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Evaluation of a customised, AI-focused educational seminar delivered to final year undergraduate radiography students in the UK: A cross-sectional study

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ABSTRACT

Introduction: AI education is essential to facilitate seamless clinical integration. The HCPC in the UK requires all radiographers to have some level of digital skills to maintain safety of clinical practice. This study aimed to evaluate the impact of a dedicated AI seminar on radiography students.
Methods: A dedicated 1.5-h in-person seminar was delivered by an AI vendor to final year undergraduate diagnostic radiography students at a UK University. The course consisted of both theory and practice training. An online survey was built and piloted, consisting of both closed and open-ended questions, to explore their level of knowledge, skills and confidence in AI, before (pre-test) and after the delivery (post-test) of the seminar using a 10-point scale. Pre-test was distributed two weeks before the seminar and post-test was open two weeks after.
Results: A total of 68 students answered the pre-test and 31 the post-test survey. Students' theoretical knowledge (Mean = 6.57 vs Mean = 3.85), skills (Mean = 5.39 vs Mean = 3.44) and confidence (Mean = 5.47 vs Mean = 3.43) on AI were all significantly improved after the seminar. Their responses became more focused and specific in the post-test survey. In both surveys students expressed concerns around reliability and accountability of AI, data management and security, patient confidentiality and overreliance on technology in the open-ended questions. They also requested more AI training with hands-on options in their undergraduate degree.
Conclusion: This study confirms the importance of even brief, but customised educational interventions relating to AI for radiographers. The learning needs to be customised to maximise knowledge retention and applicability and to include both theoretical and practical aspects for consolidation of skills.
Implications for practice: These findings will help radiography educators build more focused, tailored AI courses for future students.

Introduction

Lack of artificial intelligence (AI) understanding is a significant barrier to AI adoption in healthcare.[1] Regulators in the UK require basic AI literacy of clinicians to facilitate a seamless AI integration into clinical practice.[2] AI literacy can be defined as knowledge about the underlying AI concepts, skills, understanding of ethical concerns, and competencies about AI applications relevant to

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professional practice, in order to use AI responsibly.[3] Different professions and different roles will require different levels of AI literacy. Basic AI literacy is vital to safely navigate the digital transformation, and more advanced will be required for those who will be becoming AI champions in their respective fields; there are some digital capabilities outlined by NHS England, which will be different for different professionals (NHS, 2020).[4] For radiographers in particular, it has been proposed that they must gain the ability to use digital platforms, demonstrate foundational computational skills, understand the benefits and implications of data sharing and system interoperability, engage in self-assessment of digital literacy, demonsrate positive attitudes towards digital transformation, and demonstrate values and behaviours that embrace innovation. However, it must be noted that these are the minimum skills required for safe AI use; as this is a rapidly evolving field, it is challenging to fully define the competencies needed for radiographers. In medical imaging in both radiology and radiography, previous studies have also confirmed the pivotal role of AI education in the successful implementation of AI,[5–9] but also as a key component for ensuring responsible and ethical use of AI.[10] In a recent survey, UK radiographers declared AI education as a top priority for AI implementation.[11] Furthermore, the European Union AI act has recently stipulated by law that AI digital literacy is a requirement for safe professional practice,[12] and this has many implications for multiple professions and disciplines.

However, many challenges exist around AI education in medical imaging, despite some promising steps taken to enhance this field. First, educational institutions are still catching up with these regulatory requirements calling for staff upskilling and cross-disciplinary collaborations. Lack of AI knowledge among educators/academics within the discipline of radiography has been recognised as an important barrier of integrating AI in radiographers' academic curricula.[13] Furthermore, some educational courses for radiographers and other medical imaging and radiotherapy professionals have already been established, most of them as Continuous Professional Development (CPD) courses, or modules at a postgraduate level.[14,15] Specific AI courses have been also developed by some professional bodies.[16,17] However, there are fewer formal provisions at undergraduate level, and less so for radiographers. Although radiography involves a lot of applied practice, the majority of these AI courses are delivered fully online.

