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A Three-Arm Delphi Process for Exploring Australian Radiography Stakeholder Prioritisation of Graduate Skill Development and their Perception of How Often These Skills are Demonstrated by Graduate Radiographers

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A Three-Arm Delphi Process for Exploring Australian Radiography Stakeholder Prioritisation of Graduate Skill Development and their Perception of How Often These Skills are Demonstrated by Graduate Radiographers

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Abstract

Introduction: Clinical skills education requires commitment from academic staff, clinical supervisors, and the students themselves to ensure the attainment of specific learning goals. The aims of this study were to identify specific skill areas that radiography education stakeholders feel are important to develop in Australian radiography students, and to evaluate how frequently the stakeholders believe graduate radiographers demonstrate these skills.

Methods: A three-arm Delphi process of consensus development was used to survey radiography academic educators, radiographers, and radiography students as three separate expert groups. Three to four rounds covered the nomination of professional skills important to participants, the rating and ranking of importance of these skills, and identification of how well the stakeholder groups feel graduate radiographers demonstrate these skills.

Results: Twenty-four stakeholders participated in the study. Thirty-four professional capabilities were identified as being important by at least one stakeholder group. Six capabilities were rated as being very or extremely important by all groups with no large differences of ratings identified between groups for the remaining capabilities. The student group felt that graduate radiographers demonstrate identified clinical skills more frequently than was perceived by the other groups.

Conclusion: The agreement between radiographer education stakeholder groups as to the importance of identified professional capabilities indicates that each group is likely to place similar emphases on the teaching and learning of these skills. Differences of opinion between students and educators around student/graduate performance levels can inform areas for improvement in student performance and educator feedback approaches.

Keywords
Radiography; Education; Professional Capability; Clinical Skill

Key contributions

- The methodological approach to this study, used to observe differences between clinical education stakeholder groups' opinions and observations, could be easily adapted by academics across all disciplines.
- This is the first known study which provides a comparison between radiography education stakeholder groups of the level of importance they place on specific clinical skills areas to be developed in Australian radiography students.
- A common finding across Allied Health Education, was that differences of opinion were identified between radiography students and educators about how well, or often, students demonstrate required graduate clinical skills, and this could provide a foundation for deeper exploration into how this gap could be narrowed.

Introduction

Preparing radiography students for professional practice is achieved through cooperation between various stakeholders: tertiary education academics, supervisors overseeing the training of students during clinical placements, and the students themselves (Martin & Hughes, 2009). Success is determined by how well they achieve specific learning goals, which are usually established by their educational institution in line with local accreditation guidelines and prescribed professional competencies.

In Australia, the Medical Radiation Practice Board of Australia (MRPBA) outlines the professional capabilities (PCs) for radiographers (Medical Radiation Practice Board of Australia, 2020). These PCs are derived from the standards and attributes for Australian health professions regulated under the National Law (Queensland Health, 2009). They align with five domains considered to be important for student preparedness for professional practice, identified through industry and public stakeholder consultation: professional and ethical conduct, professional communication and collaboration, evidence-informed practice and professional learning, radiation safety and risk management, and practice in medical radiation science (diagnostic radiography). Tertiary education institutions use these PCs to set learning objectives for radiography students.

Work integrated learning (WIL) through clinical placements is a key component of the development of radiographer professional capabilities. The MRPBA accreditation standards for medical radiation practice (Medical Radiation Practice Accreditation Committee, 2019) stipulates that "…students are provided with extensive and diverse work-integrated learning experiences in a range of settings with a range of patients/clients and clinical presentations" (p. 19). There is no set number of placement hours or scheduling required for MRPBA accreditation. Rather than nominating WIL hours, the MRPBA states that, "Education providers are expected to explain how the entire spectrum of work integrated learning experiences will ensure graduates achieve the professional capabilities" (Medical Radiation Practice

Accreditation Committee, 2019, p.9). This autonomy results in radiography programs across Australia having slightly different clinical placement timetabling and assessment processes.

While the professional practice domains are clearly documented, different stakeholders may have varying views on the importance or emphasis that should be placed on each professional practice domain. If there are conflicting views, judgements of individual student learning goals and the perceived success of educational programs in meeting stated learning goals are also likely to vary amongst stakeholders. To date, there is no identified literature investigating how radiographer education stakeholders rate different domains by importance.

Furthermore, tensions can exist in instances when a student's or graduate's perception of their clinical skills ability does not align with the clinical competence observed by academic staff or radiographers in their workplace. Anecdotal conversations with educators and radiographers often indicate generalised concerns with some areas of clinical competence in graduate radiographers. Whilst there have been studies exploring the perceptions of radiographer and other health professional clinical skills development and work readiness (Makanjee et al., 2023; Malau-Aduli et al., 2022; Mariño et al., 2022; Pettit et al., 2017; Walker et al., 2013), little has been found which directly compares how radiography students or graduates rate their clinical skills abilities with how their abilities are perceived by other stakeholders.

An investigation of how radiography education stakeholders (academics, radiographers, and students), rate professional practice domains would help inform educators where teaching emphasis should occur and guide further investigation into why any identified differences exist.

Study aims

This study aimed to identify skill areas that three radiography education stakeholder groups (academics, radiographers, and final year students) feel are important to develop in radiography students in Australia.

A secondary aim was to identify how these stakeholder groups rank the importance of those skills, and how frequently they believe graduate radiographers demonstrate these skills.

Methods

Ethics approval was obtained from the University of South Australia's Human Research Ethics Committee (#201344).

