology at the present time and in the future. We must reconsider the current approach to addressing the growing curriculum if we hope to keep the content and duration of radiology or nuclear medicine residency programs within a reasonable scope, breath, and time. Expanding the scholarship of medical imaging, which has traditionally predominantly recognized activities of discovery, integration, and application of knowledge, to include equal recognition of the scholarship of teaching is a pressing necessity if we hope to cope with the incoming tide of new knowledge and if radiology is to ride the crest of these inevitable changes.

The scholarship in outreach is the last but not the least important activity that measures the impact of scholarship on the community at local, regional, and global levels. Lerner et al. define “applied developmental science” as a scholarship that seeks to advance the integration of developmental research with actions – policies and programs – that promote positive development and/or enhance the life chances of vulnerable children and families (Lerner et al. 2000). Sandmann et al. recommend that scholars engage in community-based projects (defined as the scholarship of outreach), as an additional dimension within the many missions in academia. These authors suggest that community outreach provides an excellent opportunity to learn about the scholar’s own work (Sandmann et al. 2000). These two separate projects share the same foundation, that is to foster the scholarship in outreach, and may become a model for sharing radiology teaching and learning experience with colleagues from developing countries such as China, Cambodia, or Peru as documented elsewhere in this book. In order to be accepted as a scholarly activity, outreach projects must be guided by a question that leads to knowledge discovery, integration, application, transmission, or preservation. Following on from Glassik’s model, the scholarship of outreach must be guided by clear goals, appropriate methods, significant results, effective communication, and reflective critique (Sandmann et al. 2000). In fact the scholarship of outreach may become a “fifth dimension” of scholarly activities complementing the four others defined by Boyer.

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2.2 Why Expand Scholarship in Medical Imaging?

The “ecosystem” of medical imaging is changing rapidly because of the acceleration of knowledge discovery in medical imaging in particular and in biomedical science in general. The new ecosystem of medical imaging includes, among others, the ability to map the human genome with its implications in life science and medical practices, the development of information technology (imaging informatics), and the availability of huge databases and powerful computers (computer grids, ultradense storage, and databases that integrate clinical, laboratory, and imaging data as well as DNA/protein sequences, advanced data mining, and pattern-discovery algorithms) (Thrall 2005; Branstetter 2007a, b; Garlatti and Sharples 1998). These medical and technological breakthroughs have already altered the pattern of medical practice. New medical imaging methods (molecular imaging, cell imaging, functional imaging, etc.) are now available, and most of them are already in operation in clinical practices. Progress in pharmacogenetics will soon lead to a new way of treating patients in the form of personalized medicine, not to mention the hope of an effective adult and embryonic stem-cell therapy for certain diseases. At the core of these tremendous changes stands medical imaging, which is becoming a sort of “medical GPS” that detects, targets, and destroys abnormal molecules or cells. To reach this goal, radiology educators may have to think about redesigning the medical imaging curriculum to equip future physicians and radiologists, and nuclear medicine physicians as well with a body of knowledge that meets the demands of medical practice in the postgenomic and digital eras (Thrall 2005).

Another technology that has revolutionized the way radiologists “read their films” is the widespread use of picture archiving and communication systems, which is addressed elsewhere in this book. The interpretation of a huge number of images, which can reach a few thousand in one computed tomography study, called also for a new way to interpret medical images. Computer-assisted diagnosis has already become operative in some advanced medical imaging centers. Equally important, there will be a major paradigm shift for radiologists who are used to the anatomical dimension of the human body to move towards a functioning interpretation of medical imaging. Finally, molecular imaging is looming on the horizon and may soon become available for some selected clinical situations. Again here radiologists have to move from organ to cells then to molecules (Hoffman and Gambhir 2007).

These medical and technological advances have already blurred the boundaries between “radiology” and nuclear medicine. Hybrid imaging, which is now already in operation, has actually “merged” the two specialties. This raises the question as to how to train physicians to become specialists who can operate in this new environment. Here again there is a need for innovation of the curriculum that needs to include new parameters imposed by the new medical imaging ecosystem (Hoffman and Gambhir 2007; Gunderman et al. 2002; Williamson et al. 2004).

Besides the issues related to curriculum content that would equip specialists to practice in this changing and expanding environment, the scholarship of teaching/learning must take into consideration the educational requirements of accreditation agencies such as the American Board of Radiology, the American Board of Nuclear Medicine, and the Royal College of Physicians and Surgeons of Canada, keeping in mind the specific requirements of, for example, the Canadian system of CanMEDS.

