'Real' formative assessment? An exploratory study of simulated learning in the post-compulsory radiography curriculum.

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Abstract

This article explores the student experience of simulated learning in post-compulsory radiography education. The content is based on the varied experiences of students using both laboratory-based simulation exercises and a virtual reality computer simulation activity by situating these views within a wider understanding of the students' journey through their undergraduate and postgraduate studies. Much research on the application of technology in pedagogy in post-compulsory education has sought to find ways of measuring the efficacy of such interventions in raising student achievement. This research reveals a diverse range of student experiences in learning with technology. There are potential pedagogical benefits with computer simulation in radiography education; however the research reveals the need for educators and policy-makers to recognise the sheer complexity of radiography practice and the importance of evaluating simulation within a holistic view of the curriculum. The data was gathered via four focus group discussions; one research interview; and reflections that were made about simulated learning within research diaries. The article contributes to new knowledge about the use of simulated learning in post-compulsory medical education.

Keywords: radiography education; post-compulsory education; simulated learning; experiential learning.

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Introduction

The ‘holy grail’ of curriculum design for the health professions is simulated activities that can be seen to improve real world performance in a clinical setting, leading to better patient outcomes (Cook, Erwin and Triola 2010); preferably in a cost-effective manner. In HEIs, where there is the preparation of undergraduate and postgraduate students for practice, much of the necessary burden of enabling students to achieve an acceptable standard has traditionally fallen upon the practice placement; potentially a high-stakes strategy for both the student, at risk of failure, and the practice environment. Student error should be identified by supervision, however, an error prone student still leaves consequences for the service, such as a prolonged burden of supervision, service inefficiency, reputational damage to the service, and the ever present potential for patient harm; an apology for an error does not always elicit forgiveness from a service-user. There could in fact be said to be, as Ziv et al. (2003) note, an ethical imperative to the use of simulation activities in this instance. For these reasons the use of simulated activities in pedagogy has long been a well-accepted part of health care education. In radiography, in particular, where there is an obvious impossibility of enacting the full range of skills outside of practice, because of potentially harmful ionising radiation, there is a logical attraction to pedagogy with computerised virtual patients.

Simulation, whether engaged in ‘role-play’ based simulation activities in an x-ray room environment, or using a screen-based computer simulation, where the student, for example, manipulates a computer-generated avatar representing a patient, provides opportunities for the formative assessment of activities that resemble those that occur in practice. This therefore enables a kind of experiential learning prior to placement. Experiential learning aims to bridge theory and practice in pre-professional education by giving the student a way of inhabiting a professional role and learning how to perform it. In

radiography education this includes not just practising human interactions to gain their tutor's feedback on their attitude, language-use and enacted approach to patient ethics, but also human-technology interactions, to master specialised equipment, become familiar with work routines and processes, and avoid exposure errors and the possible patient harm that could result.

Much of the available research on simulation in health care education has focussed on demonstrating the efficacy of teaching interventions that are designed to improve student achievement. It has, also understandably, been difficult to arrive at very clear answers to such perennially tricky cause-and-effect questions in respect of the effectiveness of teaching interventions, although systematic reviews have given a good idea of the benefit that can result from technology-enhanced simulation (Cook et al., 2011) and simulation involving computer-generated virtual patients (Cook, Erwin and Triola, 2010) compared to no intervention. Much trickier, given the variations in both educational and research practices, is to arrive at answers regarding the reasons for differences in the size of effect between the studies included or the clear benefits of such technology-enhanced simulation compared to other possible teaching interventions. The latter was also true of a small-scale study attempting to capture the benefits of the screen-based computer simulator that formed part of the student experience in this study (Cosson and Willis 2012a). There is a clear need for such studies to continue, however, we argue that there is also a need for continued theorising about the role of simulation in the overall curriculum that is informed by an understanding of the student experience of knowledge acquisition.

