Teaching practical skills in radiology: What is the role of educational theory?

Poster No.: C-0255
Congress: ECR 2010
Type: Audit/Professional Issues
Topic: Audit/Professional Issues
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Keywords: Educational Theory, Practical Skills, Radiology Training
DOI: 10.1594/ecr2010/C-0255

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Purpose

The main purpose of this project is to describe the aspects of modern educational theory which are relevant to the teaching of practical skills in radiology. A secondary aim is to highlight to clinical supervisors that educational theory has a role in everyday practice and is not simply an academic construct.

Study/Project design

This project used observational field research techniques to identify situations where educational theory is applied to the methods used for teaching radiology trainees at our institution. Unobtrusive observations from a trainer and a trainee were used to illustrate specific examples. Observations were performed in a variety of clinical radiology settings where a trainee was being directly supervised by a consultant radiologist.

Results

Modern educational theories in use were observed in the following clinical settings: Hysterosalpingograms, Barium Enema training, Breast Biopsy training and Interventional Radiology

Educational theories identified included: situated learning, Kolb's model of experiential learning, social learning theory, use of simulation materials and active observation.

Table 1: Observed examples of educational theory in use during radiology teaching

<table>
<thead>
<tr>
<th></th>
<th>Hysterosalpingograms</th>
<th>Barium Enemas</th>
<th>Breast Biopsy</th>
<th>Interventional Radiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Situated Learning</td>
<td>Direct practical experience</td>
<td>Direct practical experience</td>
<td>Direct practical experience</td>
<td>Direct practical experience</td>
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<td><strong>Social learning theory</strong></td>
<td><strong>Communication skills demonstrated by extended team</strong></td>
<td><strong>Communication skills demonstrated by extended team</strong></td>
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<tr>
<td><strong>Kolb’s model of experiential learning</strong></td>
<td><strong>Stepwise acquisition of skills with the opportunity to refine skills though a list of multiple cases</strong></td>
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<tr>
<td><strong>Active Observation</strong></td>
<td><strong>Identifying to the trainer specific observed aspects of the consultation</strong></td>
<td><strong>Talking through the procedure prior to starting allowing the trainer to identify areas where closer supervision might be required</strong></td>
<td><strong>Describing to the trainer techniques used to provide reassurance to patients during biopsy</strong></td>
<td><strong>Giving the trainer verbal directions in the performance of a technique allowing assessment of the trainees readiness to undertake the procedure themselves</strong></td>
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<td><strong>Simulation</strong></td>
<td><strong>Use of drawings to plan images to be acquired and a water bottle to explain fluid dynamics</strong></td>
<td><strong>Use of a turkey breast with concealed olives to practice hand eye coordination techniques</strong></td>
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**Discussion**

**Situated Learning**
Practical radiology training is by definition situational learning with the patient interaction providing a 'real life' context around which to frame theoretical learning and develop practical skills. Situated Learning Theory argues that learning is most effective in the natural environment of the subject matter. This allows the learner to appreciate the context and culture within which the learning takes place, and therefore develop appropriate attitudes and behaviours along with mastering the necessary skills. For the observed intimate procedures of hysterosalpingography and breast biopsy, students were able to learn how to empathise and reassure patients whilst undertaking their examinations.

**Social theory of Learning**

Such activity is supported by the social theory of learning whereby trainees can be directed to develop both practical and communication skills by learning from the entire team of staff responsible for that episode of care. This theory considers the boundaries between training and practice to be artificial with a recognition that the work itself provides opportunities for learning to occur.

**Active Observation**

Active observation as described by Morris and McKimm outlines a framework for adding structure to leaner observations. The student is guided by the trainer to make specific purposeful observations to help them understand how and why the trainer is performing a certain technique. Active observation is a key element of social patterns of learning. This is a very useful technique in busy clinics where time constraints require a period when trainees have to watch rather than perform clinical investigations. Examples noted in this study included trainees being asked to note the role of the nursing staff in reassuring patients during hysterosalpingography or noting how the trainer dealt with patients who were fearful of needles during breast biopsy and intervention. In the interventional suite this technique is used to assess trainees' readiness to perform procedures safely.