The issues mentioned above have addressed some of the complexities involved in the organization of teaching and learning in the context of a profession. In addition, curriculum planning must also take into consideration societal needs as the ultimate goal of any biomedical research in general and medical imaging in particular. Finally, the globalization of biomedical research and education with numerous transnational research and educational projects merits consideration in the planning and establishment of medical imaging residency programs.

A last word on the expanding role of medical imaging teaching is the humanitarian needs to address the teaching/learning of the medical imaging specialty in developing countries that have been taken up by outreach programs established by universities, learned professional societies, or governmental international organizations such as the International Atomic Energy Agency.

2.3

How to Expand Scholarship in Medical Imaging Education?

As in all endeavors, an innovative approach to teaching scholarship requires a combination of factors in order to be successful. At the top of the academic organization, there is a need for staunch support from the dean of the medical school, who will advocate and engage with peers, colleagues, administrators, and students as well as embarking on that journey. At the operational level, the academic chair of radiology needs to secure the support of members in the department. Not all members will be convinced at the early phase of the development of an auspicious environment for teaching scholarship to blossom. However, a few will respond enthusiastically and the majority will either follow or remain neutral with respect to the new initiative. The next crucial step is to recruit professional educationists willing to interact with radiologists; radiologists who bring a very different background in education and training to their commitment to teach their own specialty, despite the lack of a formal qualification in educational principles. Finally, the department chair must be able to secure the resources necessary to sustain a “business plan” to foster and practice the scholarship of teaching and learning.

2.3.1

Academic Leadership

In order to foster, to value, and to implement the scholarship of teaching unfailing support is required from the academic senior leadership team, including the provost, the dean of the medical school, and the radiology department chair. Leadership support must be translated into a business plan that includes sufficient resources, such as administrative, academic (educationists appointed within the clinical department and/or clinical radiologists with a formal qualification in education), equipment, space and supplies, and operational funding as well. In addition to senior leadership support, Fincher et al. suggest that clinicians and basic scientists must form coalitions with other educators to advocate changes needed to enhance teaching scholarship, through policy-setting committees (Fincher et al. 2000).

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2.3.2

Faculty Members

Most academic departments of radiology invite faculty members to serve on educational committees (undergraduate and postgraduate) depending on their declared interest in and dedication to teaching. Although few have any formal training in education, their “passion for teaching” forms a necessary but insufficient requirement to do the work of developing and implementing a curriculum based on sound educational principles. As a result, programs tend to resemble an amalgam of presentations centered around the “medical expert” role, but devoid of any overarching vision or understanding of curriculum design, which includes, for example, plans for appropriate pedagogical strategies or meaningful assessment and evaluation. Educationalists are able to bring this knowledge and expertise to the department to work collaboratively on the macro issues that surround planning, and then on the micro issues that involve teaching.

It is important for educationalists to document all teaching and educational activities as a means of assessing and responding to the varying needs of the department, to build evidence to support scholarly activities, and as a way of generating exemplars to share across the department with committees experiencing similar challenges. The documentation also serves additional purposes. First, it allows each faculty member to build a teaching portfolio that reflects his/her own career development. Second, the collection of portfolios across the departmental faculty members can be assessed to reflect improved excellence in teaching within the department, a crucial tool for measurement of performance during the annual review. The development of a “scholarship-in-education” portfolio (Wood and May 2006) should include:

- › Teaching and evaluation activities
- › Educational program directorship
- › Educational research (presentations, seminars, publications)
- › Grants in education
- › Educational awards
- › Educational services (committees, councils, organizations, etc.)
- › Advising, resident and graduate student supervision
- › Curriculum development
- › Outreach activities and
- › Professional development

The “educational portfolio” model has been adopted as recognized criteria for promotion in many academic institutions (Hafler and Lovejoy 2000). For Simpson et al., “educational excellence requires documentation of the quantity and quality of education activities. Documenting a scholarly approach requires demonstrating evidence of drawing from and building on the work of others, and documenting scholarship requires contributing public display, peer review and dissemination; both involve engagement with the community of educators” (Simpson et al. 2007).

