

# From Exams to Assignments: towards a more authentic assessment in the Science of Radiotherapy

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## Introduction and Background

- The Science of Radiotherapy can often be a challenge for both BSc and PGDip pre-registration Therapeutic Radiographer students. As such, a blended learning and teaching approach is adopted, with a mixed programme of assessment styles – seen/unseen exams and written assignments. Within the programmes as a whole, other styles are also used – OSCEs, presentations and online exams.
- Timed unseen exams have their strengths and merit, but assignment style assessments for the Science elements have also proved of greater worth than originally imagined.
- For some Science modules, on both BSc and PGDip programmes, a change in assessment type was necessary due to the recent pandemic. Conventional wisdom might have suggested exams should be converted to online, scheduled exams. But the opportunity arose to test further the power of assignments for examining relevant knowledge and understanding, but with the added advantage of being able to create more authentic styles – ones which painted real, detailed and relevant clinical scenarios, often seen in modern clinical radiotherapy.
- Carefully designed, they would require the student to go beyond the mere reproduction of class materials (as some might have feared), to demonstrate a depth of understanding and connectedness with different parts of the module syllabus and class tutorials.
- For all levels of the programmes, but especially the advanced ones, significant critique and critical appraisal would be needed from module materials and peer-reviewed evidence base; to show a full depth of understanding of the scientific concepts.
- The modules examined here cover a range of topics, such as Linac operation, in vivo dosimetry, radiobiology, proton beam therapy and other advanced technologies (Fig 1)