**Kolb's Model**

Kolb's model breaks the learning of practical skills into stages. The trainee, having observed the procedure, undertakes a component and is given the chance to reflect on their performance, considering ways in which it might be improved. With the next patient they develop skills by using their refined technique. Behavioural Learning theory suggests that breaking down tasks into smaller steps, and then repeating these steps aids learning. This technique was put to good use during hysterosalpingography lists where training was broken down into the following steps:
Step 1: Passing the catheter

Step 2: Acquiring the correct images

Step 3: Passing the speculum

The steps were taught in this order, rather than the sequence in which the procedure is performed, to reflect increasing levels of difficulty. When the trainee achieves proficiency in one step they add to it the next, thus minimising patient discomfort. This approach provided graded experience in conjunction with the development of communication skills which provided suitable reassurance to patients.

Figure 1 demonstrates the stages of Kolb’s model used to teach hysterosalpingography.

Simulation

Simulation allows the trainees to either practice specific skills e.g. biopsy technique in order to improve safety and confidence, or to use teaching aids to assist in multi modality development of skills, e.g. barium enema training.

When teaching barium studies, it can be difficult for the novice to appreciate how appropriate manoeuvring of a patient allows better image acquisition. If the trainee were to begin by learning on a patient, there is an increased risk of patient discomfort, inappropriate radiation exposure and subsequent trainee anxiety.

In the barium room a 1.5 litre bottle is used as a substitute for the patient. This allows the trainer to demonstrate how contrast should be manipulated around the colon in a barium enema, the novice trainee uses the bottle to understand how rotating the patient helps to coat the colon, and the effect that moving the patient has on the flow of barium. Trainees are encouraged to visualise and draw on a whiteboard the views which they are about to take in order to rehearse the technique and provide visual prompts for the study.

The theory of multimedia learning suggests that people learn more effectively from visual and auditory stimuli than words alone.[iii] A range of simulations of varying technological complexity have been used to teach skills to medical students.[iii] Kneebone (2005) argues that the most effective simulations are underpinned by educational theory rather than technological sophistication[iv]. He identifies 4 key areas by which simulations can be evaluated outlined in the table below.

Table 2 demonstrates how simulation in the barium room addresses these areas.
<table>
<thead>
<tr>
<th>Key Area</th>
<th>Training</th>
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<tbody>
<tr>
<td>Technical proficiency</td>
<td>The model facilitates technical proficiency by allowing the trainee to conceptualise techniques that they cannot visualise in the patient.</td>
</tr>
<tr>
<td>Expert assistance</td>
<td>This model is used in conjunction with, rather than as a replacement for instruction from the expert trainer.</td>
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<td>Professional context</td>
<td>Training takes place within the fluoroscopy suite. Learning from the model is consolidated by observing the trainer perform the study.</td>
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<tr>
<td>Affective component</td>
<td>Using the models allows the trainee to learn basic aspects of the technique in a safe environment. This lets them gain confidence before learning on a patient.</td>
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</tbody>
</table>

When teaching breast biopsies, the risks of complications from the procedure as well as the anxieties of the patient need to be considered. We use an olive within a turkey breast to represent a target lesion, and the trainee practices ultrasound guided biopsies on this model. This allows technical skill to be developed without needing to worry about the effect of uncertain behaviour on a patient.

Images for this section:
**Fig. 1:** Figure 1: Stages of Kolb’s model and how they are used to teach hysterosalpingography.
Conclusions

At our institution, educational theory provides the grounding for many training techniques. We have demonstrated how a range of theories and strategies including behaviourist learning theory, Kolb's model of experiential learning, situated learning, simulation and active observation can be used effectively in a range of imaging subspecialties to teach trainees effectively.

References


Personal Information