Beyond the establishment of faculty career development among physicians and basic scientists, it is crucial to include professional educationists within a clearly defined structure

dedicated for the support of scholarly activities in radiology education. This is the fundamental point that needs to be emphasized within the endeavor. Physicians and basic scientists have been educated and trained to produce scholarly works in their respective clinical and scientific fields. Few of these faculty members have had any formal training in education such as curriculum design or development, philosophy and theories of education, cognitive psychology, measurements and assessment, etc. Hence, there is crucial need for the inclusion of professionals educationists within the radiology department. Ideally, in order to build a sustainable team, the educationalists would require a faculty appointment with a clear path for career development similar to those held by the clinicians and scientists in the field.

2.3.3

Specific Educational Structures

There are many types of structures within a medical school or a university that are dedicated to the development of teaching scholarship. An academy of/for medical educators is one example, with models from the University of California, San Francisco and from the UK (Bligh and Brice 2007; Cooke et al. 2007; Sandars and McAreavey 2007).

The overall aim [is] to develop and sustain medical education as an academic discipline. This is an important milestone in the journey of ensuring that medical education becomes a recognized professional discipline in the UK. Our experience suggests that few educators apply the same degree of scholarship to medical education as they do to their other professional discipline, such as being a physician or being a general medical practitioner. The potential of the new academy to improve the quality of medical education will be determined by its membership and their understanding of the nature of the scholarship of medical education (Sandars and McAreavey 2007).

These structures have been established to foster teaching scholarship in medical education in general. We have developed our own model, focusing exclusively on teaching/learning scholarship in radiology/nuclear medicine. For the first time in the history of the department, the Faculty of Education has entered into a partnership with the Department of Medical Imaging, Schulich School of Medicine and Dentistry, University of Western Ontario (<http://www.edu.uwo.ca/cedrnm/>). The purpose of the interdisciplinary collaboration is to support the vision of optimizing the role and function of education in radiology/nuclear medicine. This center has three main goals:

1. Strengthen curriculum design and implementation (including IT) in response to educational needs
2. Support and guide “the art of teaching” for faculty and residents at both practical and theoretical levels
3. Advance educational scholarship in medical imaging education through research

These three goals are the operational translation of the scholarship of teaching and learning as defined above. Within less than 2 years, the center was involved in several academic activities that included curriculum design and implementation as well as in supporting and guiding “the art of teaching” for faculty members and residents:

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In practical terms, the educators from our center:

- › Serve on the Department of Radiology's Resident Training Committee, both at undergraduate and et postgraduate levels
- › Participate in Schulich's faculty and staff development courses in all applicable areas (for example, Web conferencing or CanMEDS roles)
- › Attend the biannual department meeting of the Department of Medical Imaging
- › Attend journal club meetings, citywide and grand rounds to gain understanding of the radiology/nuclear medicine resident's experience

In theoretical terms the educators:

- › Met with various medical students showing an interest in radiology education to discuss the possibility of their involvement with the center's activities
- › Met with the Associate Dean of Undergraduate Medical Education to gain understanding of the initial knowledge base of radiology residents
- › Met with various members of the department on a one-on-one basis to discuss teaching methods and solutions and mentoring and to review their course materials
- › Met with the chief residents from the areas of both radiology and nuclear medicine to discuss the role of the center and what can be offered to them specifically
- › Met with members of the Schulich School of Medicine and Dentistry's Research Office to discuss funding possibilities and application

The center contributed to the advancement of scholarship in medical imaging education by:

- › Establishing an educational series, developed and presented to residents, faculty, radiologists, and nuclear medicine scientists on the topics of anatomy of curriculum, teaching and learning theories, assessment and evaluation, and building a culture for mentorship
- › Presenting the aforementioned educational series by invitation locally, nationally, and internationally (at the Duke-National University of Singapore Medical School)
- › Applying for and receiving funding for radiology education research
- › Establishing and organizing the First Annual Scholarship in Radiology Education conference, which was hosted jointly by the Schulich School of Medicine and Dentistry and the Faculty of Education, University of Western Ontario
- › Launching the Society for Scholarship in Radiology Education

2.4 Conclusion

In this chapter we have defined what scholarship is in academic radiology, identified the categories, explored why and how we should expand scholarship in this clinical field, and stressed the importance of the scholarship of teaching in radiology departments. In order

to achieve excellence in educational scholarship in radiology, there is a need to invest substantially in building intellectual capacity (educationists and radiologist-educators, resident-educators) and in developing adequate infrastructures. Exploring scholarship in radiology education is in its infancy and calls for a broader consultation and debate among educators and radiologists in order to expand the understanding of its concept and its implication in order to integrate its values into the training of radiologists to meet the accelerating changes of the practice of radiology.

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