Understanding the Dreyfus model of skill acquisition to improve ultrasound training for obstetrics and gynaecology trainees

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Abstract

There have been significant problems in ultrasound training since the introduction of the new postgraduate curriculum for obstetrics and gynaecology. It is therefore important to understand how the skill of ultrasound is acquired in order to be able to improve the training program. Here, the potential application of the Dreyfus model of skill acquisition has been analysed to map the progression from novice to master and the progressions between each stage analysed. Although the Dreyfus model is not a perfect match for ultrasound scanning, it provides us with a theoretical framework on which to underpin educational practice in this field.

Keywords: Dreyfus, ultrasound training, obstetrics and gynaecology

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Introduction to the problem

The introduction of the new Postgraduate Medical Education and Training Board-approved Royal College of Obstetricians and Gynaecologists (RCOG) curriculum involved major changes to ultrasound training for trainees.¹ Prior to these changes, basic ultrasound would be 'informally' acquired during training and those wishing to obtain formal qualification in more advanced skills could undertake a diploma from the RCOG. With the introduction of the new curriculum came an expectation that all trainees should be able to scan to a basic level, with optional intermediate modules for those wishing to undertake further training. Rather than a separate qualification, such as the previous diploma (involving dedicated, protected scanning time), training is now integrated into the general obstetrics and gynaecology program much like any other skill (e.g. Caesarean section) with progress assessed by a competency-based logbook and work-based assessments.¹

Unfortunately, this has led to ultrasound training becoming one of the most contentious areas of the curriculum. There is often little time in busy rotas to set aside for regular protected scanning sessions. In addition, many hospitals do not have consultants capable of supervising training, so the burden falls upon ultrasonographers. There is a shortage of qualified sonographers who not only have increasingly full scanning sessions but also their own students to teach. In short, there are now too many obstetrics and gynaecology

trainees needing ultrasound training, too little cover in rotas for them to be educated effectively, too few supervisors and too few resources.²

In practice, trainees may go months in between supervised scanning sessions and have different supervisors each time. There is little provision for reducing the number of patients on an ultrasound list to allow time for teaching. This ad hoc approach to training leads to trainees with limited experience and confidence and does nothing to solve the problem of too few obstetricians and gynaecologists who can competently scan. The result is that 'deanery delivery of ultrasound training is an ongoing issue' as noted by the General Medical Council.³

It is clear that there is no magic solution to the current problem.² There will be few extra resources provided for ultrasound training and no sudden increase in training time or available supervisors. Therefore, it is imperative to maximise the opportunities that are present and ensure that training is as efficient as possible to meet the goal of producing clinicians who are competent and confident in performing basic ultrasonography. I propose that it is first necessary to understand how trainees learn to scan and progress from novice to master. To do this I will analyse the Dreyfus and Dreyfus model of skill acquisition applied to ultrasound training and examine some of its strengths and weaknesses in this domain. I will then consider how this theoretical underpinning may be used to influence educational practice.

The Dreyfus model of skill acquisition

The Dreyfus model, first proposed in 1980, breaks down the process of practical skill acquisition into five distinct stages.⁴ The original model was subsequently adapted to the learning of clinical skills and the five stages widened to include a sixth. These stages are novice, advanced beginner, competent, proficient, expert and master.⁵ The original model cast the description of the development of a practical skill as a 'successive transformation of four mental functions' from a 'primitive' to a 'sophisticated' form. Essentially, by developing sophisticated forms of recollection, recognition, decision and awareness, it is possible to move from the rule-based analytical novice engaged in active thought to the intuitive, experience-driven master of a particular skill capable of other activities simultaneously.⁴

The Dreyfus model applied to clinical ultrasound

The novice

Initially, the novice approaches every ultrasound examination in the same fashion, with no flexibility for patient signs or symptoms. Ultrasound findings are reported, rather than interpreted, because there is no previous experience to compare with, and are reported in isolation without clinical correlation, i.e. the scan is viewed in a non-situational way.

The novice has to actively think through every step of the ultrasound examination. This includes: doing the scan in a set sequence; having to consciously consider probe orientation in order to map the images on the screen to the patient and actively considering how to optimise the images in terms of power, focus and depth. Due to the level of concentration required to do this, they are unable to perform tasks simultaneously, such as talk to and reassure the patient or observe the patient for signs of discomfort or pain.