This study aimed to evaluate the impact of a dedicated in-person AI seminar on undergraduate radiography students' knowledge, skills, and confidence in relation to AI, and to capture their perspectives, hopes and concerns for the emergence of AI within radiography practice.

Methods

Study design

This is a mixed methods longitudinal study, employing an online survey before and after the introduction of an educational intervention as the main data collection tool.[18] Reporting of this study is aligned with the Checklist for Reporting Results of Internet E-Surveys (CHERRIES).[19]

Setting

A dedicated 1.5-h seminar was delivered in-person by an AI vendor to final year undergraduate diagnostic radiography students at City St George's, University of London after careful co-ordination and long discussions by the department's research director with the head of department, vendor representative and respective programme director. These discussions ensured that the teaching level, duration, content and format of the course would be appropriate for the students. They also explored and agreed the optimal student group, time and date for this educational provision to be delivered at, to ensure optimal outcomes. Staff members were present to help facilitate the delivery of this seminar and enhance student engagement with the learning material and the surveys. The team have worked before with the same vendor for their postgraduate programme; there was therefore already established mutal respect and support, to ensure the students learned about both the challenges and opportunities of AI without a commercial pitch.

This seminar was part of extracurricular seminars delivered to year 3 students, attendance was optional and no assignments or marking were involved in this work. Student incentives included an electronic personalised attendance certificate for their academic records subject to their attendance of the seminar.

The course consisted of both theory about AI, delivered in a didactic fashion, and a practical demonstration session delivered to be more interactive and discursive. Both theory and practical sessions covered four main learning objectives, with real-world use cases in different pathologies, such as lung cancer in oncology and acute stroke in neurology. Topics discussed included the below, which were mapped to the respective learning outcomes (in brackets):

- A basic overview of AI, Deep/Machine Learning and AI products (basic AI literacy)
- An understanding of AI's intended use and role within radiography (ethical use of AI)
- An understanding of how AI fits into clinical workflows (overcoming barriers to adoption)
- A practical demostration of AI and the ability to share relevant feedback (all of the above learning outcomes in one example, for better understanding and consolidation).

This was followed up by a class discussion, to encourage students to reflect and ask questions.

Practical demonstration involved showing different use cases, as explained above, on a computer and shared screen, and how the AI tool of the respective company could be used in different contexts, what to be aware of for optimal use and its limitations; students were also able to ask questions at this stage, so this was an interactive session. The AI lead/Research director of the department was also present to support discussions and answer student queries if required.

Ethical concerns on the use of AI in medical imaging were also addressed in this course. However, due to time constraints, this discussion was only limited to ethical challenges around the intended use of AI tools and the UK requirements/standards for responsible AI.

Data collection

An online anonymous survey was created based on prior literature, research team discussions and prior student enquiries, consisting of both closed and open-ended questions, to explore their level of knowledge, skills and confidence in AI, before (pre-test) and after the delivery of the seminar (post-test). Both surveys were piloted with student radiographers ($n = 3$) prior to being launched. The pre-test survey was distributed to the students 2 weeks before the course; immediately after the course the post-test survey was launched and remained open for another 2 weeks, with weekly reminders by the programme director and staff members. Participation to the survey was voluntary and not linked to class performance or marks. After initial generic demographic information (gender and age range) was requested, the respondents were asked to rate (on a scale from 1 to 10) their theoretical knowledge of AI, their practical experience with AI, as well as their confidence in working with AI. These were assessed using self-rated scales. These were followed by open-ended questions that enabled them to discuss topics relating to AI beyond the ones formally asked in the survey, but also to offer feedback on the training they received. These asked them to freely describe how they perceived the term AI, what they would like to learn to be prepared for their role as radiographers, their thoughts on their confidence to work with AI as prospective radiographers, how they thought that AI could help clinical radiography, their perceptions on the risks of using AI in radiography, and finally, any additional thoughts/comments on the topic.

