

# **Teaching Radiology Courses: How to Address Learning Needs of Medical Students Through Interacting in Radiology**

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#### **ARTICLE INFO**

#### **ABSTRACT**

#### **Keywords:**

Radiology courses Learning needs Interaction Medical education Radiologists in radiology courses (RC) at teaching and university hospitals train medical students in competent image interpreting and reporting (IIR). Information extracted from imaging is crucial for clinical decisions and therapies. This article attempted to explore a teaching approach adapted from adult education for clinical teachers in radiology to address learning needs (LN) in radiology by interacting and tailoring teaching content to LN. The following conclusions were drawn: Addressing LN could encourage students to learn about IIR; Integrating students to negotiate teaching content should take place if feasible, despite high workload and little teaching time in clinical routine; Negotiating with students and co-teachers of other imaging disciplines would help to tailor course specifics to LN and avoid redundancies; Interacting with medical students could be efficient and effective for clinical teaching and learning in RC.

## 1. Introduction

Radiology courses (RC) at teaching and university hospitals encompass more than merely fulfilling an educational assignment for radiologists. Clinical teachers in radiology should reflect on their educating to consider medical students' expectations and catch learning needs (LN) in image interpreting and reporting (IIR) of common clinical patterns in imaging besides anatomical structures. Radiologists should try to tailor teaching content in IIR. With time being limited in one-session-courses, radiologists and student groups should discuss LN. With that said, it seems essential to rapidly address students' pre-knowledge of common indications and radiology, without setting objectives too high or too low (ESR, 2015). The purpose of this article was to explore a teaching approach in RC by presenting ways of addressing LN adapted after Arnold et al. (Arnold, 2018).

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## 2. Description

## 2.1. Encouraging interaction with students in radiology

RC described comprise for instance radiographic, gastrointestinal and abdominal, musculo-skeletal and interventional imaging. Clinical teachers in radiology are recommended to reach out to medical students through dialogue at eye level (Lujan and DiCarlo, 2017; Petsch, 2018) to roughly find out about LN before actually going into course specifics. It seems suitable inquiring on pre-knowledge in one-session-courses (Taylor and Hamdy, 2013) at the beginning of class to efficiently cater LN (ESR, 2015; Petsch et al., 2020a) in the limited time available. It can be argued that communication, if only brief, is the key. LN could be negotiated to tailor teaching objectives to group learning levels (Gunderman and Bedi, 2013; ESR, 2015). If relevant, teachers can adjust requests on clinical and interventional radiology and patient care.

Face to face interaction allows teachers to instantly prompt learning processes (Taylor and Hamdy, 2013; Petsch et al., 2020a) or to clarify main topics yet unclear (Bullock et al., 2008). It allows to check back on requests and pointedly find out about LN in IIR. Brief dialogue in class (Bullock et al., 2008) offers both radiologist and students the chance to rapidly bring across mutual learning and teaching objectives (Webb et al., 2013; Saul, 2018; Petsch et al., 2020a). It allows both parties to mutually decide on an agenda, if feasible even in limited time available (Bullock et al., 2008; Arnold, 2010).

Additional teaching and contact time is limited due to an increase of workload in radiologists' daily workflow (Gunderman and Bedi, 2013) and in numerous case conferences (Petsch et al., 2020a). With tight work schedules and educational assignments, teachers might be reluctant to integrate negotiating topics in class. Yet, despite all, radiologists must ensure that students throughout medical school become familiar with IIR regarding the most common indications and contraindications. Students should not be left without the chance to learn about radiology (Gunderman and Bedi, 2013). Already knowing about anatomical structures, they should be trained in detecting basic patterns and demonstrating the most common pathologic findings. Radiologists should be in touch with co-teachers of other RC to reach a consensus in one's teaching approach (Petsch, 2018), focus on relevant topics, avoid redundancies (Webb et al., 2013; Dettmer et al., 2015), and tailor clinical content to LN (Petsch et al., 2020a). As radiology is imperative to clinical diagnostics and interventional procedures, radiological imaging is inevitable for medical education (ESR, 2017). Radiologists should encourage students to understand imaging as the basis for initial medical assessment.

