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Original Article

Teaching, learning and assessment of undergraduate radiography students: a strategy to develop progression towards competency

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Abstract

A new clinical teaching, learning and assessment strategy for radiotherapy and diagnostic imaging undergraduates was developed by action research. Outcome-based competencies were used together with other strategies to progress students' learning through successive levels with the aim of developing essential and desirable attributes of the respective professions. The planning team consisted of academic and clinical staff resulting in a shared project. Specific outcomes for each profession were devised by subgroups of the original team. The radiotherapy scheme implemented formative staged outcomes and the report focuses mainly on this strategy. Evaluation reveals that discriminations can be made at an early stage between those students achieving and those who are not. Highlighting specific areas for improvement allows opportunities for remedial work and creation of individual action plans. Key clinical staff underwent specific training to facilitate students' development and act as effective gatekeepers to progression. Recommendations for further research are to survey graduates now in employment to investigate how well they feel the scheme has fitted them for practice. There is also the potential to survey those who left the course prior to completion to discover if the scheme has helped to develop transferable skills for life long learning.

Keywords

Assessment; radiography; outcomes; competency

INTRODUCTION

This report describes a series of events resulting in the development of a renewed clinical teaching, learning and assessment strategy for radiotherapy undergraduates. The methodology used was that of action research that is described as naturalistic, open ended and non-structured involving self-evaluation, reflection on outcomes, planning and implementation of practical changes[1,2] and is a method commonly used in the fields of healthcare and education for the development and training of professionals.[3,4]

BACKGROUND TO DEVELOPMENT OF A CLINICAL ASSESSMENT STRATEGY

Historically apart from the requirement for students to complete a set number of treatments or examinations in specific categories (the logbook) there has not been a nationally adopted assessment scheme for radiography clinical education. Prior to 1989 this school of radiography, as it was then, along with others, adopted a clinical assessment scheme, devised by the London and Home Counties

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Table 1. Packaging clinical placements into the professional radiotherapy (RT) and diagnostic imaging (DI) modules

Level	Titles of professional studies modules	Number of academic credits	Integrated placement experience, number of weeks
1	Foundation RT/DI studies	40	15
2	Intermediate RT/DI studies I & II	30 + 30	15
3	Advanced RT/DI studies	40	15

(Each year would together with other modules, amount to 120 academic credits).

radiography-working group. Assessments were made of students' performances on a number of set procedures throughout their training during which they were expected to take lead roles; the focus was on practical skill attainment.

Following the publication of Working Paper 10[5] radiography schools moved into Higher Education (HE) with the result that each emerging radiography degree programme was afforded the opportunity to review their clinical education and assessment schemes as part of the validation of their new curricula.

Consequently at this university a re-validation event, which included both radiotherapy and diagnostic imaging programmes, offered the prospect for review of clinical teaching and learning strategies. To reinforce integration of academic and clinical learning the clinical components (placements) were packaged together into professional study modules across three years of the programmes (Table 1). A planning team was formed to initiate the design of an accompanying clinical education strategy.

FORMATION OF THE TEAM AND EVALUATION OF THE PREVIOUS ASSESSMENT SCHEME

Recommendations are that any competency-based scheme should involve in its design role holders and experts in the field.[5,6] To this end 34 clinical radiographers of both disciplines specifically involved in student education met with academic radiography staff. From this first meeting in May 1995, it was vitally important that there would be sharing of ideas and process resulting in joint clinical and academic ownership of any emergent scheme. It was felt that as the educational principles were common to both radiotherapy and diagnostic programmes, the initial discussions would benefit from involvement of clinicians and stakeholders of both professions. At a later date profession-specific working parties (radiotherapy and diagnostic imaging) were devolved from this main group to define their specific learning outcomes.

In November of the same year, the planning team met to evaluate the existing scheme used to date. Main weaknesses highlighted were; excessive focus on assessment of psychomotor skills to the exclusion of other attributes; a potential for some students to achieve exaggerated high marks as result of the scoring system; an absence of a vehicle for reflection or self-evaluation and a lack of identified progression through levels of learning.