The Delphi methodology

A Delphi survey methodology was used to seek consensus amongst respondents (Hasson et al., 2000). Participants completed a series of questionnaires developed in response to the results of previous surveys as they moved through the process. This continued until the

opinions of each group converged, and consensus was reached within each group. It was recommended by early Delphi developers that this process involve at least two rounds, with four rounds considered to be optimal (Hasson et al., 2000; Kerr & Tindale, 2014). Identifying the appropriate number of rounds took into consideration the impacts of time requirements for participants, particularly noting the potential for low response rates due to the multiple feedback stages which build the Delphi process, resulting in survey fatigue (Hsu & Sandford 2007).

Rather than bringing all education stakeholder groups together to seek consensus, the multi-arm methodology described in this study allowed for observation of similarities and differences across the three groups (Owens et al., 2008).

Participants

The Delphi process engaged participants who are considered 'experts', or who have a functional understanding of the topic being investigated (Hasson et al., 2000). The 'experts' in this study were stakeholders considered to have a functional understanding of professional skills education (Marshall et al., 2007; St. John-Matthews et al., 2017; Timmerberg et al., 2019). Purposive sampling was used to group stakeholders into three 'expert' groups in radiography education:

- Academic educators
- Radiographers
- Students

Academic educators were sought from accredited radiography programs across Australia. To ensure the group participants could contribute with a functional understanding of the topic, these academics must have been qualified radiographers, and have had clinical radiography experience, as opposed to academics from other backgrounds who taught into a radiography program.

Radiographers were recruited to offer their insights as clinical education stakeholders and professional team members who work with recent graduates. As the functional understanding of a profession varies according to type of experience, the radiographer cohort included early career radiographers, those with more than five years of experience, clinical supervisors, rural and urban radiographers, and radiographers in managerial positions.

Students in the final (fourth) year of their radiography degree were recruited. This ensured students had completed several clinical placement rotations, thus improving their level of functional understanding of radiographic clinical skills education.

The total sample size sought to encompass a range of curricula and perspectives relevant to the topic in order to produce a wide range of ideas (Falzarano & Pinto Zipp, 2013; Hasson et al., 2000; Keeney et al., 2011). A larger sample size was sought for the radiographer group than for the other groups to ensure representation from a range of locations and workplace experiences.

Recruitment

The social media platforms, LinkedIn, Twitter, and Facebook were used to promote the study and assist with recruitment. Additionally, the Medical Radiations Australia Council of Medical Radiations Discipline Heads provided support to identify and recruit a range of radiographers, academic educators, and students.

Potential participants were sent an email with a description of the study describing the process and commitment. Individuals who consented to participate in the study were asked to complete a series of questions surrounding their experience to determine if further recruitment was required to achieve a sample representing a wide range of experiences.

Survey

Each survey round was completed by participants using an on-line survey tool (Survey Monkey Inc, San Mateo, California).

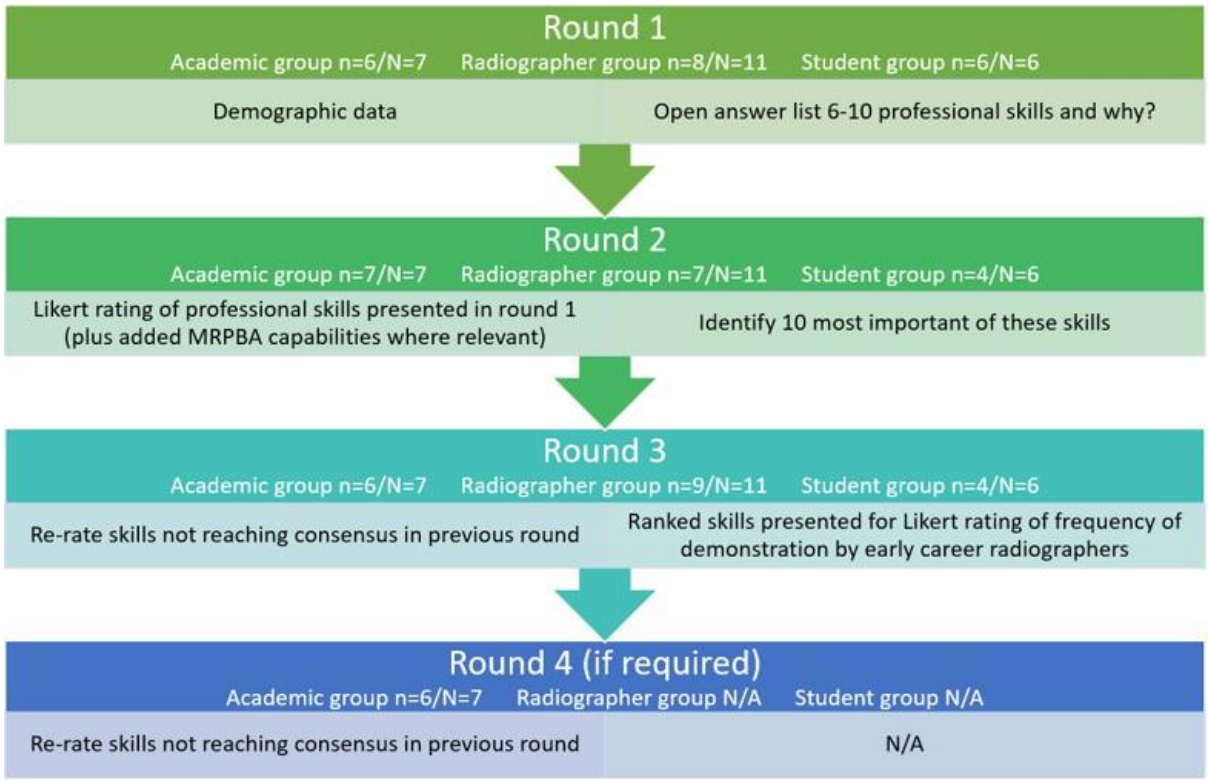
A pilot of the first survey round evaluated the clarity of questions, ease of use of the survey tool, and the amount of time required to complete the survey (Keeney et al., 2011). Three local experts were selected to represent each of the three stakeholder groups.