An innovative teaching approach in radiology (Gunderman and Hafeez, 2010) might, however, not find much agreement if increasing workload dominates daily clinical routine. Patient care is foremost, but students as future medical doctors need radiology teaching (Murakami et al., 2014) in particular. Instead of discarding existing teaching settings to establish new RC, teachers could continue using existing ones. By addressing LN through mutual deciding, students are encouraged to demonstrate active learning (Bovill, 2013) and participation (Bullock et al., 2008). Yet, Bovill et al. (2015) argue that negotiating as a sole teaching approach should be scrutinized by clarifying when to address LN. Teaching objectives cannot entirely be discarded for the sake of catering all LN. It is further argued that negotiating specifics will demand a more flexible and sensitive behavior to needs (Bovill, 2013). It is the choice of the teacher to gauge mutual deciding.

## 2.2. Addressing learning needs in radiology by interacting

Flexible face to face interaction seems suitable for a teaching approach largely looking at addressing LN (Arnold, 2018; Petsch et al., 2020a). One adapted pedagogical method applied in adult education derives from the four 'strategies of demand' by Arnold et al. (Arnold,

2018). With this approach LN can be addressed through dialogue, while being time-effective for clinical teaching and learning in radiology (Petsch et al., 2020a). If medical students state they are missing basic insight into radiology in particular (Visscher et al., 2015), or sufficient interaction with radiologists (Wirth et al., 2018), this feedback should be reflected (Berman, 2015) by looking at what they must learn for clinical and interventional radiology. An interactive teaching approach is useful when content has not entirely been decided on (Arnold, 2018), or when teaching material is subject to revision. Dialogue as in clear (Bullock et al., 2008) and flexible discussions at eye level (Lujan and DiCarlo, 2017; Petsch, 2018), and briefings or debriefings among participants involved (Arnold, 2018), can be suitable to encourage an active learning attitude (Bullock et al., 2008; Arnold, 2018). Arnold (2018) indicates that LN can best be understood by looking at existing courses to have an idea from where to start tailoring teaching content. It is, however, stated that LN can only be met temporarily and cannot entirely be satisfied, as LN are dynamic and continuously subject to change (Arnold, 2018) throughout any type of education.

### 3. Discussion

## 3.1. Ways of interacting in teaching radiology

Clinical teachers in radiology look at what students must learn to work as a radiologist, or to work with IIR as a non-radiologist (Gunderman and Hafeez, 2010). Common teaching in clinical diagnostics and therapy includes detecting and describing patterns on projection radiographs, magnetic resonance imaging (MRI) and computer tomography (CT) scans and ultrasound imaging. Students are e.g. trained to understand normal patterns of gastrointestinal and abdominal images, clarify acute abdominal symptoms, recognize findings of liver disease, or describe fractures with acute trauma patients in appropriate terms (Webb et al., 2013). Basic teaching should be enhanced for those, who are little or not interested in radiology but who cannot avoid IIR in their future clinical duties. It should be enhanced for those who remain undecided about their medical career but who will encounter radiological imaging, and for those who have opted for radiology. Either way, with radiology being inevitable for medical education (ESR, 2017), and often indispensable for patients during hospitalization (Buerke et al., 2012), students will have to learn the basics in diagnostic workup, and in IIR for their clinical work and patient care (Gunderman and Bedi, 2013; Murakami et al., 2014; Dettmer et al., 2015). All medical students must learn which information of an indication is crucial for diagnosis and the most suitable therapy. They must learn that clinical decisions depend on information extracted from competent IIR (Petsch et al., 2020b). Teachers should be flexible in their teaching behavior to find the right balance between meeting general LN (Berman, 2015; Arnold, 2018) and catering individual LN and interests (ESR, 2015).

