Title

Contemporary practice education: Exploring student perceptions of an industrial radiography placement for final year diagnostic radiography students.

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Abstract

Introduction: There is a paucity of evidence in diagnostic radiography evaluating a career path into industrial imaging despite several higher education institutes stating this route as a career option on graduation. The link between a career in industrial radiography and diagnostic routes is unknown although there are anecdotal examples of individuals transferring between the two. Successfully obtaining a first post job following graduation in diagnostic radiography can be challenging in the current financial climate. A partnership was formed with an energy sector company that offered non-destructive testing / non-destructive evaluation (NDT/NDE) employing industrial radiographic technicians.

Method: As an initial pilot, 5 (n=5) final year diagnostic radiography students visited an industrial radiography site and underwent theoretical and practical training. Following this placement they engaged in a focus group and the student perceptions/responses were explored and recorded.

Results: Common themes were identified and categorised via a thematic analysis. These were; radiation safety, physics and technology, widening access, graduate attributes/transferable skill sets and working conditions.

Conclusion: Student discussion focussed around the benefits of working conditions in healthcare, the value of technology, safety and physics education in alternative placements and the transferability of skills into other/industrial sectors (e.g. NDT/NDE). Contemporary practice placements are a useful pedagogical approach to develop complex conceptual theoretical constructs, such as radiation physics. An in depth evaluation between the two industries skill sets is postulated. Additionally, this could offer alternative/emerging roles to interested diagnostic radiographers potentially meeting the skill shortage in industrial radiography.

Introduction

It could be argued that the first use of X-rays was for an industrial (not medical) application; Roentgen produced a radiograph of a set of weights in a box to show his colleagues [1]. His most famous image however, was the radiograph he produced of his 'wife's' hand which captured the imagination of the scientific community.

Prior to 1912 X-rays were mostly used within the dental and medical fields. During these years X-ray equipment was fragile and broke down under the high voltages required to penetrate metals, therefore it was not until reliable vacuum tubes and high voltage x-ray generators that industrial imaging became possible. Industrial and medical imaging strands were closely linked until the 1940's until they began to diverge into separate professions [2]. This was due in a large part to the explosion of more technical non destructive imaging and evaluation techniques needed during the conflict of World War 2. From this point in time, industrial imaging techniques have moved away from shared roots and today include varied modalities to image all kinds of products in integrity management from aircraft wings to racing cars. There is no set route or academic criteria to become a non-destructive testing radiographer. Entry into the career is often through school leaver apprenticeships or by completing a certificate or diploma in engineering and then applying for trainee positions.

There is a paucity of evidence in diagnostic radiography evaluating a career path into industrial imaging despite several higher education institutes inferring this route as a career option on graduation [3,4,5]. The link between careers in these two strands of radiography is unknown although there are anecdotal examples of individuals transferring between the two. At first glance it would appear that there are some transferable skills and similarities in the knowledge of applying the electromagnetic spectrum in imaging in different situations, however it is evident that further exploration is needed to establish similarities and/or differences between these two imaging fields.

The medical radiography profession is wide reaching and creative. Emerging roles and advanced practice are common place within its culture. Despite this, successfully obtaining a first-post job following graduation in diagnostic radiography can be challenging in the current financial climate [6] therefore, a career in industrial radiography may be attractive. Due to the location of our training institution in Aberdeen a novel and explorative partnership was formed with an energy sector company that offered non-destructive testing / non-destructive evaluation (NDT/NDE) using industrial radiographic technicians. Aberdeen is often referred to as the energy capital of Europe indeed almost two thirds of the City and Shire's employment is directly linked to the oil and gas industry [7]. It has been the centre of oil production and subsequent energy supply for the UK since the 1970's and has a thriving industrial imaging sector.

All undergraduate students on diagnostic radiography courses within the UK have a substantial amount of time allocated to practice education. The majority of time within placements is spent within the traditional hospital and community imaging setting; x-ray, other imaging modalities and nursing environments. Contemporary practice placement research within imaging has more recently focussed upon the caring/communication skill set development. This is undoubtedly in response to the recommendations of prominent enquiries such as the Francis Report [8]. At Robert Gordon University, the use of care homes as contemporary placements for imaging students [9] has highlighted the benefits of innovative and mutually beneficial contemporary placements for students and providers. Other allied health profession groups are also seeking non traditional placements to develop adaptive, responsive graduates and new skill sets. Non-traditional practice placements within Occupational Therapy (OT) have been explored and evidenced over the last 20 years [10]. Despite this substantial research base in OT, it has been highlighted that there is an evidence void of the systematic learning benefits associated with these placements, especially when evaluating the student experience [11,12]. Within OT the pertinence for further evaluation and exploration into non-traditional placements concerning role emergence for the profession and project development for students has been stated [13].