Experiential learning has at its basis a desire to undo the Platonic ranking of experience in the creation of knowledge and, as Dewey argues (2004, 262), position experience:

> *'as a deliberate control of what is done with reference to making what happens to us and what we do to things as fertile as possible of suggestions (of suggested meanings) and a means for trying out the validity of the suggestions.'*

In this epistemology, 'knowing flows directly from doing' (Dewey 2004, 264). What is critical to this process for Dewey, and those building on his philosophy, (for example Kolb 2015) is, of course, the need for structured reflection on this experience. We argue, in line with this thinking, that a key consideration when designing learning innovations in this area is the placing of simulation within a more holistic understanding of the student experience of the curriculum. While this may not provide empirical evidence of benefit, without an understanding of the meanings ascribed by the student to their experience through reflection and how they act on those meanings, there can be little firm understanding of how their educational experience relates to their current and future practice.

This research was carried out with radiography students who have used simulated learning to develop skills as part of their degree programmes. The qualitative data collection captured a range of student views on the benefits and challenges of using simulated learning and revealed a great variety of learning experiences. This resulted in part because of the students' differing experiences of the curriculum and the variety of points they were at in their journey towards a degree, particularly with regard to practice placements on their courses. What all of the students had in common, however, was an evaluation of simulation in terms of its ability to orient themselves in relation to others and towards the relevant technology used in practice. We argue that this reveals the importance of recognising the complexity of both radiography practice and educational practice and the need to develop a nuanced view of the place of simulated learning within the curriculum and its challenges.

Research context

The research in this article comes from radiography students (n=13) who are based in a university in North-East England. The students use both role play simulation activities in an

x-ray room and a screen-based computer simulator to help them to develop their skills in radiography. Simulation is used to develop specific skills and knowledge so that clinical abilities are nurtured in students and this has been a focus of a number of studies (for example, Cook, Erwin, and Triola 2010; Parker and Myrick 2009; Shiner 2018; and Thoirs, Giles and Barber 2010). Experiential learning aims to support the construction of patterns of cognition and behaviour through practice and repetition of that practice and simulation can potentially provide both this and an insight into the complexity of practice situations (Reader 2011) in a relatively risk-free environment (Shinnock and Woo 2012) to help health students develop skills and minimise future risks (Stroup 2014). However, a holistic understanding of learning by simulation in education is unlikely to be captured if the perceptions of the students who are engaged in simulated learning are not fully considered and placed, both spatially and temporally, in their overall experience of the curriculum. Studies, for example, Raymond (2012) may acknowledge that learners enjoy learning by simulation and that it holds the potential to reduce students' anxiety in clinical scenarios (Pollock and Biles 2016), however, we argue that it is important to explore, as fully as possible, the complete nature of this learning experience.

Theoretical framework

In view of the complexity that appears to characterise the nature of radiography education, we have applied a theoretical framework to the research that is based on understanding the student as having to navigate a variety of sites and types of knowledge and performance, involving potentially radical changes to the presentation of themselves in this aspect of their everyday life.

In understanding the relationship that exists between student practice and the curriculum it is useful to consider theories of literacy as social practice and reflect on how this may affect our understanding of what Eraut (2007) terms the epistemology of practice.

Literary texts can be regarded as being ‘ways of representing the world to others’ (Barton 2007, 34, cited in Ingleby 2019). In radiography education the ‘texts’, for example, books about radiography, such as Ehrlich and Coakes (2016) and Whitley et al. (2014), and for example, the slides used in academic lectures, hold the potential to become the basis of ‘literary events’ that are regarded as being ‘occasions in everyday life where the written word has a role’ (Barton 2007, 35, cited in Ingleby 2019). The curriculum that is associated with the research, the BSc (Hons) Diagnostic Radiography degree, is also informed by wider documents that shape its general educational context, for example, the 2015 QAA benchmark statement for biomedical sciences; and the 2016 QAA benchmark statement for health studies. This exemplifies what Eraut (2000) terms the codified knowledge that the student is expected to grasp, and this is what post-compulsory education is primarily concerned with and organised for. In post-compulsory education it is these textually based contexts that are traditionally seen as being the parts of the curriculum of prime importance and so worthy of summative assessment. However, as Eraut goes on to argue, practice depends upon cultural knowledge, and this is informally acquired through activity that then has to be assimilated and performed by the individual so that it becomes ‘personal knowledge’ (Eraut, 2007, 406).