## 3.2. Negotiating learning needs in radiology

Clinical teachers should partially adjust content, such as complex clinical cases (Subramaniam and Gibson, 2007) to LN by negotiating (Gunderman and Bedi, 2013) with students and co-teachers of other RC (Petsch et al., 2020a). As radiology interfaces with many specialties that need diagnostic imaging for patient care, e.g. gastroenterology, urology, gynecology, general or orthopedic surgery, neurology or neurosurgery, negotiating with co-teachers is fruitful for teaching. Negotiating could help clarify general and basic LN, which might be useful for radiologists who tend to teach too complicated or uncommon clinical patterns or radiological techniques. Yet, it should be considered that negotiating cannot always be assigned (Arnold, 2018) when looking at introductory or advanced RC. Negotiations should be

guided by teachers as facilitators in their field (Bullock et al., 2008; Arnold, 2018) to decide on a possible mutual agenda (Arnold, 2010).

Even a lose consensus with co-teachers could help focus on the relevant, and avoid disproportionate redundancies (Webb et al., 2013; Petsch et al., 2020a) throughout a clinical radiology curriculum (Dettmer et al., 2015). Mutual deciding could be suggestive in mandatory introductory RC when covering the use of imaging modalities, e.g. chest radiographs and CT scans to detect pneumothorax, or projection radiography as the most frequent radiological procedure in intensive care (Schülke et al., 2011), CT scans to identify bone tumors, MRI to show nerve damage, contrast enhancement in PET or CT scans to detect lymph nodes, which are frequently unclear in formation and density (Buerke et al., 2010). Basics in medical physics show interfaces e.g. with radiation physics and protection, radiation therapy, radiation biology and nuclear medicine. It seems reasonable to adjust topics on types and effects of radiation, or safety and risks in ionizing radiation exposure. Topics of interventional neuroradiology, e.g. detecting stroke mimics in multimodal CT (Velasco et al., 2020), treating acute ischemic stroke through recanalization, common vascular disease or spinal injuries, or indications, contraindications and risks of interventional procedures, e.g. revascularization of intracranial aneurysms, should be adjusted with neurologists and neurosurgeons. As acute ischemic stroke needs radiological and clinical consideration for the most suitable therapy, thus requiring complex multidisciplinary decision making (Velasco et al., 2019), multidisciplinary cooperating should take place. Yet, clinical teachers should consider that negotiating with students is more laborious (Bovill et al., 2015) than simply predetermining content among teachers or co-teachers. As radiologists mainly pursue clinical duties besides research and medical teaching, time is an essential factor in a busy workflow particularly besides limited staff, overly busy clinical schedules, and sick leave or holiday cover. If radiology departments hold academic coordinators, these could handle communicating, coordinating, and foster cooperating in teaching, e.g. in conference settings (Subramaniam and Gibson, 2007) or on interdisciplinary rounds (Saul, 2018).

Yet, if LN are negotiated in one cohort, these change with future student groups, as topics may be adjusted from term to term (ESR, 2017). If possible, clinical teachers should approach each term flexibly when discussing content (Bovill, 2013). Chances in class, beneficial for the acquisition of knowledge and development of skills, should be used (Gunderman and Bedi, 2013; Arnold, 2018) in clinical and interventional radiology. If students address to be trained on applying diagnostic ultrasound (ESR, 2015), watch invasive image-guided procedures such as CT-guided biopsies of the liver, follow how hygienic regulations are applied during contrast agent injection for CT scanning, and comprehend the significance of efficient workflow and patient handling adhering to hygiene (Buerke et al., 2011), such feasible opportunities should be gauged. One can agree with Bovill (2013), however, that it is important for teachers to set lines prior to class as to which topics are open for discussion or which will be pre-set by radiologists, possibly with co-teachers. It is necessary to enter class open for reasonable tailoring to optimize both learning and teaching roles (Bovill, 2013) as well as radiology education overall. Yet, there is no avoiding the fact that curriculum standards within the department and faculty must be adhered (Bullock et al., 2008; Bovill et al., 2015). In order to decide on course specifics constructively, face to face dialogue at eye level (Petsch, 2018) is an option.