The competent

The competent scanner has sufficient experience and has seen enough cases to be able to start interpreting the images in terms of the situation, rather than simply describing what is on the screen. For example, an echogenic adnexal mass medial to the left ovary becomes a left ectopic pregnancy in the patient in early pregnancy with abdominal pain and vaginal bleeding. However, they do not have enough experience to interpret every case in this way and therefore use a mixture of pattern recognition and analytical reasoning. They still approach every examination the same way in order 'not to miss anything' and with a similar level of active vigilance to a novice.

The proficient

The proficient scanner can now be more holistic in the recognition of clinical problems and is able to start interpreting the images with a view to potential management. For example an ovarian cyst with septations, which in an otherwise well patient would be removed, can be confidently said to

have low malignant potential based on ultrasound appearances and experience and actively watched in a patient with medical co-morbidities. As Caraccio et al.⁵ state, they "can live with ambiguity".

Although the proficient scanner by now has a large internal library of experience, they still need to approach new and complicated problems analytically. They remain aware of their own limitations and are comfortable asking for second opinions.

The expert

The expert scanner can scan intuitively. They can tailor the scan according to the patient's signs and symptoms and are happy to scan in a different order if required. For example, they are unconcerned by the foetus in an awkward position whilst trying to do an anomaly scan and instead scan what they can and have acquired a variety of 'tricks' to get round the problem. They are continuously adjusting the machine settings whilst simultaneously scanning to always obtain the best possible images. Because they no longer need such active attention on what they are doing, they are able to engage with other tasks. This might include recognising the patient's well-being or discomfort and being able to talk and reassure them or being able to teach a medical student at the same time. Similarly, they can integrate the patient's response into the clinical findings. For example, the patient's tender posterior vaginal fornix is noticed and combined with the finding of an ovarian cyst to suggest a diagnosis of endometriosis.

The master

The master scanner is an expert, capable of moments of genius, who scans completely intuitively and is able to get crystal clear images where others have struggled, understands the machine and ultrasound principles completely and applies them practically without thought. He/she is the sonographer that others come to for a second and definitive opinion and maintains complete integration of patient signs and symptoms and ultrasound images in real time with a therapeutic focus rather than diagnostic.

Applying the adapted Dreyfus model to training

As stated by Hobson,² much of the supervision of trainees in ultrasound has fallen on sonographers rather than consultants. There is, however, a clear difference between sonographers and clinicians that scan. Whereas the responsibility of a sonographer is to try and provide a diagnosis or at least a description of the problem, the ultimate role of the clinician is to not only diagnose the problem but also manage it. Therefore, training in ultrasound for clinicians needs to reflect this different focus.

Having set out an adaptation of the Dreyfus model applied to ultrasound, it is now necessary to consider how this might be used to improve training. The old method of unsupervised trial and error is no longer acceptable and as Dreyfus and Dreyfus⁴ state, learning is much more efficient with the aid of an instructor. In an ideal

training programme therefore, there would be an overall educational supervisor responsible for the training of the individual. The educational supervisor, by being aware of the stage in the adapted Dreyfus model that the learner is at, may tailor the education and opportunities to allow the individual to make efficient progress.⁴

Novice to competence

The step from novice to competent scanner involves the development of a personal library of experience. Therefore, the novice scanner needs to be allowed to scan as many patients as practically possible to build this library. At the initial stage, there is a role for simulation, particularly when learning the skill of transvaginal ultrasound. Ideally, this would be taught and supervised by one educator so that a consistent approach may be learned. Heer et al.⁶ showed that using a simulation system, medical students with no experience could learn to undertake basic transvaginal scanning and achieve results that are consistent with those obtained by experienced doctors. With the set of rules acquired from practice on the simulator, the novice must then step up to real patients. Initially, the novice should be supervised by their educational supervisor in scanning sessions, with a limited number of patients, to allow the learner the extra time that their scanning requires. Informed consent is vital to allow the supervisor and learner to feel comfortable exchanging real-time feedback. An experienced sonographer in the room provides someone to reassure the patient and notice if he/she is getting distressed, while the learner is absorbed in scanning. This experience can then be broadened to supervision by other supervisors to allow the learner to develop a range of approaches.