In attempting to understand the student experience of trying to bridge these different sites of knowledge production, the research was informed partly by the ideas of Goffman (1971). Goffman’s notion of social interaction as a performance can be understood as presenting a set of ‘dramaturgical problems’ in terms of the presentation of the activity to others (1971, 26) and we argue that this helps in making sense of the ways in which the students phrase their experiences. Key to the construction of what constitutes success in practice and the potential challenges to this success are not primarily issues of academic learning but those of performance to an audience of qualified practitioners. The experience of

placement, either actual or predicted, was referred to by students as being '*part apprenticeship and part audition'*.

The observed part of the performance is what Goffman labels the 'front' and includes an ability to control the performance environment, including the appropriate use of 'props' (1971, 33). In radiography, the key prop is the radiographic equipment and control over it results in the ability to position it appropriately and select suitable exposures for the intervention. However, other aspects of Goffman's (1971) front include the students' demeanour, their expressions and their subsequent control over the patients; who in this performance are both partly audience and partly prop and, as a result, present a potentially unpredictable element of the interaction. Through the research we aimed to create one of Goffman's 'back regions' where otherwise 'suppressed facts' can be accessed (1971, 114). This is not to say that we consider that the data gained through this means to be privileged in terms of the truth or otherwise of the student learning experience. However, we would suggest that it provides insights that could be useful in further pedagogical developments.

Simulation, in theory, enables the student to gain experience of control over the setting that will form part of their performance of practice and of their manner when placed in this setting. However, part of the complexity of achieving the desired performance of practice is the need to marry together disparate sources of authority assimilated through quite different forms of educational transmission; on the one hand the codified knowledge of textbooks and lectures and, on the other, the cultural knowledge, often providing quite different information, acquired during placement**.** From the educationalist's perspective it may appear axiomatic that the student's ability to perform practice will be dependent upon learning the necessary technical knowledge 'behind' the skills to be utilised. This is usually placed within the conventional forms of academic pedagogy (lectures and seminars), simulated practice in a laboratory and actual practice, with newly developed forms of screen-

based computer simulation itself now added to these traditional practices. However, nonetheless, the traditional, transmission aspect of the pedagogy, the lecture, has typically been at the forefront and signalled the key priorities of the curriculum. This results in students moving across different 'domains' of learning (Barton 2007; Barton, Hamilton and Ivanić 2000; Gee 1996, cited in Ingleby 2019), that is 'different places in life where people act differently and use language differently' Barton (2007, 39, cited in Ingleby 2019). This research has explored the challenges that the students face in blending together the learning from these different domains into a coherent way of presenting themselves as competent practitioners and how useful they find simulated learning to be, or not be, in this process. We have evaluated the usefulness of the simulated activities largely in line with Goffman's (1971) ideas about managing the setting and manner of performance, the two aspects that lie within the student's possible control.

Methodology

The research explores the perceptions of undergraduate and postgraduate radiography students about the place of simulated learning in their curricula using a qualitative, interpretive model of research (using group interviews, an individual interview and reflective diaries used by the researchers). This small-scale study made use of a sample of 13 students, 10 on a BSc (Hons) Diagnostic Radiography programme, four of whom were distance-learners based *in situ*, and three on an MSc Diagnostic Radiography (Pre-registration) course. 10 of the research participants were females and three males and the age of the research participants ranged from 19 to 55 years. This was part of a strategy that aimed for a degree of deliberate divergence within the sample in order to actively seek different experiences and avoid the risk of selectively choosing cases that may fit any preconceived notions; particularly that may lead to a positive or negative view of the benefits of simulation. The students were also at a range of positions temporally in terms of their place on their degrees,

with some being interviewed prior to attending their placement (n=3); others having done one practice placement of the two on the course (n=9); and one having done both placements. If the kind of promising innovations explored by Cosson and Willis (2012b); Peisachovich et al. (2019) and Shanahan (2016) are to be meaningfully judged we would suggest that snapshots in time of student perceptions immediately post-simulation activities are likely to fail to give the kind of holistic understanding of their usefulness in the overall curriculum.