## 3.3. Tailoring teaching in radiology

Negotiating through dialogue could be helpful to tailor specifics to LN. These could be discussed on the spot (Arnold, 2018), and agreed on within one's reach. Students instantly have the chance to voice LN on an individual or group basis, while teachers guide discussions with expertise (Bullock et al., 2008; Arnold, 2018; Saul, 2018). Communicating this way can

add to making teaching objectives more comprehensible, which is supportive of identifying individual and group learning objectives (Gunderman and Bedi, 2013; Taylor and Hamdy, 2013; ESR, 2015). If medical students are unsure where to place learning objectives and achievements in radiology (Wirth et al., 2018), or if they call their encounter with radiology being a discouraging one, or a lost chance in medical education (Visscher et al., 2015), open communicating should happen. In multiple-session-courses, dialogue is a chance for both teacher and students to oversee teaching and learning processes (Arnold, 2018) and adjust content if applicable. Clinical teachers should endeavor professional dialogue reminding oneself that one's assumptions about LN do not remain rigid but will change in ongoing teaching processes (Berman, 2015; Arnold, 2018).

Assuming that medical students interact with the intention of contributing to RC for their own learning benefit, radiologists should encourage active input (Bullock et al., 2008; Arnold, 2018). Particularly with one-session-courses, teachers or academic coordinators could notify students by e-mail or on a learning platform prompting brief replies on anticipating LN on course specifics, or references on possible redundancies. This will give teachers the chance to outline verbal feedback prior to class, to arrange a list of topics on offer, which will safe time for LN to be discussed. Preparation might be laborious at first attempt, but should reduce once being routine of one's course preparation. With multiple-session-courses, students' knowledge of imaging can repeatedly be scanned (ESR, 2015) for common indications and contraindications by prompting radiological and clinical questions (Bullock et al., 2008) in briefings and debriefings (Arnold, 2018). These could finish off a session and start the next as recapitulating, which is a good method engaging (Bullock et al., 2008) students effectively. By communicating with students at their knowledge level (ESR, 2015), radiologists support development of solid skills in IIR. This enables clinical teachers to draw nearer to a group's level, so basics are not repeated and students generally get to apply their clinical knowledge or skills more effectively. Teachers involve students in deciding on a challenging course setting in radiology suitable to their level, without overloading and placing objectives too high or too low (ESR, 2015). It is, however, difficult to fully involve students in deciding on the quality and quantity of content, e.g. of clinical cases due to their complexity (Subramaniam and Gibson, 2007), continuous advancing of radiology in its subordinate fields (ESR, 2017), or the vast amount of mandatory medical teaching material (Berman, 2015). However, taking into consideration that students can contribute to course specifics (Bullock et al., 2008), radiologists should not dismiss this opportunity but should use it for constructive dialogue at eye level (Petsch, 2018). They should seize available learning and teaching opportunities (Arnold, 2018), and welcome students' input on LN where appropriate. If this supports medical students to learn which information in imaging is crucial for the most suitable diagnosis and therapy, and if it emphasizes that clinical decisions depend on competent IIR (Petsch et al., 2020b), clinical teachers should reflect on their teaching (ESR, 2015) and address LN where possible.

#### 4. Limitations

The educational opportunities described do not cover all the chances and difficulties radiologists may experience in addressing LN in diagnostic and interventional radiology and neuroradiology in RC. Although theories from adult education are often applied to medical education, clinical teachers might find it challenging to ensure practicability of the theoretical approach in addressing LN in clinical routine.

#### 5. Conclusions

The purpose of this article was to explore how radiologists could address LN in RC through interacting. By applying a teaching approach adapted after Arnold et al., it was concluded that addressing LN could encourage medical students in radiology to learn about IIR; that integrating students to negotiate teaching content should take place despite high workload and little contact time in clinical routine; that interacting would contribute to learning about radiological imaging and its relevance for clinical decisions and therapies; and that negotiating with students and co-teachers would be helpful to tailor course specifics to LN if feasible and avoid redundancies. It is argued that interacting could be efficient and effective for clinical teaching and learning in RC at teaching and university hospitals.

#### 6. Disclosure Statement

The authors report no conflicts of interest. The first author and co-authors alone are responsible for the content and writing of this article.

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### 9. List Of Abbreviations

Computer tomography: CT

Image interpreting and reporting: IIR

Learning needs: LN

Magnetic resonance imaging: MRI

Radiology courses: RC

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