Data analysis

All quantitative data was analysed using the Statistical Package for Social Sciences (SPSS) software, version 28.0 (IBM Corp, Armonk, New York), whereas all qualitative data were analysed using NVivo, version 14 (QSR International Pty LTD). Descriptive results from quantitative data are presented using frequencies, tables, and graphs. The Kruskal–Wallis nonparametric test was used for inferential statistics, to explore differences of knowledge, skills and confidence between pre- and post-test surveys, male and female students and across the students' age groups. Due to the brevity of the free-text responses, a qualitative content analysis was undertaken to further explore students' feelings and experiences of the training. First, all responses were coded into individual units of meaning. These codes were organised into initial coded themes and cross-checked against the original dataset to ensure relevance. The coded themes were then categorised into final clusters and reviewed by the wider research team.[20] An inductive approach was employed for content analysis, as this is a well-established way to study a phenomenon that has not been previously explored within a specific context.[21]

Ethics

All participants were informed about the scope and objectives of this study prior to their participation through emails by the programme director and compiled by the wider research team. Informed e-consent was obtained using a dedicated consent button on the first slide of the survey.[22]

Results

A total of 68 students participated in the pre-test and 31 participants completed the post-test. Due to survey attrition, not all questions were answered by all respondents. Hence, all frequencies presented below correspond to the actual number of responses received for each question. The main demographic data of the respondents are summarised below (Table 1).

A significant improvement was observed in the students' knowledge, skills and confidence post-test responses compared to their pre-test responses (Fig. 1). More specifically, students'

Table 1
Main demographics.

		Pre-test	Post-test
Gender	Male	9 (13.2 %)	4 (12.9 %)
	Female	57 (83.8 %)	27 (87.1 %)
	Non-binary	1 (1.5 %)	–
	Prefer not to say	1 (1.5 %)	–
Age	18–22 years old	51 (75 %)	23 (74.2 %)
	23–30 years old	8 (11.8 %)	4 (12.9 %)
	30+ years old	9 (13.2 %)	4 (12.9 %)

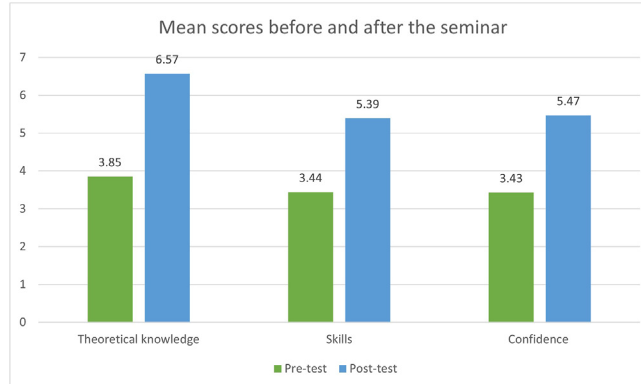

Figure 1. Differences before and after the dedicated AI seminar in knowledge, skills and confidence in working with AI.

theoretical knowledge on AI was significantly improved after the seminar (Mean = 6.57; SD = 2.14 vs Mean = 3.85; SD = 2.29). Similarly, they reported enhanced skills in using AI (Mean = 5.39; SD = 2.58 vs Mean = 3.44 SD = 2.25) and enhanced confidence in using AI tools (Mean = 5.47; SD = 2.730 vs Mean = 3.43; SD = 2.45).

The Kruskal–Wallis test indicated some statistically significant differences between male and female students for the pre-test, with males demonstrating higher levels of AI self-declared knowledge (p-value = 0.01), practical experience with AI (p-value = 0.04), and confidence in using AI (p-value = 0.01). It is important to note that none of the above statistical differences were detected across genders for the post-test. Also, no statistical differences were observed with regards to the age of the respondents for both tests.

Qualitative findings

Fifteen coded themes were generated from the qualitative content analysis and categorised into three coding clusters, which were

Figure 2. Coding clusters and respective themes derived from content analysis.

subsequently developed to reflect the combined themes (Fig. 2). Coded themes are presented by frequency of occurrence in the dataset along with illustrative participant quotations (Supplementary material).