Interviews were held on campus at a time and place convenient for the participants and were deliberately discursive, ranging over topics related to their degree course, including, but not being limited to, the experience of simulation. In this way the researchers constructed with the participants a view of their experience of simulation in relation to the curriculum as a whole, rather than focussing in on it and thus suggesting that it was the only, or main area, of learning to be paid attention to. The researchers involved in the interviewing were also at pains to present themselves as social scientists, totally outside of the world of radiography education and largely ignorant of the technical aspects of it, not least because of the element of truth in this, but also to make sure that the participants felt comfortable in explaining their experience in whatever detail necessary. This limited the need for the research participants to take into consideration what Goffman (1971) would call 'face', that is their own, or the researcher's, self-esteem. The discussions lasted between 35 minutes for the single respondent and around 45 to just over 50 minutes for the groups.

The research transcripts were analysed by constant comparison drawing on longstanding notions of what constitutes credible qualitative research developed by, amongst others, Mehan (1979) and Seale (1999) and, more recently, systematised by Braun and Clarke (2006). This sought to ensure a credible overall approach and to attempt to be sure that any conclusions reached about the perceived uses of, or problems with, simulation were based on a comprehensive data analysis. The focus group and interview data were transcribed by a

professional research transcribing service and the resulting transcripts tackled in a process roughly equivalent to Braun and Clarke's (2006) six stage engagement with data ('familiarisation'; 'generation of initial codes'; 'searching for themes'; 'reviewing themes'; 'defining and naming themes'; and 'generating a research report'). We also ensured that all of our research participants were provided with the opportunity to read through the transcribed research transcripts and provide further comments, retractions or alterations if they wished. Participants were anonymised in the final written article (Merriam 2009).

Findings

Despite what appears on paper as an integrated curriculum, all of the students who were interviewed made a clear distinction between learning about 'theory' and learning through 'practice'. There was no doubt in their minds that the important site of learning was the latter; as one, post placement student, put it: '*placement is where you are going to learn most of what you need to know'.* The difference between theory and practice is clearly demarcated with another student reflecting that: '*for now we have theory lectures and also we have some practical……..where we practice what it would be like to do an x-ray*.'

There was, however, a sharp divide in perception between the students yet to attend a placement and those post-placement in terms of their preparedness for practice and of the degree to which this preparedness was based upon experiencing simulation. The former saw clear links between what simulation provided and what they expected to be necessary, whether this was '*learning how to manoeuvre the machine'*, '*aligning the machine to make sure it's centred*', getting '*a feel for how to take an x-ray for different parts of the body'* or the skills of '*interaction with the patient'.* However, all post placement students had a somewhat different idea of how well they were actually prepared, with one, for example, suggesting, albeit in a very light-hearted fashion, that the stresses of placement were such that talking about it for some of them may be '*like post-traumatic stress, reliving it'*.

Understanding the reasons for this, given the students' ability to detail the aims of the simulated activities, was complex.

Not least, however, is that the performance of practice is actually so complex as to make role play based simulation in an x-ray room struggle to meet the students' needs in this regard. Students experienced what they saw as enormous variations in practice between different NHS Trusts or hospitals and between different individual practitioners. This reveals that the students, although being given license to make certain 'mistakes' in front of the patient/audience, are still nevertheless having to create a range of different ways of performing, and, alongside that, different ways of utilising the necessary technical information. In other words, there is not one 'script' that can be learnt and repeated out in the 'real world' but a need to adapt to other scripts in each new team the students find themselves in, sometimes in a way that challenges some of the presumptions of experiential learning.

'It's a lot of trying to please certain people, rather than trying to figure it out your own way.'

Or, as another participant put it:

> *'You sort of remember who likes it this way and that they like it when you do this and it ends up being a bit more about 'pleasing', than about how you would do it to get the best image'.*

Additionally, having to vary the manner of performance, and control the setting of performance is not easily learnt as the radiographic equipment varies from one setting to another due to different hospitals and Trusts sourcing their machines from different manufacturers, a point that will be returned to later.