Delphi survey process

The final survey process is summarised in Figure 1.

Figure 1

Outline of Delphi Survey Process and Participant Numbers for each Round



Note. n = number of respondents for the round from each participant group; N = number of participants for each expert group who enrolled in the study.

Round one survey

Round one included collecting the level and range of clinical radiography experience from participants to establish representation of the stakeholder population. Participants were then asked to identify six to ten professional skills, and to provide a brief explanation as to why they felt each one was important. This allowed participants to respond without their ideas being influenced by suggested options (Hasson et al., 2000).

Analysis of round one survey and preparation of round two survey

The professional skills identified through the round one questionnaire were grouped by similar themes and categorised into specific professional skills to be presented to participants in round two. Any adjustments to wording were minimised so participants could recognise the professional skills categories they had initially identified (Hasson et al., 2000). Any of the professional skills, outlined by the Medical Radiation Practice Board of Australia (MRPBA, 2013) and not identified by participants in the first round, were added for consideration by participants.

Round two survey

Part one

Round two first asked participants to rate the importance of the professional skills categories prepared from round one. A brief definition for each category was provided for clarity. Participants used a 5-point Likert scale to rate importance for each category (Not at all important; Not so important; Somewhat important; Very important; Extremely important).

Part two

Participants were then presented with a list of all the professional skills they had been asked to rate in part one of round two. From this list, they were asked to nominate the ten skills they felt were most important. This was used to determine the ten most highly ranked professional skills by each participant group.

Analysis of round two survey and preparation of round three survey

The responses from part one of the round two questionnaire were analysed for consensus. Consensus was achieved when at least 70% of participants responded in any particular category (Hsu & Sandford, 2007). For example, if more than 70% of the participants identified a professional skill as being 'Not so important', then consensus was met. Professional skills were removed from the next round of the survey when consensus was achieved.

Round three survey

Part one

Round three required participants to use the same Likert scale to rate the professional skills which had not achieved consensus in round two, part one. The participants were provided with the results for each professional skill from the previous round, so they could see the achieved level of agreement (Keeney et al., 2011).

Part two

In round two, part two, the ten most highly ranked professional skills were identified. Where the overall percentage of the tenth-ranked skill was equal to that of others, the number of the most highly ranked skills were increased to include the extra skills with the same ranking. These professional skills were presented to participants in part two of the round three survey. To meet the second aim of this Delphi survey, participants were asked to rate how well graduate radiographers demonstrate each of these skills, using a 5-point Likert scale: (Never demonstrated; Rarely demonstrated; Sometimes demonstrated; Regularly demonstrated; Always demonstrated). These results were recorded, without further process aiming to achieve consensus.

Analysis of round three and consideration of the need for further rounds

The responses from part one of the round three survey were collated, and the professional skills for which consensus was achieved were recorded. Consensus was not achieved for some professional skills ratings, so a fourth round was considered. Participant engagement (the likelihood of obtaining responses from a cohort which may be experiencing survey fatigue), and the observed stability (difference in percentage for each Likert category) of the responses from previous rounds were reviewed. Consequently, a fourth round was administered to the academic group only.

Results

Participants

Seven radiography academics, eleven radiographers, and six final year radiography students enrolled in the study. The numbers of respondents who participated in each survey round have been presented in Figure 1, which describes the Delphi process.

Participant clinical experience data is presented in Table 1. The academic and student groups represented three out of the eleven radiography programs in Australia. There was a wide range of experience in years across the academic and radiographer groups. Participants in the radiographer group reported roles ranging from early career to team leaders and clinical tutors. Academic participants reported having worked in senior radiography positions as part of their clinical roles. Radiographer and academic participants reported a range of working experiences with students both in clinical supervisory and academic capacities. Academic and radiographer groups worked in private and public imaging departments, in both stand-alone private imaging practices and hospital environments. Academics and radiographers reported having worked as radiographers in urban, rural, and remote areas, with the majority having worked primarily or mainly in urban locations.

The student group reported little variety in their clinical placement experiences. Students had placements solely or mainly in urban locations and mainly in private imaging companies, with equal experience in stand-alone private imaging practices or hospital environments.

Identification of professional skills

Table 2 presents the professional skills identified by each participant group in round one. The academic group identified all five MRPBA PC domains in round one. Of these domains, both the radiographer and student groups did not identify *evidence-based practice*, and the radiographer group did not identify *ethical conduct* nor *radiation safety and risk management*.

Importance rating of presented themes

The Delphi process was concluded at the end of round three for the radiographer and student groups because analysis demonstrated minimal change in rating responses (stability of response), and the engagement level was decreasing. A fourth round was presented to the academic group due to the outstanding number of clinical skills for which consensus was still to be achieved, the good level of group engagement and response, and the lack of response stability between the second and third rounds.

Tables 3a and 3b summarise the importance ratings of professional skills for each group. The majority of professional skills outlined in the MRPBA professional capabilities domains and subcategories have been rated as being either very or extremely important by the expert groups (Table 3a). Of those professional skills not explicitly described in the MRPBA professional capabilities (Table 3b), *empathy*, *teamwork*, and *attention to detail* were the most highly rated by the expert groups who initially identified them.

Most highly ranked professional skills and how often these are demonstrated by graduate radiographers

In relation to the most highly ranked skills nominated by participants during round two, part two, and presented in round three, the trend was for the student group to state that graduate radiographers regularly or always demonstrated these skills. They did not identify any skills as being never or rarely demonstrated and nominated several skills as always being demonstrated (Figures 2 and 3). The radiographer and academic groups trended towards clinical skills being sometimes demonstrated, with few being always demonstrated by graduate radiographers (Figures 2 and 3).