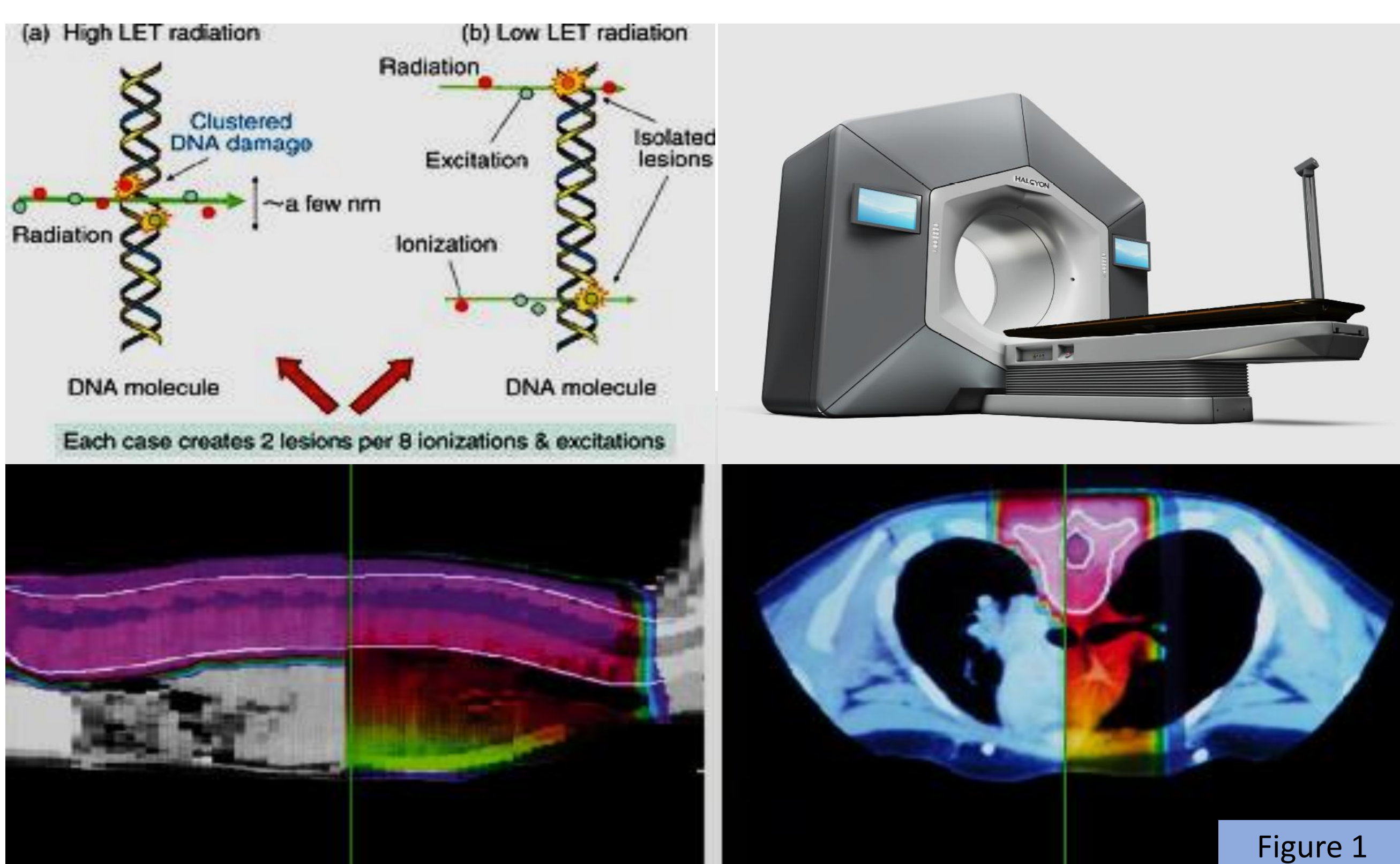


Figure 1

## Experiences

- Science modules within both BSc and PGDip programmes are considered here. The BSc is a three year programme; the PGDip a 2 year. The style of assignments produced is shown below in Fig 2; and all the modules considered are shown in Table 1.
- For the BSc (Yr2), one module (RADT229) changed from unseen exam and assignment to complete assignments because of COVID. Two modules (219 and 229) were merged for our newly accredited BSc programme into RADT214 – but the assignment style was maintained.
- For the PGDip, one Yr 1 module (RADT622) changed from unseen exam to assignment because of COVID; the assignment style is still in place in the programme (now RADT627).

6. For external beam radiotherapy for cancer of the prostate, two possible treatment regimes using IMRT or VMAT are a moderately hypofractionated course of 60 Gy in 20 fractions over 4 weeks and a stereotactic body radiotherapy ultra-hypofractionated course of 42.7 Gy in 7 fractions, 3 days per week over 2.5 weeks. Compare and contrast these two regimes by:

- Defining the "5R's of Radiotherapy" and evaluating them for these two treatment approaches
- Performing a BED calculation to compare the two quantitatively and evaluate which one is better and why. Use  $\alpha/\beta$  ratio values of 1.5Gy for the prostate tumour and 3Gy for nearby normal tissues
- Explaining two possible reasons why the BED calculation compares approximate estimate of the relative effectiveness of one regime

**BSc programme, Yr2**

**PGDip programme, Yr1**

Figure 2

**PGDip programme, Yr1**

1) A local MP around one of the newly commissioned MDS proton treatment centre has been written to from a patient, asking about the suitability of PBT for treating their prostate cancer. Discuss and critique the technical aspects associated with proton beam production, including in your discussion one of the following elements:

- Discussion of the key features of a compact, superconducting cyclotron for proton beam production
- Discussion of the features of energy modulation for spreading out the Bragg peak in the beam direction, explaining why it is needed
- Discussion of the design and use of beam lines in a single cyclotron, multi-gantry proton beam facility, explaining their purpose and the challenges presented if there is a fault with the cyclotron

2) A prostate patient has not attended for radiotherapy photon treatment and has missed 2 fractions (fractions 2 and 3). The patient has been treated as part of a trial with a prescription of 36.25Gy, 5F over 2 weeks (treating on alternate weekdays). Two possible alterations to his treatment have been offered:

- Continuing his treatment on alternate days until completed, meaning he will complete treatment 4 days later than planned and within 14 days in total
- Treating the patient 2 times a day on fractions 4 and 5 ensuring he completes treatment in the originally planned time scale.

Critique these two options and state, with reference to 5R's of radiotherapy, the advantages and disadvantages of each option. There is no requirement to discuss appointment or departmental pressures in your work.

For this assignment, debate critically ONE of the following statements. Ensure you bring forward evidence both FOR and AGAINST the Motion, and include a table which critically appraises any clinical evidence presented. Conclude clearly whether, in your opinion, the motion is carried or not.

- "This House believes that rotational therapies using CT gantry-based equipment are the more advanced technologies for radiotherapy"  
Evidence could focus on technologies such as Tomotherapy/Radiact, Halcyon, Viewray MRIdian, Elekta UNITY, Reflexion etc. including ANY clinical site(s) of your choice
- "This House believes that Proton Beam Therapy (PBT) is the only way forward now for radiotherapy"  
Evidence could focus on ANY clinical site(s) and/or ANY type(s) of PBT technology of your choice
- "This House believes that an MR-only workflow should be implemented NOW for radiotherapy"  
Evidence could focus on ANY clinical site(s) of your choice

**PGDip programme, Yr2**

## Results and Discussion

- Module results are shown in Table 1; shown as the range and mean results (in %). For both RADT622 and RADT229 (S2 of 201920, the start of lockdown), the mean results were lower than previous years. Results for subsequent years seem largely unaffected though.
- What is not evident is a change to a much higher mean or compacted range (towards the higher credit) with the use of assignments. As shown, compared with the other modules, with a longer history of assignment style assessments, the results always show a wide range of marks demonstrating a good test of abilities across the cohorts.

	201718	201819	201920**	202021**	202122	202223
<b>PGDip (Class size)</b>	22	19	22	21	19	17
RADT622 (E 100%)	55-86: 71	43-90: 70	45-89: 61			
RADT627 (A 100%)				48-89: 62	52-83: 68	N/A
RADT712 (E 100%)*	35-85: 63	51-80: 66	52-86: 65	50-90: 67		
RADT722 (A 50%)						
RADT722 (A 50%) (Module)	52-83: 62	56-85: 71	59-82: 71	28-87: 69		
RADT717 (A 50%)					54-80: 64	51-79: 66
RADT717 (A 50%) (Module)						
RADT713 (A 50%)						
RADT713 (A 50%) (Module)	46-79: 63	55-84: 67	56-83: 63	56-87: 71	55-86: 68	
RADT719 (A 50%)						
RADT719 (A 50%) (Module)						53-83: 71
<b>BSc (Class size)</b>	30	26	22	28	37	39
RADT219 (A 30%)						
RADT219 (E 70%) (Module)	38-79: 60	33-76: 61	44-82: 62			
RADT229 (A 30%)						
RADT229 (E 70%) (Module)	44-87: 63	37-77: 63	30-70: 57			
RADT214 (A 100%)				27-84: 64	15-83: 65	33-90: 67
* Seen Exam						
** COVID affected years						
			Yellow shade = Exam component changed to Assignment			