A logbook of experience and work-based assessments should be completed to show progression and the end of each scanning session should include a debrief and period of reflection.

The next stage is to start unsupervised ultrasound scanning. To ensure that the department and individual feel comfortable at this stage, a set of rules should be agreed upon to ensure patient safety. This might include reviewing the images with an expert after the scan, having a very low threshold for rescanning the patient by someone with more experience or limiting the type of patients who are scanned. For example, scans may be limited to those who already have confirmed intra-uterine pregnancies or those very unlikely to have ectopic pregnancies.

Competence to proficiency

As competency develops, restrictions on scanning may be relaxed, but with a clear expectation that a second opinion should be sought when the learner is unsure. The learner should be present during second opinion scans and encouraged to reflect afterwards to maximise the learning opportunity. At this point, the learner should be integrating into the clinical team, e.g. the early pregnancy or gynaecology oncology team and becoming a member of a learning community. Learning is now fundamentally by participation, and weekly team meetings, with interesting cases and

images, should be held for the benefit of the whole community. This evolution from the acquisition of knowledge to the participation in learning may be seen in terms of the learning metaphors described by Sfard⁷ as a complementary process.

It is at this stage that the learner must be encouraged to see beyond the ultrasound scan and start to consider clinical management as well. Learners should be enabled to follow their patients through to the operating theatre to see the clinical correlation with their ultrasound findings. This helps to reinforce the sense of responsibility for patient outcomes associated with their ultrasound scans and decision-making. This is very similar to the sense of 'emotional buy-in' referred to by Caraccio et al.⁵ that needs to occur at this stage in training.

Many of these learning structures may be difficult to build in a district general hospital with other rota pressures. The formation of an acute gynaecology team responsible for admitting, scanning and ultimately operating on patients might form part of the solution.

Proficiency to expert

The shift is now from teaching to mentoring. At this stage the proficient scanner needs a mentor, someone that they can bounce ideas off of and who supports them as they become intuitive practitioners. This stage probably takes the longest as again it is firmly rooted in continuous exposure to clinical cases and reflection afterwards. Caraccio et al.⁵ suggest that, at this stage, it is important that the learner is "not presented with complex unknowns" otherwise they risk slipping back into analytical practice rather than developing and trusting their intuition.

Expert to master

The expert ultrasonographer now needs interesting and complex cases to keep them occupied and developing. They should be encouraged to start providing second opinions to other clinicians and it may be that at this point they start to become educators themselves. Similarly, the processes of reflection and self-assessment must be developed to become a truly masterful practitioner.

Discussion

While superficially it seems possible to map the Dreyfus model to ultrasound scanning, a number of important issues arise.

Do ultrasound experts rely on intuition and non-analytical problem-solving as much as the Dreyfus model suggests?

The answer, I would suggest, is probably not. As Pena⁸ discusses in his critique of the Dreyfus model applied to clinical problem solving, clinical experts must use both analytical and non-analytical approaches concurrently. Intuition may suggest a diagnosis, but this is only the initial step, as this provisional diagnosis must be considered rationally and proof sought in the form of investigations. The two forms of reasoning are probably not mutually

exclusive and it is likely that both contribute to final decision-making. The expert may well be the person who can use both forms efficiently rather than relying simply on intuition.⁹ Similarly, in the field of ultrasound, it is hard to imagine even expert scanners scanning without questioning their initial intuition of what they are scanning. It is also worth casting a critical eye over the original Dreyfus model in this regard. The practical example the Dreyfus brothers worked with was that of aviation, a field which more than any other, forces even its experts to follow rigid procedures and checklists rather than simply trusting in the intuitive ability of pilots to fly. This is a form of 'enforced' regression back to analytical reasoning.

Does the model work when the aim of training is not to produce 'masters' but simply competency?