Table 1

Summary of Participant Clinical Experience

		Participant group responses (n)		
		Academic (n/N = 6/7)	**Radiographer (n/N = 8/11)**	**Student (n/N = 6/6)**
Number of years of experience as a radiographer in Australia	0-5	1	3	N/A
	6-10	2	1	N/A
	11-20	1	2	N/A
	21-30	0	2	N/A
	31+	2	0	N/A
Regions of employment/ clinical placement experience	Solely in urban locations	2	3	2
	Solely in rural or remote locations	0	0	0
	Mainly in urban locations	2	2	3
	Mainly in rural or remote locations	0	2	0
	Equally in urban and rural or remote locations	2	1	0
	Equally in rural and remote locations	0	0	0
Employment/ clinical placement workplace category	Solely in a private imaging company	0	3	0
	Solely for a public health department	1	0	0
	Mainly in a private imaging company	2	0	5
	Mainly in a public health department	2	3	0
	Equally in private imaging and public health	1	2	0

Employment/ clinical placement imaging department location	Solely in stand-alone private imaging practices	0	0	0
	Solely in a hospital environment	2	0	0
	Mainly in stand-alone private imaging practices	0	2	1
	Mainly in a hospital environment	2	4	1
	Equally in stand-alone private imaging practices and hospital environments	2	2	3

Note. n = number of participants in each group who responded to the first round of the survey, in which demographic data was collected; N = number of participants in each group who agreed to participate in the survey.

Table 2

Professional Skills Themes Identified by each Participant Group in Round One and Presented in Round Two after Thematic Analysis

	Identified by participant group in round one		
Professional skills themes	**Academic**	**Radiographer**	**Student**
Adaptability and problem-solving skills – ability to adjust to unexpected situations	Y	Y	Y
Anatomical knowledge		Y	Y
Attention to detail	Y	Y	
Clinical skill knowledge – understanding and demonstration of all required skills for clinical competency	Y	Y	Y
Communication with other health professionals	Y		Y
Communication with patients and family/carers	Y	Y	Y
Communication with staff	Y	Y	
Confidence			Y
Critical thinking – ability to assess clinical requirements for patients, and to identify the best technical approaches for each examination	Y		
Cultural awareness – self-awareness of cultural values, beliefs, and perceptions, and how these influence our experiences with those of other cultural backgrounds		Y	
Efficiency with workflow	Y	Y	Y
Emotional Intelligence – capacity to be aware of, control, and express one's emotions, and to handle interpersonal relationships judiciously and empathetically		Y	

Empathy – for patients and colleagues	Y	Y	Y
Ethical conduct and professional behaviour – understanding of the basic principles underpinning bio-ethics, and adherence to professional codes of conduct	Y		Y
Evidence-based practice – ability to consider relevant research, clinical expertise, and patient values in the approach to different clinical examinations	Y		
Ingenuity – the quality of being clever, original, and inventive	Y	Y	
Initiative		Y	Y
IT skills – ability and knowledge to use the required IT interfaces (i.e.: patient information databases) effectively	Y	Y	
Manual handling		Y	
Mentoring skills to support supervision roles	Y		
Organisation of workflow	Y	Y	
Patience		Y	
Patient advocacy – ability to empower patients and assist them with their treatment or diagnostic pathway	Y		Y
Physics knowledge	Y	Y	
Radiation safety and risk management	Y		Y
Reflection – ability to consider previous experiences and improve workplace practices	Y	Y	
Resilience		Y	Y
Respect for patients and co-workers			Y

Self-concept of skill level – awareness of one's own clinical skill ability	Y	Y	
Self-development – identification of required self-directed learning needs for improvement of skills			Y
Self-promotion and networking for professional advancement			Y
Teamwork		Y	Y
Technical skills – ability and knowledge to use the required imaging technological interfaces effectively	Y	Y	Y
Trust in others			Y

Note. Skills in italic font represent themes identified as core professional capabilities by the Medical Radiation Practice Board of Australia.

Table 3a

Summary of ranking of importance of professional skills for each of the participant groups throughout the Delphi process: MRPBA professional capabilities domains and subcategories

Skill	Academic group	Radiographer group	Student group
Communication with patients and family/carers	Extremely	Extremely	Extremely
Communication with other health professionals	Extremely		100% Very/Extremely
Communication with staff	Very	Extremely	
Respect for patients and co-workers			Extremely
Cultural Awareness		85.5% Somewhat/Very	
Radiation safety and Risk management	Extremely	Extremely	Very
Manual Handling		Very	
Technical skills	Extremely	Very	Very
IT skills	66.67% Very (as the median)	85.5% Somewhat/Very	
Clinical skill knowledge	Extremely	100% Very/Extremely	Extremely
Adaptability and problem-solving skills	100% Very/Extremely	Very	Very
Anatomical knowledge		87.5% Very/Extremely	Very
Physics knowledge	83.33% Somewhat/Very	Somewhat	
Ethical conduct and professional behaviour	Extremely	87.5% Very/Extremely	75% Very/Extremely
Patient advocacy	Very		Very
Self-concept of skill level	100% Very/Extremely	Very	
Evidence-based practice	Very	100% Somewhat/Very	Very
Critical thinking	Extremely		
Reflection	Very	100% Somewhat/Very	
Self-development			Very

Note. Grey shaded cells = professional capability not identified by the group; coloured cells = MRPBA professional capabilities domains (blue)/subcategories (orange); green = consensus not achieved for one level of importance, in which case percentage across two levels is presented as an indication of the range of importance placed on a skill by the group.