Alongside these issues, educators have long found teaching and embedding difficult conceptual constructs challenging. It is no surprise that diagnostic radiography students often disengage with physics topics within the imaging curriculum. Amongst students, physics is often considered a difficult and highly abstract subject and interest in it appears to have been on decline for sometime [14,15]. Pedagogically teaching difficult theoretical concepts has been researched but not when evaluating novel approaches such as practice education to help reinforce conceptual physics learning. It is apparent that this is an area which requires more applied and novel pedagogical thinking to assist students in their learning construct.

Through these various ideology strands pursuing a contemporary practice education placement with an industrial imaging partner would seem logical; the aim being to discover similarities and/or differences between the two professions and how the placement was reviewed by the students. No evidence could be found that supported or indeed rejected similar opportunities, therefore in this situation a small scale pilot was preferred.

Methodology

Initial meetings between the radiography placement coordinator and an oil and gas industrial radiography business were arranged. A limited opportunity for final year students to participate in an exploratory pilot placement was organised and planned at the industrial imaging onshore facility.

Population and Sample

An opportunistic sample of final year students in the diagnostic radiography program (n=29) were invited via email to participate in the placement in order to equally advertise the opportunity. Five students (4 females: 1 male) replied and were recruited to undertake the placement. The age range of the sample was between 20-22 years of age.

Placement

Prior to the industrial placement a risk assessment was conducted and reasonable control methods were actioned. Ethical dimensions were considered and it was confirmed that as an educational service development, formal approval via the School’s research ethics procedure was not required. Nevertheless normal governance procedures were employed including establishing informed consent and the right to withdraw, and confirmation of data management and protection arrangements. Additionally, the students were briefed and had to read, agree to and sign the radiation local rules of the industrial radiography site. The students were requested to wear warm, practical clothing due to the nature of the placement. The students were required to take their own radiation monitoring film badges in addition to electronic personal dosimeters provided by the employer. Personal protective equipment was provided by the placement employer to ensure students complied with the health and safety requirements of the working environment.

A learning contract was put in place by the NDT manager in partnership with the radiography placement coordinator and the students to cover the key theoretical concepts before the practical application. This was given to the students before the placement and they were asked to prepare by independently researching the topics in the contract. Theoretical components that were covered by the teaching component included darkroom processes both manual and automatic, radiography of plates and pipe using x-ray and open source imaging (Se75 and Ir192), ultrasonic testing of plate thickness and weld testing, and an overview of magnetics, penetrants and eddy currents. The students then had the opportunity to watch and with assistance or direct supervision conduct some of the non-destructive imaging/testing when on placement at the site.

In the week following the placement, students were invited to attend a focus group to discuss/explore their experiences. All five students attended and gave written informed consent to participate. A facilitator was used within the group to prompt discussions using ‘touch-words’ and phrases to encourage discussion. The purpose of the ‘prompts’ was to encourage a ‘rich’ inductive approach; resultant themes identifying strong links to the data. Inductive analysis was an attempt to process the data without trying to fit it into a pre-existing coding frame, or the researcher’s analytic preconceptions. The group discussion was limited to an hour or to saturation; whichever occurred first. Responses were recorded via an audio-recorder for later transcription. The audio-recording of the focus group was transcribed by the researcher. Common themes were identified via a process of initial coding and a 6 phase thematic analysis. The findings of the study are presented within the discussion as a narrative response series. This way of data presentation and discussion is believed to support oral exploratory research of radiographic experiences [16].

Results and Discussion

Five students participated in the project and focus group discussion. Although a small cohort, a significant quantity of in-depth data was provided that allowed valid thematic analysis to take place, leading to the identification of four overarching themes. The themes as considered below, were perhaps not unexpected given the context, however the variety of comments within these indicated a fairly broad range of perspectives on the part of the subjects.

Radiation Safety

All of the students contributed to this theme within the focus group and it was most commonly coded theme. Within the theme, a specific element was identified that related to relative awareness or perception of radiation risk and its acknowledgement. In particular, there was some belief that the industrial radiographers were less concerned about radiation protection and comments in this respect included:

> "I don't think that I would have been comfortable doing the radiation source stuff…The x-ray, they're actually really precise at setting it up."

> "They have to set up perimeters when they are offshore but for them they didn't wear any protection at all, for them it is just distance from the source."

> "They have a pigtail with the radioactive source that comes out and they were saying sometimes it gets stuck and they have got to go in and manually put it back in."

> "Arguably the reason why you are getting so much money is because it is dangerous. Like you are put at risk one way or anything if there is a radiation spill hazard then that is your problem you have to go and deal with it…you have got to do it as part of that job."