The relevance of role play based simulation activities in an x-ray room then is hampered by both the technical aspects of the available equipment and the changing nature of

the performance demanded, particularly because in such simulation the issue of 'face' is so important, meaning that: '*There's not a lot of people who volunteer to be 'patients' or 'radiographers'……it's just like the bravest ones or the craziest'*. To the less confident student this is not puzzling but understandable, however, as '*it takes a while to get comfortable'* yet the effect is that it appears that '*about 70% of people from my group don't even get a chance (to take part), never even seen them do it'*. To the more avowedly confident student this is more a case for bemusement:

> *'I was actually surprised about the practical sessions because I thought we're going to be fighting for who's going to be a volunteer and who's going to be a patient, well it's like the completely opposite way. Like the lecturers try to squeeze the answers out of some of us'*.

This does not mean that those students who do not avail themselves of this opportunity do not wish they had or are not able to see the benefit of this type of simulation. One student noted how she had not participated and one of the possible effects of this:

> *'I'm quite a shy person especially in front of a whole class. I didn't want to get up and position someone in front of everyone. I just didn't like doing that……..so when we've come on our placement and some of the radiographers are asking, 'With this hand, do you want to do it?' and I say 'I don't know how to' and they're like 'You don't know even know how to do a hand?'*

Most of the research participants mentioned not feeling that they knew enough about positioning before placement, simply because they did not believe they had enough time to practice the use of the radiographic equipment and the manipulation of 'patients' to become confident with controlling the setting. This may be because role play time is short and

partly taken up with the tutor's explanation of the task, however for many it is a consequence of the performance that is involved:

> 'W*e could never just go into the room and practice when nobody was around.....it was always in front of five or six of the other students and.....obviously you can't just (emphasis) get comfortable with it'.*

This research is not, of course, trying to suggest that role play simulation is without value and certainly some of the views expressed did suggest the kind of positive experience of simulation that is noted by Peisachovich et al. (2019). Some of these benefits include the opportunity to gain something akin to the type of interaction with human patients that is necessary for successful practice. This is another aspect of the complexity of professionalism that some of the students found to be particularly stressful:

> *'Obviously in our hospital, most people who are coming in for an x-ray are in pain and they can't move, so that's such a shock. You're having to force somebody to move something that's really painful.....it goes against what you want to do as a person.'*

In other words radiography practice involves, as Goffman (1971) would put it, maintaining expressive control during performance in a setting that the student's past experience has not prepared them for. There are then clear and quite large challenges with designing role play simulation so that students can be prepared adequately for placement. What then can a screen-based computer simulator add to this experience and how did students view the place of that activity within their wider curriculum?

The screen-based simulation used on the diagnostic radiography courses is a commercially available simulator that aims to give students the experience of positioning the patient, directing the central ray, collimation, placing the receptor and side markers, choice of

scatter rejection, exposure factor setting, filtration and use of the Bucky tray. Cosson and Willis (2012a) have noted that one of the benefits of the simulator is that it is substantially more cost-efficient than physical simulation and also that students found it an enjoyable learning task (2012b). Moreover, in terms of providing the performance experience students appear to need, a clear benefit is its role in enabling the students to learn control of aspects of the setting, in particular the use of radiation and the effect of various settings on the success, or otherwise, of the examination. The ability to gain experience of the use of exposure of 'patients' to ionising radiation was seen by all of the participants as a key part of their preparation, not least because of the visual experience of the effects of different exposures on the resulting x-ray images.

It is of interest that despite the virtual nature of the pedagogy with a screen-based computer simulator, the language used by the participants emphasised its apparent physicality. *'That was like real, wasn't it? If you positioned it wrong and you took the image, it would come up wrong.'* Another participant added that: *'You get an image for a start'.* In comparison to the laboratory simulation this activity appeared to present the students with an experiential learning experience that married elements of the technical knowledge they need to internalise, some, elements of the performance they need to master, that is, it worked across some of the different domains of learning the student has to navigate. This was most apparent when the students discussed the use of the computer simulator to master ideas around exposure. '*It shows you how you can minimise your dose, so it puts in everything you've learnt, you know why it's important to minimise the dose'.*