Table 1

- Student feedback has been good (Fig 3) – with very positive comments. Negative comments only centred on the timing of deadlines, especially for modules with two components of assessment. The change in teaching style adopted (through a blend of recorded and F2F approaches and the greater use of interaction and tutorial style discussion) has also been commended and might be viewed as a necessary component of this style of assessment.

"I have never been overly keen on physics but have thoroughly enjoyed all his teaching, including this module and particularly enjoyed the freedom we got with assignments and change to explore topics that interested us" (PGDip)

"Assignment is a really good way of assessing us, we got good feedback in plenty of time," (BSc)

"The module is well organised with lectures related to each assignment kept separate. Great support provided for each assignment - emails are always answered quickly, and with great detail!" (PGDip)

"The assessment method is excellent and I am actually enjoying completing the assignment for this module. The assessment method improved my understanding due to the fact that it is a demonstration by the student of how well the information is understood and the implications surrounding it, and not just how well the student retains information" (BSc)

"Module was very well organised and run, I found the tutorials all incredibly helpful and formative feedback was very informative and helped massively with my assignments" (PGDip)

Figure 3

- Carefully crafted, these assignments allow a greater flexibility with setting a real, authentic scenario and then examining the depth of knowledge, critique and understanding around the subject area in different ways – as shown in Fig 2. The style has been commended through both internal and external scrutiny (Fig 4). Depth of understanding needs to be shown from multiple aspects of each module and cannot just be copied verbatim from class materials.
- A brief examination of these assignments through ChatGPT has shown that they are robust with respect to AI interpretation – ChatGPT answers produced are too shallow and lack the depth of understanding needed to perform well in these modules.

**External Examiner's Comments**

Assessment criteria and mark scheme are provided	Yes	No
Assessment criteria and mark scheme are appropriate	Yes	No
Assessment instructions are clear and appropriate	Yes	No

Comments (e.g. academic standards, assessment of learning outcomes, appropriate assessment for level, quality of feedback provided, internal moderation)

I agree with the internal moderator's comments.

This was an interesting and sufficiently challenging assignment that asked students to apply the concepts studied in the module to examples of practical relevance in the contemporary clinical environment. It clearly covered the set learning outcomes and was accessible in that the material was clearly covered during the course and supporting literature was provided. It is of an appropriate length and level to act in place of an exam for this module.

Extensive detailed and supportive feedback has been provided to students, both holistically and against each of the questions answered. The feedback both recognises good work and offers constructive suggestions for improvement. It will support students in providing stronger submissions for future assignments.

The range of marks is appropriate, with the spread and average consistent with performance in previous years.

External Examiner Signature: \_\_\_\_\_

Date: 28/03/2023

**BSc programme**

**PGDip programme**

Comments (e.g. academic standards, assessment of learning outcomes, appropriate assessment for level, quality of feedback provided)

This was a highly relevant assessment embedding sound understanding of errors and challenging students to evaluate their impact with reference to the evidence base. It matched well to learning outcomes and was at an appropriate level. Marking and feedback was provided in line with school guidance and I agree with the marks and comments provided. Marker comments provided useful food for thought in relation to future career development and an ongoing commitment to accuracy.

Internal Moderator Signature: \_\_\_\_\_

Date: 04/01/23

**External Examiner's Comments**

Assessment criteria and mark scheme are provided	Yes	No
Assessment criteria and mark scheme are appropriate	Yes	No
Assessment instructions are clear and appropriate	Yes	No

Comments (e.g. academic standards, assessment of learning outcomes, appropriate assessment for level, quality of feedback provided, internal moderation)

Agree with the internal moderator. The assignment provides a good opportunity to assess students' knowledge and understanding of errors, their impact and demonstrate critical evaluation writing skills. Thorough feedback has been provided which is highly supportive and in line with University policy.

Figure 4

## Conclusions

- By careful design, the use of authentic, scenario-based assignments has proven to be a robust and highly appropriate assessment tool in the variety of assessment styles used on our Therapeutic Radiography programmes.
- A full range of results are produced and maintained (especially compared to unseen exams) and still reflects different abilities and levels of knowledge and understanding.
- The assignments allow for a demonstration of deeper critique and, in more advanced modules, critical evaluation and appraisal with respect to the evidence base.
- Class response has been excellent and the assignment style reflects that needed for many Therapeutic Radiographer tasks in the modern radiotherapy dept.; for instance, service, equipment and technique evaluation, clinical audit, business case preparation etc..
- Assignments can be considered an effective alternative to unseen exams in this instance.