> "The radiation protection that we wear is so strict in hospitals for us, than it is for them."

> "I think that we are taught like far too much that this is so dangerous. In reality if you are in the room nowadays and someone exposes it is pretty much minimal but they are on the opposite end of the scale where they don't understand at all how dangerous it is."

> "They are quite good with their dose readers though. Each has two and they have one that they carry with them as well…So they seemed quite strict."

> "I think that it gives you a better understanding of somebody else's perception of radiation which is good; it gives you an understanding about what other people think about it. We are really cautious about it and they are not so cautious, they have the same understanding about it physics wise, but we have a completely different understanding about the danger of it."

The comments seem to indicate that the inculcation of a rigorous radiation safety culture in diagnostic radiography is effective, leading to a concern on the part of the subjects that there were elements of industrial radiography that were literally dangerous.

Due to the nature of the 'unfamiliar' environment it was perhaps unsurprising that students were conscious of their own radiation safety and that of others. Additionally noted was the precision of the technique and the associated radiation risk factors should there be complications. Nevertheless, the discussion also centred around a perceived lack of understanding of the radiation risks amongst industrial radiographers comparatively. It was clear the students noted that the perceptions of the risks from industrial radiographers were very different from their own despite working essentially with the same entities. There is no evidence to suggest that incidents of radiation over exposure are prevalent within this industrial group, however the very different nature of the equipment and set ups may have been significant. It could be argued that the students, coming from a more consistent and highly controlled environment may have held a more idealised view of radiation safety requirements.

There could be value in encouraging students to consider in more depth, the real and perceived dangers that exist in their own working environments in order to ensure that they have a reasoned understanding that is not based simply on blind acceptance of principles.

Physics and Technology

> "They're like the physics for you will be easy, so that's the only skill that will be transferable to them, is the physics."

> "They do have CR and DR for the odd thing but it is primarily plain film, like manual film dipping and timing - how long, and that's just because that's what they know works. I didn't realise like that they would have to re-do films you…Like he said that the shades were too light or that they were too close to each other so they would have to go and re-do certain films. I didn't realise that they would be so picky about films of pipes."

> "We got to do the darkroom processing…you know proper dipping and everything. It was really cool."

> "They said the technology is filtering down, but it takes years and years and years to come. They see what is happening on the medical side and it is 25-50 years before they get it, but they don't need it that's the fact of the matter. It is a crude method, they don't need the technology, a human life is all more important than doing well testing."

> "I think that it was the physics side; the teaching is the same thing, although they were saying it in a different way. I thought that was interesting the way they explained the physics and that is transferable to both its 1st year since we have done the imaging science. It was really useful going through that again and their perspective; it is different from the way we think of it."

> "It was good because the stuff that they use is just so basic, that when you go you get a completely better understanding like nothings encased in like white gloss... the cathode and the anode were just sticking out and it wasn't in any box or anything… you just like dragged it into place… when you are teaching imaging science and you are teaching the cathode and anode it might be useful to see it...this way…and imagine a patient."

The second most commonly coded theme was the physics and technology related to the experience. Students enjoyed the practical experience gained in manual image processing as this is now an essentially defunct skill in the UK workforce. Nevertheless, this could prove useful in alternative careers/sectors or distant geographical areas. The remit of educational institutes is to produce graduates that are fit for a global stage. The manual nature of radiographic processing working within developing countries/NGO has perhaps been overlooked in recent times. Experiences like this could give the students enhanced skills within this niche market. The students also discussed the sometimes 'crude' technologies deployed and the long time for technologies to filter into the industrial sector. This is interesting, especially given the advantages of CR/DR and tomographic capabilities of modern imaging technology and the potential for financial support in the oil and gas sector.

Most importantly perhaps, was the positive impact that the placement had on their physics knowledge and understanding. The experience had helped to scaffold their previous theoretical knowledge into a practical domain. Physically 'seeing' the equipment out with its "white gloss" casing reinforced their previous theoretical learning. This is important, especially given the known difficulties of engagement of students with challenging conceptual learning, such as radiation physics.

Working Conditions

> "He did try and relate it to the workshop…doing your rope access and you are dangling; trying to set this all up with pipes and it is windy…I liked how he related it to all different situations and offshore."

> "You are stuck in all these confined spaces, its freezing, you are hanging off here, everyone hates you because you are messing up everybody's plans and its nightshift 12 hours. There was one of the guys there saying that he went offshore sitting there for 4 days doing nothing. He was like, "you think that it is good getting paid for doing nothing, but it is so boring." So they were brutally honest.

> "Rope suspension, helicopters there is a lot of dangerous things that you have got to do as part of that job. So is the money worth it to you, doing that sort of thing?"