A key element that was valued by the participants was learning safe levels of exposure as the computer simulator enabled practice but with '*the safety of not over-radiating (sic) a patient if it's wrong'*. One student characterised this as showing them '*how you can be a better practitioner'* because of the nature of the activity, including the chance for multiple

attempts, thus providing learning through repetition and trial-and-error, and these are both key aspects of experiential learning. This meant that for the students it included a vital aspect of practice but went further, in a shorter time, than actual practice in placement by allowing repeated attempts at the same activity. When contrasting the computer simulator to the role play in an x-ray room, the same student noted that when using the screen-based computer simulator: '*We actually have to set the numbers.....and actually know what radiation dose to give to the patient in a particular body part, in the lab we don't really focus that much on that technical side'.*

Of interest to this conceptualisation of the activity is the repeated use of the word 'actually', counter-intuitively suggesting a physicality or real-world quality to the virtual performance activity that the role play simulation is unable to provide.

Students also commented on the ability of the computer simulator to give them valuable experience in the use of markers and, to a lesser extent, positioning, yet it was the nature of the experiential learning involved that appeared uppermost in their considerations. The individual nature of the activity, the chances for repeated uses of it, carried out at a pace that is set by the learner and the breadth of different practice scenarios were all mentioned as positive aspects of the simulation that were overall presented as offering a built in formative assessment: *'I like to keep the image that's not very good and then have the other one, which was the improvement, so I've got a comparison to help my learning'.*

> *'I'm just taking my time when I'm on the computer, taking my time to make sure that I understand everything. And I don't usually look over to my course mates, unless I get stuck and then I ask for advice from my course mates or the lecturer. But it's more like I'm trying to make sure that I understand what I'm doing, I'm taking my time'.*

However, this is not to say that the participants thought that the computer simulator was enough to fully prepare them for the rigours of performing in their placement. Those students who were slightly less enamoured of the benefits of the computer simulator tended to be those who expressed a continuing nervousness regarding safety and patient handling. Screen based computer simulation again, despite its clear benefits in some ways, comes up against the challenge of the complex nature of practice where the student is navigating performance in settings that are unfamiliar and learning to interact in new teams, both of which provide obvious challenges. This may be because a crucial part of the setting, the radiographic equipment, is not itself standardised:

> *'There's different doses for different parts of the body..... and they're different depending on whether you're using digital cassettes or whether you're on a mobile. It's just completely different everywhere so you get your head around one set of exposures and you've got a different machine and it's a different set there. It's really confusing'.*

This obviously means that when the student enters the performance setting it is one that they can struggle to appear to have control over. Added to this are the previously mentioned variations in individual practice that make marrying the domains of learning potentially problematic. '*They have a list behind each x-ray machine telling you what the exposures are and then (the radiographer will) say, 'Well, they're rubbish. Don't use that one''.* This seemed to create insecurity within the research participants in respect of deciding upon the authority of the different sources of knowledge. This insecurity is only ever really addressed when the mastery of the performance is gained. 'A*t some point, you just know what to do and when you know what to do you know how to apply it to different situations as well, like in more complicated situation'.*

It appears obvious then that designing simulation activities is a process that needs to take into account as much as possible of the range of experiences that constitute student placement, however also one that necessitates thinking about its place within the overall curriculum. One possible means of using the curriculum to marry the different domains of learning is to align them more clearly. If performance of certain activities is a prerequisite of practice then possibly it needs to be a prerequisite of the 'academic' domain as well, rather than one that is in effect optional. Participants were all of the view that a reason for the relative unimportance of some of the simulation activities was because they were not subject to examination in them, whilst, in what they perceived as their purely 'academic' modules, they were. '*The laboratory simulations weren't as important to us because we had exams……and we had essays'.*

> *'As a first year student we have a lot of exams coming up. Obviously you do not know what you're doing anyway and so preparing for those exams I didn't feel like I had the time to spend it on the simulation part of the whole thing so I didn't really know what to do when I went in placement'.*

The importance of summative assessment for students and its effect on progression is not very surprising, however, if so, neither should be the message received by the students about those activities that are not subject to summative assessment; it clearly signals its level of importance.