Following this initial analysis, debate focused on how to progressively develop the students' levels of learning from novice to expert as described by Benner[7] and Dreyfus.[8] Parallels were drawn with General National Qualifications (GNVQs) and National Vocational Qualifications (NVQs) that use outcome-based competencies. "Outcome based assessment leads to comprehensive assessment, covering all the outcomes not just a sample, and to more emphasis on assessing performance, demonstrations of skill as well as knowledge".[9] Many sandwich and vocational based degrees now use outcome based assessments[10,11] and since Dearing[12] this looks set to continue as outcome based assessment filters through higher education.

The planning team met again in April 1996 to brainstorm essential and desirable skills, attributes and attitudes of newly qualified radiographers as a basis for production of learning outcomes which

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needed to be relevant, realistic and measurable. The downside to outcome based assessment is that there is the potential for students to become too competency driven to the stage that they become 'technical operatives'.[3] To counter these concerns, the team explored strategies that would foster deeper level processing of information and introduce situational understanding such as pieces of reflective work.[8,13,14]

In order that a developmental teaching and learning strategy was reflected in the terminology used, and a distinction made from the previous scheme, the planning team decided to use the terms 'appraisers' and 'appraisals' rather than 'assessor' and 'assessments'.

Defining the learning outcomes

To identify what could be expected of students in their first placement experience appropriate levels of outcomes were debated by the team in conjunction with reference to Bloom,[15] and the university's academic guidelines. Cheetham and Chivers[16] reported that during the initial stages of a professional's education a novice with no or minimal specialist experience to reflect upon needs more direction and learns best from experiences of other team members. Although novices may be not able to judge and understand situations they can be taught to recognise objective attributes without benefit of experience.[8] Therefore it was decided that although first year students might well encounter a wide range of patients in their placement, the learning outcomes at this level would focus mainly on routine clinical cases. As students receive some theoretical underpinning to their first placement due to a prior academic block their actions would be rooted in a good knowledge base from which to apply scientific principles. Development of students' psychomotor skills founded on this base would therefore be expected. However it was recognised that it would be unrealistic to expect novices to 'think on their feet' although later development of this trait for professional practice would be important.[16]

As planning progressed two sets of award specific assessment tools were developed, one for radiotherapy and the other for diagnostic imaging practice. A series of small pilot studies took place and the working parties met regularly to monitor and evaluate the scheme before it was implemented with a new cohort of first year students. The report now focuses on how this has been applied to radiotherapy students.

LEVEL ONE RADIOTHERAPY LEARNING OUTCOMES

To facilitate the students' early development in the first year several progressive stages of outcomes were designed for formative use leading to summative appraisals. At level one the outcomes centred mainly on knowledge and comprehension, development of basic psychomotor skills in relation to megavoltage photon therapy and some focus on application and attitudinal concepts. As part of the radiotherapy radiographer's role is to provide a valuable contact point for patients on a daily basis, receiving and responding to a range of stimuli or messages at this level is a vital attribute to develop. The latter attributes have been described as belonging to the affective domain.[15] Eventually outcomes emerged from all three domains and were built on at successive levels.

The value of formative clinical outcomes is that it enables early recognition of any weak areas[17] and can be used as a basis to generate feedback and devise learning contracts. At each stage students and the clinical educators who are designated radiographers (appraisers) are encouraged to take stock, reflect on progress and make future plans. This approach was further formalised by the use of written 'negotiated statements' where records of students' weekly discussions with appraisers are documented in partnership and used to devise action plans for the following weeks. This strategy enables students to take some responsibility for their own education, encouraging deeper learning, and allowing the potential for both parties to focus on specific areas. In this way teaching and learning opportunities can be identified to aid students in achieving their outcomes.