Table 3b

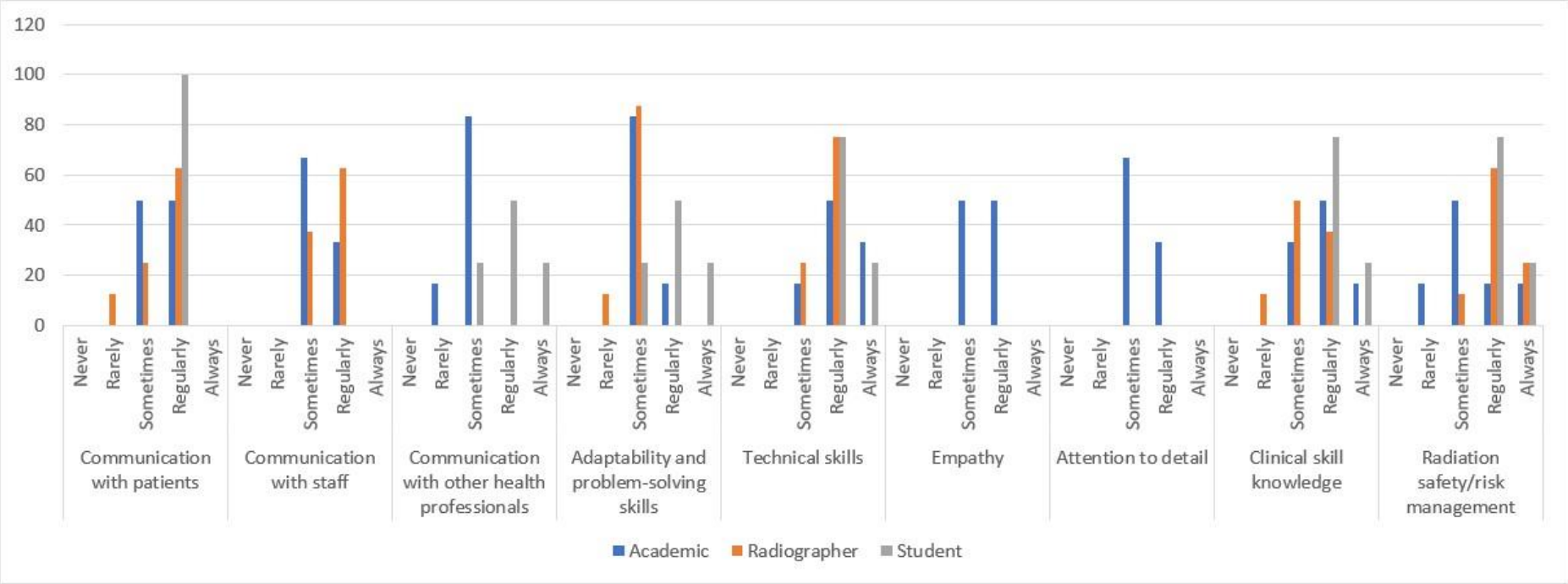
Summary of Ranking of Importance of Professional Skills for each of the Participant Groups throughout the Delphi Process: Skills Not Identified as MRPBA Professional Capabilities

Skill	Academic group	Radiographer group	Student group
Empathy	Extremely	Very	Very
Teamwork		100% Very/Extremely	Extremely
Attention to detail	Extremely	Very	
Efficiency with workflow	83.33% Somewhat/Very	Very	Very
Organisation of workflow	Very	Very	
Resilience		Very	Very
Initiative		100% Very/Extremely	Very
Emotional intelligence		Very	
Patience		Very	
Confidence			Very
Mentoring skills	Very		
Ingenuity	83.33% Somewhat/Very	Somewhat	
Trust in others			Somewhat
Self-promotion			100% Not so/Somewhat

Note. Grey shaded cells = professional capability not identified by the group; green cells = consensus not achieved for one level of importance, in which case percentage across two levels is presented as an indication of the range of importance placed on a skill by the group.

Figure 2

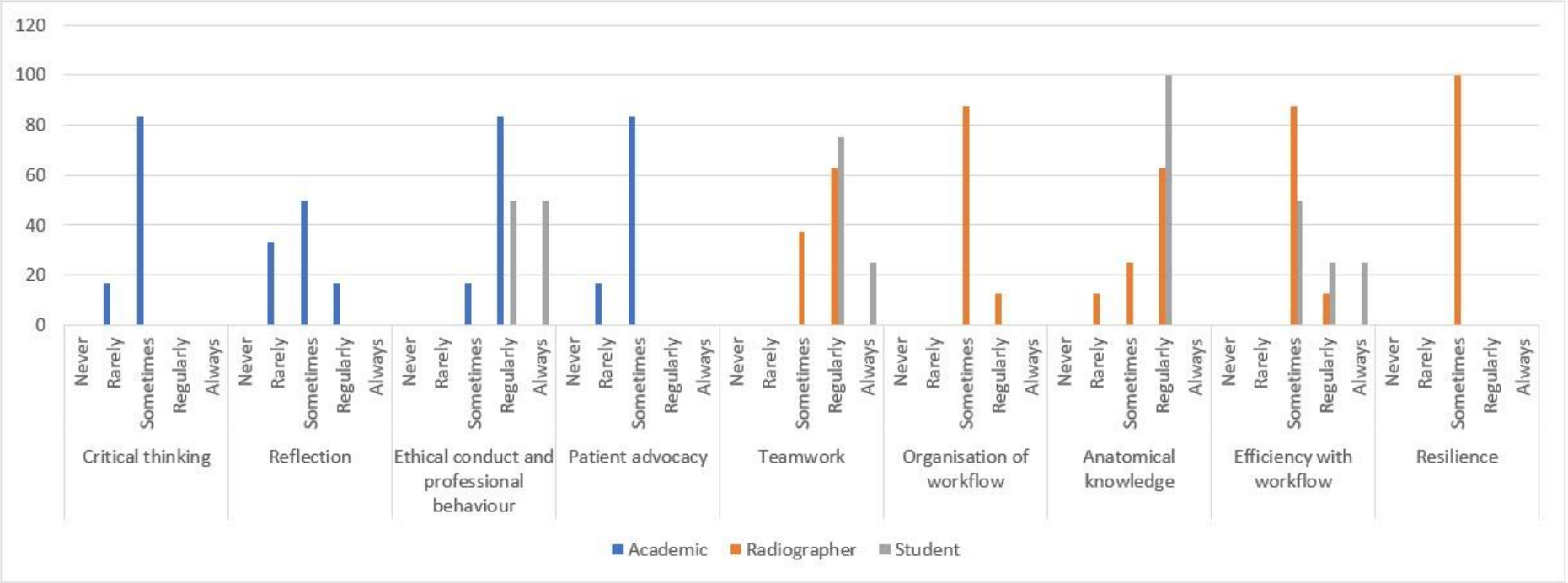
Frequency of Skills Demonstration by Graduate Radiographers – Perspectives of each Participant Group (Part 1)