Attitudes to AI in practice

Prior to the educational session, students' attitudes towards the use of AI in clinical practice were generally positive, and this was further enhanced after the training (n = 19). They spoke of AI being supportive to practice, and improving efficiency:

"I feel excited and look forward to a more efficient and streamlined work environment."

Despite these positive reactions, students also expressed considerable apprehension with the technology (n = 82). These were primarily related to concerns around reliability and accountability of AI, particularly in relation to diagnostic accuracy, and welcomed strict governance around data management and security to avoid breeches of patient confidentiality. A number of students also voiced their unease about practitioners becoming overly reliant on AI technology, and how this may impact the radiographer's role and skills in the future:

"… when being rotated to a different clinical site where AI has not been introduced some may struggle … everything has to be done manually … instead of relying on AI."

Students' feelings of confidence in using AI in clinical practice was often referred to in relation to their exposure to the technology whilst on placement (n = 39). Those regularly using AI software reported feeling more confident than those who did not:

"I don't think I'm that confident as I have limited experience."

Real-world knowledge, understanding, and application of AI

Students' understanding of the uses of AI in clinical radiographic practice was far improved following the educational session; while they collectively seemed unsure of its applications prior to the session, they were able to name some specific uses afterwards (n = 99) with reference to clinical decision support and diagnosis predominantly, in addition to scheduling and workflow, and image quality improvement:

"It can help with understanding image quality optimisation and the dose which is required to obtain an optimal image for each examination."

However, students also identified further educational and training needs in AI (n = 67), such as gaining more practical experience and dealing with discrepancies of clinical judgement. Following the session, student's theoretical understanding of AI, as captured in their survey responses, was notably improved (n = 54), although a number of students expressed their want to know exactly how AI would be integrated into their clinical departments, practice, and their professional identities (n = 23), asking:

"How much of an impact will AI have on my role?"

This question was further reflected on by students who considered benefits of AI technology for radiographers in reducing workloads and improving overall job satisfaction (n = 22).

Figure 3. Word cloud reflecting the 50 most common words used by students across both surveys.

Students also considered the impact of AI on the patient's experience (n = 13). Fig. 3 represents the 50 most frequently utilised words in the survey. The overall sentiment is positive, and the top three words "learning, human, patient" reflect how students fundamentally conceptualised and positioned AI technology within their clinical practice as a useful adjunct to, but not a replacement for a person-centred patient-practitioner interaction:

"AI is not as personal as humans. This could possibly result in emotions and feelings being overlooked … This can reduce patient satisfaction."

Yet, there were still a small proportion of students who disclosed their continued uncertainty and lack of understanding of AI applications in clinical practice (n = 13), calling for continued education and training beyond this session to ensure currency and relevance in knowledge:

"I'd like to keep up with the advances in the future to remain confident."

Experiences of AI education

Student feedback on the educational session highlighted how the use of live and interactive software demonstrations provided useful context to better understand the theoretical principles of AI (n = 19). This was beneficial for consolidation of student learning, and provided useful and relatable insight into the application and integration of AI tools within the clinical workflow which often changed their perception:

"I thought AI would be more of a negative thing, but the seminar showed me the positives and just how groundbreaking this technology is."

Many students who expressed a greater understanding of AI in practice following the educational session, also spoke of their increased confidence in using AI in their daily roles (n = 15). Most students reflected positively on the session (n = 9); some spoke of their desire to continue exploring their learning in AI, inferring that access to quality educational experiences should be available to all:

"I hope everyone is given the opportunity to attend and understand how fascinating AI really is."

However, some students recommended areas for improvement in the educational session (n = 9) such as scheduling a longer time, greater encouragement of, and opportunity for, active participation from the group, and including more real-world user stories from the wider multidisciplinary ecosystem in medical imaging:

"Maybe provide the perspectives of radiologists and what they think about this development and how it affects their practice."