> "They can't control the work that is coming in they just do it as it comes. If there are masses of work they cope with it; if there is nothing they still have to cope with it."

> “I realised actually that I do quite like working in a hospital, which I suppose is good as well. I do enjoy radiography but I have had experience in other things as well as trades. You think as well in 50 years time you are like absolutely knackered working offshore for 40/50 years. I think that a career in healthcare is much more stable and once you are in there are direct progressions you know academic routes and things that you can do.”

> “Healthcare provides totally different benefits; there are career progression routes, there is role expansion, you can do masters degrees. You know 2 years time you do a masters degree then you are going to get another job, it seems like that people appreciate your study much more in our field other than like in that…that’s how it seemed there, it is a real hit or a miss. At least with the NHS you know that if you have lots of CPD and you have good grades some of that will be taken into account.”

> “I want a much more stable career; a career that is going to provide benefits to me and healthcare is a much more stable career. It is much more rewarding as well, so it sort of cemented my choice at university and I thought, yeah…done now.”

It was apparent that the students found some similarities and many differences in their comparative working conditions. They identified that there was equal unpredictable workload in both medical and industrial fields and this has its own unique stressors. Academic qualification was perceived as more beneficial in the healthcare arena with identifiable linked progression. Students also recognised the risks that are involved with offshore radiography compared to the financial benefits and en-masse enjoyed the perceived benefit of stability within a career in medical radiography. It was also identifiable that the students empathised with the ‘hard graft’ involved with industrial work and that long service in that field was perceived as ‘knackering’ compared to service in the NHS. These findings were useful in ‘enlightening’ the students of the often insidious working benefits of a career in healthcare comparable to other industries.

Graduate attributes/transferable skill sets

> “The only thing that was relevant was the physics it doesn’t change, for example MRI whether you’re scanning a person or doing a pipe. They’re like the physics for you will be easy, so that’s the only skill that will be transferable to them, is the physics for it.”

> “He said he does his own reports so obviously we have the skills. We can look at the image and see what’s wrong with it…more precise than someone just straight out of school!”

> “I think that we are far too skilled for the job, and the money obviously is a big attraction and that’s why people are looking at it, but really we are far too skilled for the job. It is very basic radiography that they are doing.”

> “There was a trainee there and I don’t know if you seen the way he acted…he was very shy and he just walked about grumbling about things. When we are trainees in the hospital we have to act completely differently learn that professionalism.”

> “There is a knowledge link but it’s not accepted by industry, so even though it is there, it is obvious that it’s there…even if you do your degree in NDT, you still have to do your certification so it makes no difference.”

Final year students acknowledged the skills that the have acquired over the course of their training. Their perception of their skill was high compared to that of their industrial counterpart. The experience was perhaps useful therefore as a confidence building exercise. They directly referenced their enhanced writing ability in terms of report completion and critical evaluation of images as attributes that they could transfer. As discussed previously the students recognised their level of physical principle knowledge as useful in the industrial radiography sector. A student also made a comparison between the professionalism required in a hospital setting and there was some debate around the usefulness of highly articulate communication in the industrial sector, although generally this was agreed as a useful graduate attribute from the course.

As previously noted, no evidence could be found that supported or indeed rejected similar opportunities in radiography. It was very apparent from the discussions that there were obvious links between the two professions but that access/transferability between the two professions was difficult for varied perceived reasons including but not limited to; cost of courses, procedural/political reasons, networking opportunity and lack of widening access strategy in HR. In terms of knowledge and application the students again noted and acknowledged the similarities and differences between the two professions.

Conclusion

Perceptions focussed around; the particular value of safety/technology/physics education in alternative placements, benefits of healthcare working conditions, and the apparent lack of transferability into this industry despite relevant skills.

It is acknowledged that a limitation of this work was the ‘pilot’ sample size and that due to self selection, probable that these students found the experience useful. Due to the lack of literature and previous exploration into this field, a small sample was deemed reasonable. Further work into this area is needed with larger samples to correlate the beneficial experiences the students reported. It is important to note methodologically an inductive thematic analysis cannot be separated from the theoretical and epistemological commitments of the interpreting researcher. Additionally data are not coded in an epistemological vacuum [18].

Considering these limitations, large scale mixed methodological work between the two industries skill set is needed to explore widening access offering alternative roles and duel benefits to diagnostic and industrial radiographers and meet the skill shortage in industrial radiography.
Most interesting was the agreement amongst students that the experience helped their understanding of radiation physics and general engagement with difficult conceptual topics. This could prove useful when planning and organising pedagogy for radiation physics.

Conflicts of interest statement

No conflict of interest in the submission and publication of this work.

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