In the first year four progressive stages of formative outcomes were designed leading to six summative appraisals, the aim being that by the fourth stage students are confident in treating the categories of patients they are going to be appraised on. Students may encounter and gain experience

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in treating a range of patients but the appraisals undertaken during this period focus only on the more usual or routine cases rather than the complex (Table 2). In defining these categories for level 1 some debate ensued within the team. For example radical techniques used to treat patients with breast cancer were considered to be routine procedures but some of the team considered this too complex in nature for a level 1 student to be confident in undertaking. An agreement was reached and the details of the types of procedures suitable were highlighted in written guidelines to avoid ambiguity.

Suggested times for achieving each stage was arrived at by the planning team (Table 3) and this information was made available to all parties. As it is recognised that individuals learn at different rates, some flexibility is allowed for within the framework. The first stage does not pressurise the student into action but focuses on observation and discussion of these observations with the appraiser. However the observations are listed as outcomes to be met and the learning is therefore structured. Students are not restricted to their current identified outcomes, but they are not measured against those on the ensuing stage until all are achieved at the stated levels. Again much time was spent in defining the levels and exploring what these levels should be. It was suggested that the outcomes were measured against the following; 'under guidance', 'unaided but needs more practice' and 'unaided and proficient', with a category for 'not yet attempted'. Students had up to four weeks maximum to complete their summative appraisals following successful completion of all four stages.

Use of realistic time-spans allows potential for remedial action to be taken, if needed. If students are in difficulty appraisers may be able to facilitate opportunities for additional experience or provide tutorials in specific subject areas. If either the appraisers or students feel that they are not ready for summative appraisal, recommendations are made to delay in the short term and students are counselled accordingly.

The use of the negotiated statements is particularly useful for students to reflect upon their attainment to date and record their current need for improvement. For students to progress to level two of the professional studies module, successful completion is mandatory. If they are unable to achieve the required standards despite remedial support then the appraisal is deemed a fail. Although students are allowed second summative attempts, this is at the discretion of the examination board, which takes into account the views of the clinical appraisers in supporting the student further (Fig. 1).

Students who are identified as at risk of failing the summative appraisal are counselled accordingly but may still wish to attempt the appraisals in the remaining placement time. Currently academic staff are alerted to the situation if it arises and can act as intermediaries if necessary. Support to both parties is offered and as the students' progress to date has been recorded, evidence is available to support any discussions. Appraisers acting, as gatekeepers must fail those who are not at the required standard but those at risk of failing are identified prior to this point and given every opportunity to succeed. Students who show no evidence of improvement despite remedial action raises some concerns for the team and strategies for managing this more effectively are under review.

Table 2. Suitable categories for level 1 radiotherapy appraisals

Single direct field
Parallel opposed pair including those with immobilisation devices (e.g. treatment for larynx)
Field with simple beam modification
Patients without special needs*

*Such as those with physical or psychological needs that require advice and support above that which could be expected of a first year student.

Table 3. Guidance for times to achievement of outcomes leading to appraisals at level 1

Outcomes	Number of weeks	Total clinical experience
Stage 1	1–2	2
Stage 2	2	4
Stage 3	3–4	7
Stage 4	3–4	11
Appraisal period	4	15