The original Dreyfus model involved an assumption that all learners would aim to progress to master stage. However, the stated aim of the RCOG is to produce clinicians competent to undertake basic ultrasound scans and indeed the only compulsory modules are those entitled 'basic ultrasound modules'. In reality, it is probably sufficient for learners to reach the 'proficient' stage in a limited number of situations to meet this requirement. Combined with the competency-based assessment model, there is a danger that learners will be deemed competent and allowed to practise independently but without the encouragement and drive to progress to the later stages of the model. Rather than become active members of a learning community, using reflection and self-assessment to hone their skills, learners become stuck at the proficient level, able to undertake basic scans with reasonable confidence but still having to refer the more interesting cases onwards. In reality, with the pressures on the delivery of ultrasound training, active input and supervision are likely to continue until the trainee has been 'signed-off' as competent, at which point the learner will be left to fend for himself or herself. Potentially, if these learners continue scanning at this level, they will eventually continue to progress through the model but ultimately only becoming 'masters of the basic scan'.

Is regression through the model possible?

Another issue not addressed by Dreyfus and Dreyfus is whether it is possible to regress in the model. In current reality with ad hoc training, it is quite possible that someone who is working at competent level may go several months before performing any more scans and therefore regress back to the novice stage, as they lose the level of intuitiveness they had previously attained and struggle to remember the basic rules that they had been taught. The prevention of this regression needs to be built into the training program to ensure adequate progression, including when trainees rotate to a new department.

What about assessment in the Dreyfus model?

As Caraccio et al.⁵ point out, "many educators have adopted the assessment rubric of the Dreyfus and Dreyfus

model". However, it is important to remember that the Dreyfus model was a model of 'skill acquisition' rather than a model of skill assessment. In reality, there is a spectrum of learning, with the stages of the Dreyfus model being theoretical landmarks along the way. When assessing a particular skill, it is very hard to know when a learner has definitely reached each landmark. In addition, as Khan and Ramachandran discuss,¹⁰ performance is assessed by observation, an act that can have an effect on the actual performance. They go on to suggest a performance rating scale directly mapping stages in medical training to the Dreyfus stages. Ultrasound performance can be assessed by direct observation and by use of simulators to explore someone's competence. These direct observations can be in the form of the standard work-based assessments and these observations used to gauge competency. The actual performance can be monitored by the use of image review and case-based discussions as well as actual feedback from the patients. Direct correlation between performance in a given task with the original Dreyfus model may be made using the Khan and Ramachandran performance rating scale.¹⁰

What about changing clinical practice?

The problems with current ultrasound training are diverse and not easily solved. The Dreyfus model is based on the development of a personal 'library' of experience and this can only come about with regular dedicated ultrasound scanning opportunities. Obviously, this involves making ultrasound training a priority and providing protected rota time and enthusiastic educational supervisors. There are preliminary studies that suggest that simulation may have a role to play, especially in the very first stages of the Dreyfus model.¹¹ These simulators allow practice away from real patients at a time that is convenient for doctors with other clinical responsibilities. In addition, many of the high fidelity simulators have very good clinical correlation with real patients and so these cases can form part of the learner's library of experience. However, access to these simulators is limited by the very high cost of equipment.

Departments need to see the value of ensuring good ultrasound training and using trainees effectively. Philips and Rajasri¹² report on a scheme at their local hospital which sees a dedicated week of ultrasound training beginning and ending with skills assessment. The supervisors in the scanning sessions were specifically briefed regarding the students' needs and this allowed the students to progress over the course of the week. Once trainees have been deemed competent, they should be encouraged to continue scanning. This may be by encouraging them to scan patients when on call if possible and in a safe fashion or by having semi-supervised scanning lists. Once this happens and trainees become incorporated into part of the 'ultrasound team', they will also enter the 'learning community' that is essential for further progression through the Dreyfus stages. Hopefully, much of this development of ultrasound skills will also coincide with development of other obstetric and gynaecology skills. For example, learning to scan

ectopic pregnancies concurrently with learning to remove them laparoscopically is potentially very beneficial for both skills.

Conclusions

It is possible to map the Dreyfus and Dreyfus model of skill acquisition to the specific skill of ultrasound scanning in obstetrics and gynaecology. By doing so we can begin to understand the stages a novice might go through to achieve mastery, and from this, how learners passing through these stages might be helped to make adequate progression. Given the very real time and resource pressures that limit ultrasound training, this understanding can ensure that most efficient use is made of these opportunities. The adapted Dreyfus model of skill acquisition is not a perfect model for ultrasound scanning because of its overemphasis on intuitive rather than analytical problem solving and it remains to be seen of how much practical use this model will be when it comes to influencing actual practice.

DECLARATIONS

The author has no conflicts of interest to declare.

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