Note. Responses were collected from groups only where that group had initially listed the skill within their top 10 ranked clinical skills.

Figure 3

Frequency of Skills Demonstration by Graduate Radiographers – Perspectives of each Participant Group (Part 2)



Note. Responses were collected from groups only where that group had initially listed the skill within their top 10 ranked clinical skills.

Discussion

This unique study consisted of three independent Delphi surveys administered to three separate radiography education 'expert' groups to compare perceptions about the importance of specific clinical skill areas to be developed in Australian radiography students, and how well they are performed by graduates.

Identification of important radiographic clinical skills

Most skills in this study were rated as being very or extremely important by participant groups, with only a few skills regarded as moderately important (*ingenuity*, identified by the academic and radiographer groups; *physics knowledge*, identified by the academic and radiographer groups; *trust in others*, identified by the student group, *IT skills*, identified by the academic and radiographer groups; *cultural awareness*, identified by the radiographer group; and *self-promotion,* identified by the student group). This is unsurprising, considering the Delphi process started with each participant being asked to identify those clinical skills they felt were important for student radiographers to develop during their training. However, the effect of this bias was reduced with group consensus.

Only the academic group included all MRPBA capabilities in their first-round responses. *Evidence-based practice* was not identified by both the student and the radiographer groups, and *ethical conduct* and *radiation safety and risk management* were not identified by the radiographer group. However, once introduced, these skills were rated as being very or extremely important by each group. The radiographer group initially identified fewer MRPBA capability domains than the other groups. This likely reflects that radiographers are not as involved in development and/or application of learning objectives aligned to these domains as academics and students are.

The MRPBA guidelines underwent extensive stakeholder consultation and review as part of the latest update (Medical Radiation Practice Board of Australia, 2020). Although it was not the intention of this study to explore stakeholder perceptions of the MRPBA capabilities, it is interesting to observe how these results align with the professional skills identified by participants in this study. Further exploration into why some capabilities were not initially identified by the radiographer and student groups would be beneficial in understanding the different priorities for each group. These differences may impact on the development of skills on clinical placements and suggest areas for improvement in communication from academics.

The findings of this study align with an exploration of radiographers' transition into the workplace by Makanjee et al (2023) and those of a systematic review of nursing graduates' clinical competence which describes the aspects of clinical competence which qualified registered nurses felt were important for graduates to develop (Missen et al., 2016). Similar to the current study, they identified the following key themes of clinical competence: interaction/

communication, clinical/technical skills, critical thinking, and overall readiness for practice.

Communication with patients and family/carers was the most highly rated clinical skill, with consensus from all expert groups that this was an extremely important skill for student radiographers to develop. Whilst there is a notable omission of a patient stakeholder group in this study, communication is noted to be a key outcome in other work which explores patient priorities for their healthcare experience (Hannawa et al., 2022; Hyde & Hardy, 2021). It is interesting to note that only the radiographer group identified the communication sub-grouping of *cultural awareness* during the first round of the survey (Table 3a). Subsequent to this, the group did not achieve consensus for this capability and ended up with an overall moderate (somewhat/very) level of importance. Without further qualitative exploration, it is unclear why this sub-grouping is perceived differently by participants to the other fundamental blocks of communication.

Several professional skills were not initially identified by each of the groups as being important, so not all skills were evaluated by all groups in the study. *Teamwork* was nominated for inclusion by the radiographer and student groups, but not by the academic group. This is a professional skill which is consistently identified in the literature as being one of the most highly rated by employees across a broad range of industries (Babiker et al., 2014; Khoo et al., 2020; Pang et al., 2019; Rosen et al., 2018). Additionally, the radiographer group was the only one to identify and rate *emotional intelligence* and *patience*, but it did not consider *patient advocacy* or *communication with non-radiography health professionals*. This was a potential limitation of using open responses in the first round, however this method was used to limit potential bias introduced by providing a pre-formatted list of clinical skills.

Graduate performance

While there is a limitation in this study when comparing the student group with the academic and radiographer group ratings of graduate competency because of low participation numbers, the students' rating of graduate radiographer performance was higher compared with the ratings of the radiographer and academic groups. This is consistent with findings for graduate nurses, where a systematic review showed low to moderate satisfaction with graduate critical thinking skills and general communication difficulties are reported with few studies identifying satisfaction with graduate communication skills, and only a basic level of preparedness for clinical practice (Missen et al., 2016). Similarly, a study comparing medical graduates' self-assessment of clinical skills ability with expert assessments, identified a discrepancy between the perceptions of the graduates and those of the experts, with graduates consistently rating themselves more competent than rated by the experts across a range of professional capabilities (Abadel & Hattab, 2013). Beyond graduate level, Davis et al. noted a tendency for medical practitioners to remain inaccurate in their clinical skill self-assessment– with those least skilled being the most confident (Davis et al., 2006). Discrepancies between the

perceived level of graduate skills between students and experienced radiographers indicate different performance expectations between groups. These discrepancies indicate a need for further research and development to improve student perceptions of what it means to be work ready. Discussion between students and educators about discrepancies may assist in providing improved descriptions of expected graduate performance, and development of frameworks for clinical performance feedback from educators to students.