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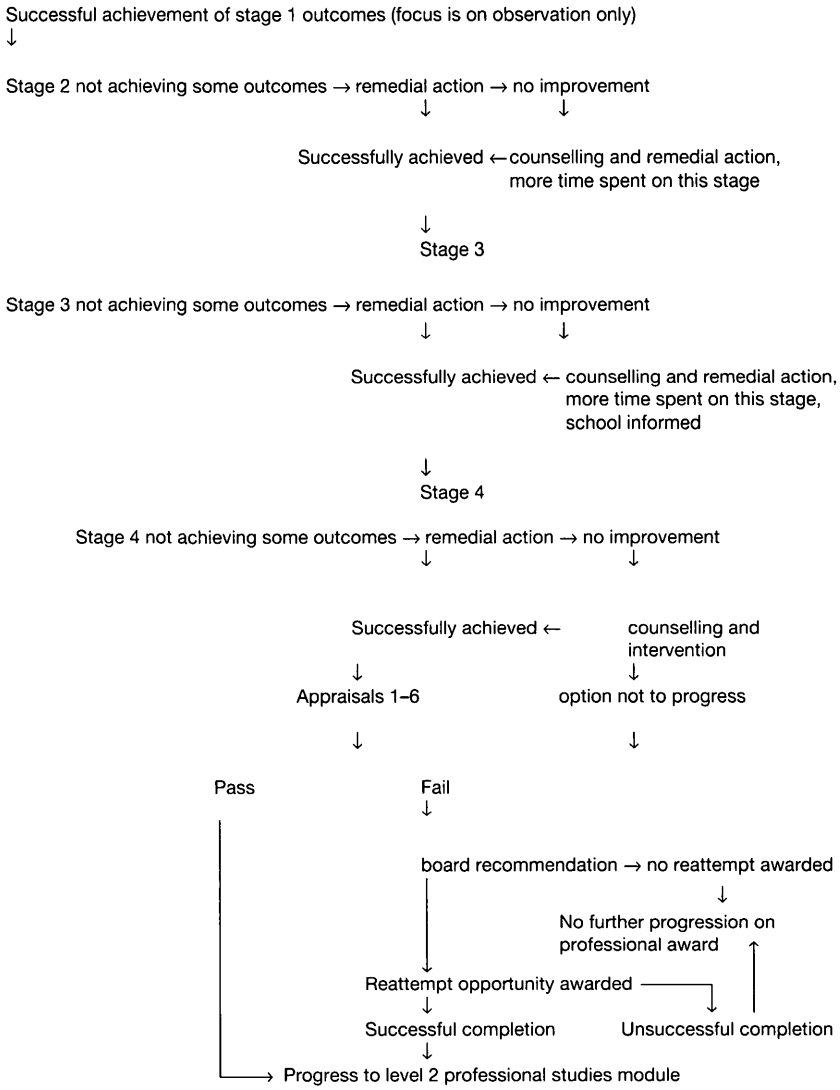


Figure 1. Flowchart to illustrate progression at level 1.

LEVEL TWO RADIOTHERAPY LEARNING OUTCOMES

Developing deeper level processing of information

It is envisaged that by the end of the second year students are competent in more routine procedures, are familiar with the contextual understanding of situations within which they work and have the requisite knowledge, skills and attitudes to embrace more challenging techniques and situations. To facilitate this, one set of formative clinical outcomes was devised leading to four summative clinical appraisals. Three appraisals concerned the use of techniques, involving megavoltage photons, and the fourth, electron applications. Students also undertake six weeks structured pretreatment experience for which the relevant outcomes were designed in conjunction with appropriately specialist staff.

Outcome-based assessment as the only teaching and learning strategy can become too prescriptive leading to 'a narrow workplace perspective with no opportunity to explore or compare experiences with others'.[18] It was important therefore that other teaching and learning strategies such as the negotiated statements were included to encourage self-evaluation and deeper level processing of information.[13] These statements together with other pieces of relevant work form part of a portfolio.

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The introduction of portfolios into medical education has been described as a useful means whereby students can document evidence of their self-development and reflective learning,[19] although some authors may debate what constitutes reflective practice for radiotherapy radiographers.[20] Students must present written accounts centred on personal reflections of critical incidents experienced in placements. These pieces of work are summatively assessed. Discussions with key clinical staff in the practice areas are part of the second year appraisals. Students are expected to talk knowledgably about their specific patient cases critically analysing management strategies. Academic staff also hold formal discussions with students at the academic institution where students are questioned about the wider context of their placement experiences in relation to megavoltage, and pre-treatment. In summary all clinical evidence from either summative or formative activities is contained within the portfolio.

To further develop deeper level processing of information the students are exposed to new environments. In this way more challenges are presented not only for further application of knowledge, skills and attitudes acquired in the first year but also for adaptation of techniques and development of problem-solving skills. Therefore second year radiotherapy students are placed in different geographical locations to those experienced in their first.