Concluding discussion

Applying the work of Goffman (1971) to the student experience explains how the social interaction involved in role play simulation and practice function as types of performance. We argue this reveals examples of what Goffman (1971, 26) refers to as 'dramaturgical problems', the key problem being 'the sustaining of a definition of the performance'

(Goffman 1971, 247). Whilst elements of interaction can be seen as pre-scripted other important elements are unpredictable, something particularly true in health profession practices. The role of a student on placement involves not merely being a learner but demonstrating learning *in situ,* displaying the ability to improvise; an ability that is particularly key to a successful placement. It is true that the student is excused from the usual appearance of 'infallibility' (Goffman, 1971, 52) however, only to an extent. The research transcripts reveal that an essential aspect of the demonstration of learning concerns the successful display of radiography skills to qualified practitioners who are like an audience that can sanction the mastery of radiography skills, making the experience, as noted previously, '*part apprenticeship and part audition'*. Such skills in social interaction may be only partially, and inconsistently, supported by the wider curriculum, however this appears to be the case because the nature of practice actually poses challenges to experiential learning. This appears to happen when the activities to be learnt are regarded as being a set of merely rationally grasped activities rather than as a 'mode of participation' (Dewey 2004, 323).

However, in the example of radiography education that this research has examined, there appears to be a dislocation between the pre-conceived experiential learning represented in the written curriculum and the actual experiential learning that enables mastery of the performance of practice for the students. One way of making role play simulation more constructively aligned may be to make it the compulsory, summative assessed performance as suggested by Peisachovich et al. (2019). However, it would also appear from this research that a key aspect of curriculum development can be the provision of screen-based computer simulation.

Understanding the student experience via Goffman's ideas of 'dramaturgical problems' (1971, 26) enables the curriculum to be seen as occurring in different 'domains' of learning (Barton 2007; Barton, Hamilton and Ivanić 2000; Gee 1996, cited in Ingleby 2019)

'where people act differently and use language differently' (Barton (2007, 39, cited in Ingleby 2019). This results in students taking part in different types of learning (Eraut, 2000; 2007) and this can pose particular problems when these types of learning are seen to be in contradiction with each other. Simulation is adopted as a way of potentially bridging these different domains, ideally giving students a glimpse into the personal knowledge needed for practice. We argue that this research reveals the challenges to the blending together of the knowledge, events and performances that are associated with simulations and placements in radiography.

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References

Barton, D. 2007. *Literacy: An Introduction to the Ecology of Written Language.* Oxford: Blackwell Publishing.

Barton, D., M. Hamilton and R. Ivanić. 2000. *Situated Literacies: Reading and Writing in Context*. London: Routledge.

Braun, V., and V. Clarke 2006. "Using Thematic Analysis in Psychology". *Qualitative Research in Psychology* 3 (2): 77-101.

Cook, D.A., Erwin, P.J. and M.M. Triola. 2010 "Computerized Virtual Patients In Health Professions Education: A Systematic Review and Meta-Analysis." *Academic Medicine* 85(10): 1589-1602.

Cook D.A., R. Hatala, R. Brydges, B. Zendejas, J.H. Szostek, A.T. Wang, P.J. Erwin, and S.J. Hamstra. 2011 "Technology-Enhanced Simulation for Health Professions Education: A Systematic Review and Meta-analysis." *JAMA* 306 (9): 978–988.

Cosson, P., and R.N. Willis. 2012a. "Comparison Of Student Radiographers' Performance In A Real X-Ray Room After Training With A Screen Based Computer Simulator". *Shaderware Occasional Series of White Papers Concerning Educational Simulation.* http://www.shaderware.com/distrib/etc/WhitePaper-ComparisonOfStudentRadiographersPerformanceInaRealXrayRoomAfterTrainingWithAScreenBasedComputerSimulator.pdf

Cosson, P., and R.N. Willis. 2012b. "Student Radiographers' Perspectives On Using A Screen-Based Computer Simulator In Diagnostic Radiography". *Shaderware Occasional Series of White Papers Concerning Educational Simulatio*n. http://www.shaderware.com/distrib/etc/Whitepaper201211-StudentRadiographerPerspectivesOnUsingAScreenBasedComputerSimulatorInDiagnosticRadiography.pdf

Dewey, J. 2004. *Democracy and Education.* Mineola, N.Y.: Dover.