Expert group representation and responsiveness

Although participation numbers were low, there was fair representation of diverse experiences within the academic and radiographer groups. The student group lacked diversity in the variety of locations in which they had spent their clinical placements. This reflects the limited range of radiographer placements that are available by location.

We could not compare the clinical experience of our study sample against the MRPBA registrant data at the time of the Delphi survey, as the registrant data does not provide details about the types of organisations their registrants work in, nor the years of experience (Medical Radiation Practice Board of Australia, 2018). However, the purpose of the Delphi process is to bring together experts to work through the research topic of interest, rather than attempt to survey a representative population from which inferential statistics could be applied (Keeney et al., 2011). With 12,531 diagnostic radiographers registered in March 2018, the process for sampling and surveying a representative population would be much different, and not one suitable for the aims of this study (Hahs-Vaughn & Lomax, 2020; Medical Radiation Practice Board of Australia, 2018).

The size and responsiveness of the participant groups impacted the number of rounds completed by each group, and a decision was made to cease surveying after round three for the student and radiographer groups. The final round for each of the groups required many reminder emails to the participants, and extended periods of time to allow for delayed responses. Low participant numbers in each group potentially limited the range of professional skills identified in the first round and later considered for importance by others. Block, Brinkman, and Gard noted the disadvantages of the Delphi technique, when compared with other consensus techniques, most notably the risk of poor response rates and the limited number of experts used for the process (Block et al., 2021). When considering which approach would be best for this consensus study, the advantages of allowing for geographical diversity and respondent autonomy outweighed any identified negatives of the Delphi process.

Beyond academics, radiographers, and radiography students, there are further stakeholders to radiography education which have not been included in this study, creating a bias towards those stakeholders who are based directly within the radiography profession. Future work

could be considered to bring in the perspectives of patients, referring practitioners, and radiologists.

Conclusion

This Delphi study compared the opinions of three radiography education stakeholder groups about the level of importance they place on different professional capabilities required for practicing radiographers. There was consistency between students, academics, and radiographers in instances when each group identified the same competencies. However, the fact that radiographer and student groups did not identify all five MRPBA PC domains suggests areas for improvement in communication between academics, radiographers and students, with the aim of reaching a shared understanding of the format and importance of professional capability development in students. Further investigation is required to understand better the slight disconnect between the skills initially nominated across each of the expert groups. This could be supported by focus group work with representatives from each of the three stakeholder groups represented in this study. Students rated the performance of graduate radiographers higher than academics and radiographers, which is an area which needs improvement to ensure students and early career graduates understand how to meet academic and radiographer expectations.

References

Abadel, F. T., & Hattab, A. S. (2013). How does the medical graduates' self-assessment of their clinical competency differ from experts' assessment? *BMC Medical Education*, *13*(1), 24. https://doi.org/10.1186/1472-6920-13-24

Babiker, A., El Husseini, M., Al Nemri, A., Al Frayh, A., Al Juryyan, N., Faki, M. O., Assiri, A., Al Saadi, M., Shaikh, F., & Al Zamil, F. (2014). Health care professional development: Working as a team to improve patient care. *Sudanese Journal of Paediatrics*, *14*(2), 9–16.

Block, Z. A., Brinkmann, J. T., & Gard, S. A. (2021). The Utilization of Consensus Techniques in Education and Research in Medical Professions. *JPO: Journal of Prosthetics and Orthotics*, *33*(3), 175–183. https://doi.org/10.1097/JPO.0000000000000367

Davis, D. A., Mazmanian, P. E., Fordis, M., Van Harrison, R., Thorpe, K. E., & Perrier, L. (2006). Accuracy of Physician Self-assessment Compared with Observed Measures of Competence: A Systematic Review. *JAMA*, *296*(9), 1094. https://doi.org/10.1001/jama.296.9.1094

Falzarano, M., & Pinto Zipp, G. (2013). Seeking consensus through the use of the Delphi technique in health sciences research. *Journal of Allied Health*, *42*(2), 99–105.

Hahs-Vaughn, D. L., & Lomax, R. G. (2020). *Statistical Concepts: A First Course*. Routledge. https://doi.org/10.4324/9780429261268

Hannawa, A. F., Wu, A. W., Kolyada, A., Potemkina, A., & Donaldson, L. J. (2022). The aspects of healthcare quality that are important to health professionals and patients: A qualitative study. *Patient Education and Counseling*, *105*(6), 1561–1570. https://doi.org/10.1016/j.pec.2021.10.016

Hasson, F., Keeney, S., & McKenna, H. (2000). Research guidelines for the Delphi survey technique. *Journal of Advanced Nursing*, *32*(4), 1008–1015. https://doi.org/10.1046/j.1365-2648.2000.t01-1-01567.x

Hsu, C.-C., & Sandford, B. A. (2007). *The Delphi Technique: Making Sense of Consensus*. https://doi.org/10.7275/PDZ9-TH90

Hyde, E., & Hardy, M. (2021). Patient centred care in diagnostic radiography (Part 1): Perceptions of service users and service deliverers. *Radiography*, *27*(1), 8–13. https://doi.org/10.1016/j.radi.2020.04.015

Keeney, S., Hasson, F., & McKenna, H. P. (2011). *The Delphi technique in nursing and health research*. Wiley-Blackwell.