This strategy also has one disadvantage in that this change can initially shake students' confidence. Students can feel like the novices they were in the first year and this can lead to de-motivation if they do not feel that they are progressing. Learning to work with new teams in new environments, adapting to different ways of working, although the underling principles might be the same, is often unsettling. For these reasons appraisers do not initiate second level objectives with students in the first week, or even the second. It is important that students adapt to their new environment and feel comfortable within it before they start on new outcomes. Therefore they are encouraged to recap on previous learning and return to their latter year one learning outcomes as a starting point.

Anecdotal evidence has shown that as long as students are supported in this transition it can prove to be beneficial. All students undergo an induction into their new placement area and are visited early on in placement by a member of academic staff as in the first year. It is important for staff to reassure students that these initial feelings of lack of confidence are normal and evidence has shown that it does pass. Final year students have said retrospectively that multi-placement experience makes them more flexible, encourages wider thinking and critical analysis of practice.

LEVEL THREE

Pre-qualification

In structuring a framework for clinical education at level three, the planning team defined essential and desirable attributes of prospective newly qualified radiographers. Clinical appraisers and managers were invited to give examples of situations where newly qualified graduates would be expected to demonstrate proficiency in a range of tasks that culminated in some aspects of management of self, clients and others. Students at this level would operate as integral members of the team taking on responsibilities such as those involved in managing a patient's first treatment. Initially students would work under close supervision but the aim would be to provide the learning opportunities to increase autonomy to meet the outcomes.

Although it could not be expected that students would act as the experts in these situations a progressively higher level of skills and knowledge would be demanded of them, such as being able to critically evaluate, prioritise, communicate and liaise effectively with others.[15]

As outcome-based assessment lends itself naturally to continuous assessment[9] the scheme evolved to include three continuous appraisals in the final year rather than a series of single occasions. This consists of three appraisals respectively in the areas of megavoltage, simulator and planning. The appraisals reflect the students' overall progress in these areas for the duration of the placement with a focus on the responsibilities that will be required of them on qualification. For example students are asked to take a holistic approach to organising

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patients' first treatment experiences, entailing use of appropriate communication skills with the patient and family, organisation of appropriate appointments, transport and aftercare via liaison with other health care professionals.

Maximum support from the appraisers is gradually relinquished as the students' progress successfully through their objectives until they manage the whole process within a team context. The appraisers confirm if students have successfully met the outcomes by a combination of direct observation and collection of evidence. The process incorporates debriefing afterwards, time for reflection and self-evaluation using the negotiated statements to formalise action plans. As in the first and second years of the programme appraisers undertake weekly discussions with students, reviewing the outcomes and identifying areas to focus on for successive weeks. Ultimately the philosophy is to make the learning experience a positive one and to date students have reported increased confidence when using this strategy.

As learning continues post-qualification some students will not reach their full potential until they are in employment.[21] To encompass room for individual growth in development, categories of achievement at level three ranged from satisfactory standard as a minimum to credit awarded for being proactive.

SUPPORTIVE MECHANISMS

Clinical appraiser training

Skills of the clinical appraisers are vital in ensuring that trainees are able to maximise personal learning from the wealth of potential educational opportunities available on placements.[22,23] The appraisers in the scheme are radiographers who have successfully completed a recognised teaching and assessing course (such as module 997 of the English National Board for Nurses, Midwives and Health Visitors). Whilst it is recognised that all radiographers have a professional responsibility towards the education and training of students, appropriate formal training is desirable.[21,24,25] A quality standard of training encourages staff development and promotes parity of assessment across placements. Currently at undergraduate level radiotherapy and diagnostic students are able to access a module in teaching and assessing at level three, but this is optional.

Although there is voluntary recruitment of clinical staff onto appropriate educational courses, there are now more than 50 radiotherapy and diagnostic appraisers on the regional database affiliated to this specific scheme. To share information and good practice across the region twice-yearly meetings are held at the academic centre, and a newsletter is distributed to all radiographers in the region. In addition some appraisers form their own local support networks and hold internal meetings.