Ehrlich, R.T., and Coakes, D.M. 2016. *Patient Care In Radiography: With An Introduction To Medical Imaging*. Missouri: Mosby.
Eraut, M. 2000. "Non-formal learning and tacit knowledge in professional work". *British Journal of Educational Psychology* 70 (1): 113-136.
Eraut, M. 2007. "Learning from other people in the workplace". *Oxford Review of Education* 33 (4): 403-422.
Gee, J.P. 1996. *Social Linguistics and Literacies*. London: RoutledgeFalmer.
Goffman, E. 1971. *The Presentation of the Self In Everyday Life* London: Pelican Books.
Ingleby, E. 2019. "It Does More Than it Says on the Tin! Problematising Higher Education in Further Education in England". *Studies in Higher Education* 44 (1-2): 20-31.
Kolb, D.A. 2015. *Experiential Learning: Experience As The Source Of Learning And Development.* Upper Saddle River, NJ.: Pearson Education.
Mehan, K. 1979 *Learning Lessons: Social Organisation in the Classroom*. Cambridge MA: Harvard University Press.
Merriam, S.B. 2009. *Qualitative Research: A Guide to Design and Implementation*. San Francisco, CA: Jossey-Bass.
Parker, B., and F. Myrick. 2009. "Transformative Learning as a Context for Human Patient Simulation". *Journal of Nursing Education* 49 (6): 326-332.
Peisachovich, E.H., L.J. Nelles, S. Murtha, C. Popovic, I. Iris Epstein, and C. Da Silva. 2019 "Proposing a Model to Embed a Simulated-Person Methodology Program Within Higher Education". *Innovations in Education and Teaching International* 56 (1): 46-56
Pollock, C., and J. Biles. 2016."Discovering the Lived Experience of Students Learning In Immersive Simulation". *Clinical Simulation in Nursing* 12 (8): 313-319.
Quality Assurance Authority. 2015. *Subject Benchmark Statement: Biomedical Sciences*. Gloucester: Quality Assurance Agency for Higher Education.
Quality Assurance Authority. 2016. *Subject Benchmark Statement: Health Studies*. Gloucester: Quality Assurance Agency for Higher Education.
Raymond, C. 2012. "Missing the Trees for the Forest? Learning Environments Versus Learning Techniques in Simulations". *Journal of Political Science Education* 8 (1): 69-84.
Reader, T. 2011. "Learning Through High-Fidelity Simulation: The Role of Episodic Memory". *British Journal of Anaesthesia* 107 (4): 483-487.
Seale, C. 1999 *The Quality of Qualitative Research*. London: Sage.
Shanahan, M. 2016 "Student perspective on using a virtual radiography simulation". *Radiography* 22 (3): 217-222.
Shiner, N. 2018 "Is there a role for simulation based education within conventional diagnostic radiography? A literature review". *Radiography* 24 (3): 262-271.
Shinnock, M.A., and M.A. Woo. 2012. "The Effect of Human Patient Simulation on Critical Thinking and its Predictors in Prelicensure Nursing Students". *Nurse Education Today* 33 (9):1062-1067.
Stroup, C. 2014. "Simulation Usage in Nursing Fundamentals: Integrative Literature Review". *Clinical Simulation in Nursing* 10 (3): 155-164.
Thoirs, K., Giles, E. and Barber, W. 2010 *Use of Simulated Learning Environments in Radiation Science Curricula.* Canberra and Adelaide: Health Workforce Australia and University of South Australia.
Whitley, A.S., Sloane, C., Anderson, C. Hoadley, G. and Holmes, K. 2014 *Clark's Positioning in Radiography.* London: CRC.
Ziv, A., P.R. Wolpe, S.D. Small, and S. Glick. 2003 "Simulation-Based Medical Education: AN Ethical Imperative". *Academic Medicine* 78(8): 783-788.

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