Discussion

AI literacy is now a requirement for safe AI deployment. This can be reflected on the digital competencies required for radiographers,[2] or the requirements set by the European Union regarding AI literacy initiative requirements for different organisations.[12] The results of this study further strengthen the importance of AI education on the future of the radiography profession. AI education/training is an important aspect of AI implementation, with previous studies highlighting education as a top priority among medical imaging professionals.[5] Radiographers in the UK have also stressed the need to acquire tailored AI education/training to successfully implement AI in their clinical practice.[11] In addition, radiographers have already indicated their preference to modules with both theoretical and practical contents, and they asked for this training to be included at undergraduate level.[23,24] Hence, hybrid, customised learning strategies, similar to the one delivered and evaluated in this study, can benefit both radiography students and educators.[14]

Findings of previous research have showed varied levels of apprehensiveness among radiographers.[25,26] Also, mixed perceptions on AI have been noted in previous studies on radiography students.[27] Besides, it has been indicated that AI will have a strong impact on radiographers' career pathways, and that it will also transform their professional roles and identity.[28,29] These findings justify students' need to acquire more knowledge on the impact of AI on their profession, to address their concerns and enhance their confidence for the future of radiography. This has been also confirmed in this study, since in both surveys students stressed the need to learn more about the impact of AI on their future roles.

In this study, students requested more hands-on training on AI tools. Radiography is an applied science discipline. Previous studies have highlighted the need to integrate interactions between theory and practice in academic courses and engage in a competences-based academic curriculum.[30] In addition, hands-on training on AI tools will further benefit students to be prepared for their future work environments.[14] Simulation of the work environments using real-world scenarios can also benefit future clinical practitioners.[31]

AI training needs to be dynamic, flexible, aligned with recent developments, and complimented by practical application in clinical placements or internships with vendors to re-inforce theoretical knowledge. Social learning, a process in which learning occurs through social interactions, can be implemented to enhance skills in clinical settings.[32]

Students' responses became more focused and less abstract when explaining AI concepts in the second survey. This was also observed in the AI terminology used after the intervention. This confirms that, although a short educational intervention, this dedicated seminar was highly impactful, and it is feasible to be adopted by many educators subject to establishing robust academic-industry partnerships with different vendors. The University collaborated with a vendor they have worked with extensively in the past, and who was willing to deliver the course at a time that suited the academic programme and tailor it exactly to the students' needs.

With regards to the observed differences across gender in the pre-test survey, our findings strengthen previous research that showed a greater level of confidence in working with AI concepts among male radiographers[7,25,33] and corroborate previous findings of less optimism of female radiographers around AI.[27] It is important to note that no gender differences were observed in the post-test survey, showing potentially that the intervention may have helped to minimise the gender gap in AI confidence, although we acknowledge this might have also been due to the smaller sample size in the post-test survey.

The results of this study demonstrate an overall positive impact of a dedicated AI seminar on final year undergraduate radiography students. The inclusion of both theoretical and hands-on training was found to be beneficial for improving the knowledge, skills, and confidence of future radiographers. However, future interventions should include more hands-on training and involve students in group activities to achieve learning through social interaction within real-life clinical scenarios, involving multidisciplinary teams.

This study has some limitations. First, the small sample size does not allow for generalisation of the results to the wider radiography undergraduate community, and thus results should be interpreted with caution. In addition, the fact that the post-test survey was completed by a smaller number of students, compared to the pre-test survey, might have introduced further response bias to this study. Despite the presence of the AI vendor, the students were encouraged by both the vendor and empowered by the academic staff to discuss the challenging areas of AI and offer honest feedback for improving their understanding and future occurrences of this session.

Conclusion

This study confirms the importance of customised AI educational interventions for radiographers and their facilitatory impact on self-reported knowledge, skills and confidence. The learning needs to be customised to maximise knowledge retention and applicability and to include both theoretical and practical aspects for consolidation of skills. Further improvements are needed to include more interactive forms of learning and hands-on training.

Ethics and declarations

Ethics approval for this study was obtained by the School of Health & Medical Sciences Research Ethics Committee at City St George's, University of London (ref: ETH2324-1274) and by the Associate Dean of Education for undergraduate studies to ensure students completed the survey on a voluntary basis and mechanisms were in place to safeguard student wellbeing, while encouraging participation.

Conflict of interest statement

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.radi.2025.102926.

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