Support and advice is also on offer to both students and staff from radiography academic staff who take on liaison roles. The liaison lecturer visits each cohort of students three times per placement providing additional opportunities for staff support and a vital academic-clinical link. Students discuss their progress to date with the visiting member of staff on each occasion; there is the opportunity to discuss learning outcomes and negotiated statements away from the practice areas on an individual basis. It is an opportunity for staff to raise any points for discussion.

A clinical co-ordinator is now in post to oversee the clinical placements, perform audits, and monitor ongoing appraisal documentation, as there are many associated administrative tasks that accompany the scheme. For example as clinical learning outcomes and documentation allied to an assessment strategy should be made transparent to all parties involved[9] paperwork has been produced in a triplicate format, providing one copy each for student, appraiser, and clinical co-ordinator. Handbooks and guides are available to all parties, but on-going evaluation and monitoring means that any documents must be updated regularly.

STRUCTURE OF PLACEMENTS

In each year of the undergraduate programmes the diagnostic imaging and radiotherapy students undertake one 15-week continuous placement. Both staff and students have preferentially evaluated these long continuous placements over shorter ones for continuity of practice and confidence building. At the end of their first placements most students have progressed to become advanced beginners.

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The pattern of clinical placements throughout both radiotherapy and diagnostic imaging programmes is determined to ensure that maximum learning opportunities are obtained with respect to length and overall quality of experience. As students progress through different levels of learning different demands are placed on them. The rotation of students through placements relevant to their respective clinical learning at specific times was considered at the planning stage. It was vital that the clinical departments used in the scheme could provide the optimum environments for supporting students in acquiring the respective learning outcomes. Decisions regarding placements were taken in full consultation with clinical managers and lead appraisers considering departmental staffing levels and equipment availability.

To ensure that students received appropriate, high quality clinical experience there is also a clinical standards agreement in place between the university and the respective participating Trust hospitals. These standards encompass the learning environment, professional development and clinical appraisers monitoring and review, forming the basis for contractual arrangements.

RESULTS AND CONCLUSION

The second cohort of radiographers is now about to graduate having experienced all three years of the new scheme, which continues to evolve with ongoing monitoring and evaluation. Early evidence collected from students, staff and key stakeholders has highlighted that the scheme discriminates between those students who are achieving and those who are in difficulties prior to the appraisal stage. The use of staged formative objectives has been instrumental in implementing appropriate courses of action for individual students.

The development of a new scheme by the process of action research has been a rewarding if not a time-consuming one. The involvement and consultation of all parties in the planning and implementation has resulted in co-ownership and whilst the tools for the appraisals have not been flawless there has been the opportunity to accommodate changes and make improvements due to constant feedback. Due to co-ownership, clinical staff are motivated and keen to persevere with the scheme although initial implementation has been time consuming. Due to the growth of the scheme and the number of clinical staff involved, there is a need for on-going professional development in the area of learning, teaching and assessment.

Anecdotal evidence from both graduates and employers has demonstrated that multi departmental experiences are instrumental in helping students develop the skills required to become flexible and adaptable practitioners. This has resulted in clinical staff endorsing the philosophy of multi-centre training with the acknowledgement that they hold some responsibility for the clinical education of each cohort and not just specific students. One of the main aims of the clinical placement philosophy is that all students should have parity of experience. Transparent assessment criteria, appraiser training, liaison lecturers, placement contracts and good academic-clinical links help reinforce this philosophy.

The continuous assessment strategy used in the third year has been rated highly by both students and staff and the radiotherapy planning team is now investigating ways of implementing this at the second level.

RECOMMENDATIONS FOR FURTHER RESEARCH

A retrospective evaluation of recent graduates as to how the scheme has prepared them for work.

An investigation into the experiences of those who left the programmes prior to completion of the award to evaluate if the scheme has been useful in developing transferable skills.

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