Kerr, N. L., & Tindale, R. S. (2014). Methods of small group research. In *Handbook of research methods in social and personality psychology, 2nd ed.* (pp. 188–219). Cambridge University Press.

Khoo, E., Zegwaard, K., & Adam, A. (2020). Employer and academic staff perceptions of science and engineering graduate competencies. *Australasian Journal of Engineering Education*, *25*(1), 103–118. https://doi.org/10.1080/22054952.2020.1801238

Makanjee, C. R., Zhang, J., & Bergh, A.-M. (2023). Roles and Responsibilities in the Transition to Working Independently: A Qualitative Study of Recently Graduated Radiographers’ Perspectives in Australia. *Journal of Multidisciplinary Healthcare*, *16*, 2471–2483. https://doi.org/10.2147/JMDH.S416510

Malau-Aduli, B. S., Jones, K., Alele, F., Adu, M. D., Drovandi, A., Knott, G., Young, L., & Jo, C. (2022). Readiness to enter the workforce: Perceptions of health professions students at a regional Australian university. *BMC Medical Education*, *22*(1), 89. https://doi.org/10.1186/s12909-022-03120-4

Mariño, R., Delany, C., Manton, D., Reid, K., Satur, J., Crombie, F., Wong, R., McNally, C., Lopez, D., Celentano, A., Lim, M., & Morgan, M. (2022). Preparedness for practice of newly qualified dental professionals in Australia—Educator, employer, and consumer perspectives. *BMC Medical Education*, *22*(1), 396. https://doi.org/10.1186/s12909-022-03476-7

Marshall, A. P., Currey, J., Aitken, L. M., & Elliott, D. (2007). Key stakeholders' expectations of educational outcomes from Australian critical care nursing courses: A Delphi study. *Australian Critical Care*, *20*(3), 89–99. https://doi.org/10.1016/j.aucc.2007.05.001

Martin, A., & Hughes, H. (2009). How to Make the Most of Work Integrated Learning: A Guide for Students. *Lecturers & Supervisors", Massey University, Private Bag 11222 Palmerston North 5301 New Zealand*.

Medical Radiation Practice Accreditation Committee. (2019). *Accreditation standards: Medical radiation practice*. https://www.ahpra.gov.au/documents/default.aspx?record=WD21/30784&dbid=AP&chksum=p31uaKToamWisUOvmFKtUg%3d%3d

Medical Radiation Practice Board of Australia. (2013). *Medical Radiation Practice Board of Australia—Retired: Professional capabilities for medical radiation practice*. https://www.medicalradiationpracticeboard.gov.au/Registration-Standards/Professional-Capabilities.aspx

Medical Radiation Practice Board of Australia (2018) *Registrant data: 1 January—31 March 2018*.

Medical Radiation Practice Board of Australia. (2020). *Medical Radiation Practice Board of Australia—Professional capabilities for medical radiation practice*. https://www.medicalradiationpracticeboard.gov.au/Registration-Standards/Professional-Capabilities.aspx

Missen, K., McKenna, L., & Beauchamp, A. (2016). Registered nurses' perceptions of new nursing graduates' clinical competence: A systematic integrative review: Nursing

graduates' clinical competence. *Nursing & Health Sciences*, *18*(2), 143–153. https://doi.org/10.1111/nhs.12249

Owens, C., Ley, A., & Aitken, P. (2008). Do different stakeholder groups share mental health research priorities? A four-arm Delphi study. *Health Expectations*, *11*(4), 418–431. https://doi.org/10.1111/j.1369-7625.2008.00492.x

Pang, E., Wong, M., Leung, C. H., & Coombes, J. (2019). Competencies for fresh graduates' success at work: Perspectives of employers. *Industry and Higher Education*, *33*(1), 55–65. https://doi.org/10.1177/0950422218792333

Pettit, J., Hodgson, Y., & Williams, I. (2017). Radiography students' and recent graduates' perceptions of the skills they acquire during their undergraduate degree programme. *Focus on Health Professional Education: A Multi-Professional Journal*, *18*(3), Article 3. https://doi.org/10.11157/fohpe.v18i3.153

Queensland Health. (2009). *Health Practitioner Regulation National Law Act 2009—Queensland Legislation—Queensland Government*. https://www.legislation.qld.gov.au/view/html/inforce/current/act-2009-045#sec.128

Rosen, M. A., DiazGranados, D., Dietz, A. S., Benishek, L. E., Thompson, D., Pronovost, P. J., & Weaver, S. J. (2018). Teamwork in Healthcare: Key Discoveries Enabling Safer, High-Quality Care. *The American Psychologist*, *73*(4), 433–450. https://doi.org/10.1037/amp0000298

St. John-Matthews, J, J. St., Wallace, M. J., & Robinson, L. (2017). The Delphi technique in radiography education research. *Radiography*, *23*, S53–S57. https://doi.org/10.1016/j.radi.2017.03.007

Timmerberg, J. F., Dole, R., Silberman, N., Goffar, S. L., Mathur, D., Miller, A., Murray, L., Pelletier, D., Simpson, M. S., Stolfi, A., Thompson, A., & Utzman, R. (2019). Physical Therapist Student Readiness for Entrance into the First Full-Time Clinical Experience: A Delphi Study. *Physical Therapy*, *99*(2), 131–146. https://doi.org/10.1093/ptj/pzy134

Walker, A., Yong, M., Pang, L., Fullarton, C., Costa, B., & Dunning, A. M. T. (2013). Work readiness of graduate health professionals. *Nurse Education Today*, *33*(2), 116–122. https://doi.org/10.1016/j.nedt.2012.01.007