Radiography – How do students understand the concept of radiography?

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A B S T R A C T

Background: Radiography as a concept has mainly been associated with the functional role of the radiographer. The concept has been studied from a theoretical point of view. However, there is a lack of a theoretical foundation and research on the actual substance of the term radiography used in education. It is therefore important to undertake an investigation in order to determine how students after three years education understand the subject of radiography.

Aim: The aim of this study was to analyse how students in the Swedish radiographers’ degree program understand the concept of radiography.

Method: A concept analysis was made according to the hybrid model, which combines theoretical, fieldwork and analytical phases. A summative content analysis was used to identify the number and content of statements. The empirical data were collected from questionnaires answered by radiography students at four universities in Sweden.

Findings: All radiography students’ exemplified radiography with statements related to the practical level although some of them also identified radiography at an abstract level, as a subject within a discipline. The attribute ‘An interdisciplinary area of knowledge’ emerged, which is an attribute on the abstract level. The practical level was described by four attributes: Mastering Medical Imaging’, ‘To accomplish images for diagnosis and interventions’, ‘Creating a caring environment’ and ‘Enabling fruitful encounters’.

Conclusion: The hybrid model used was a versatile model of concept development. The results of this study have increased the understanding of what characterizes the concept of radiography in a Swedish context.

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Radiography as a concept has mainly been associated in the past two decades with the functional role of the radiographer, the radiographer’s profession and how efficiency in the performance of the role can be enhanced, the education of radiographers and the science of radiography. This means that the content of the concept may vary according to these perspectives. Even if the general use of the concept has been studied from a theoretical point of view and defined in a linguistic form, Ahonen emphasizes that the concept still lacks a firm theoretical foundation.

In Sweden as well as in the rest of Europe, radiography has been accepted as a subject in most radiographers’ degree education. However in some programmes in Sweden radiography is integrated in for example in the subject of medicine in diagnostic radiology or health sciences. The Swedish radiography program is a 3-year separate program at university level, specialised in diagnostics and interventional radiology, and gives a certificate as a registered radiographer. The radiographers are responsible for the entire radiological examination i.e. for patient care, modalities and the medical technology involved. Although radiography has been studied from the conceptual or theoretical perspective, there is a lack of research on the substance of the term radiography used in education. It is therefore important to undertake an investigation to determine how students after three years of education understand the subject of radiography in an attempt to clarify its meaning and enable comprehension and its use in education. Concept analysis is useful in clarifying vague concepts so that everyone who uses the terminology will subsequently speak about the same thing.
aim of this study was to analyse how students in the Swedish radiographer’s degree education understand the concept of radiography.

**Method**

The concept analysis of radiography was undertaken according to the hybrid model, created by Schwartz-Barcott and Kim, which combines theoretical and empirical analysis and consists of three interrelated phases: an initial theoretical phase, a fieldwork phase and a final analytical phase. The initial phase requires a comparison of theoretical definitions used in the field, thus developing a tentative working definition. A fieldwork phase was then carried out to empirically elucidate the substance of radiography from the students’ perspective. The final analytical phase was carried out to achieve an understanding of the content and substance of radiography in the educational context and that the study might help to understand the foundations of radiography.

**Theoretical phase**

In the theoretical phase, a thorough review of the literature was done to identify definition from the perspective of the profession, research and education and other areas of radiography. The radiography literature is multifaceted and diverse. According to Nixon much of its knowledge base consists of research of nurses, medical practitioners and physicists, rather than radiographers themselves. The radiographer profession in Sweden is young (recognized in approx. 1960) and the numbers of professionals as well as the level of scientific activity in the educational institutions are limited. It is important to clarify the content and use of radiography, especially since Ahonen emphasized the necessity of examining the concept continuously. Moreover, from a literature review, Adams and Smith claim that it is fundamentally important for radiography to be further developed both as a concept and a research culture.

In relation to health sciences, the concept of radiography has been defined as an umbrella term for the two professions of diagnostic and therapeutic radiography. Radiography has, as a profession, formerly focused on the functional part and only lately has the role been extended owing to demands from the diagnostic imaging service, into areas previously dealt with by radiologists. Radiographers’ professional competence related to good nursing care has been studied using the critical incident technique. Since radiography uses knowledge from other paradigms but is characterized as an applied discipline. However, radiography has been conceptualized as a practical science, starting from the foundation of radiographer’s work, claiming that the objective of radiography is the medical imaging of a patient with the medical use of radiation. To increase the possibilities of development of the discipline Haaslund et al. suggest the implementation of evidence-based education. Authors stressed that, since nursing and medical science represent different paradigmatic approaches, this can cause difficulties when the aim is to strengthen the discipline of radiography and specific professional qualifications.

The Swedish Society of Radiographers has determined that radiography is multidisciplinary, draws on knowledge from different disciplines but stays within the boundaries of those fields, which includes radiographers’ professional knowledge, responsibilities and research area. These factors show the dynamic nature of the concept.

Since radiography uses knowledge from other paradigms but is not part of them, radiography can, according to Cash, be characterized as an applied discipline. However, radiography has been conceptualized as a practical science, starting from the foundation of radiographer’s work, claiming that the objective of radiography is the medical imaging of a patient with the medical use of radiation. To increase the possibilities of development of the discipline Haaslund et al. suggest the implementation of evidence-based education. Authors stressed that, since nursing and medical science represent different paradigmatic approaches, this can cause difficulties when the aim is to strengthen the discipline of radiography and specific professional qualifications. However, the Swedish Society of Radiographers has determined that radiography is multidisciplinary, draws on knowledge from different disciplines but stays within the boundaries of those fields, which includes radiographers’ professional knowledge, responsibilities and research area. These factors show the dynamic nature of the concept.

The concept analysis of radiography was undertaken according to the hybrid model, created by Schwartz-Barcott and Kim, which combines theoretical and empirical analysis and consists of three interrelated phases: an initial theoretical phase, a fieldwork phase and a final analytical phase. The initial phase requires a comparison of theoretical definitions used in the field, thus developing a tentative working definition. A fieldwork phase was then carried out to empirically elucidate the substance of radiography from the students’ perspective. The final analytical phase was carried out to achieve an understanding of the content and substance of radiography in the educational context and that the study might help to understand the foundations of radiography.

**The fieldwork phase**

The aim of the fieldwork phase was to refine the concept through empirical justification in an educational context, as described by Schwartz-Barcott and Kim. Refinement in this phase is an analysis of the patterns of contextual meaning of the concept using a qualitative research method.
Data collection

The empirical data were collected from questionnaires answered by radiography students toward the end of their final semester. Students in the diagnostic radiographers’ degree program at four universities in Sweden were invited to participate in the study. The students were contacted in connection with one of their final sessions. When the students had agreed to participate, their head teacher distributed a questionnaire that consisted of two open-ended questions: “What does radiography mean to you?” and “A colleague wants you to explain what radiography is: what do you say?” The answers were collected by their teacher and sent by mail to the researchers. In all, 57 of 81 students answered the questionnaire, giving a response rate of 70.4%. The respondents, 38 females and 19 males, ranged in age from 22 to 47 years (m = 29 years).

Data analysis

The answers given in the questionnaires were transcribed and underwent summative qualitative content analysis.31 Summative content analysis is an analytic method that starts with a careful reading of all responses in order to obtain a sense of the overall content. Meaning units, essential words and sentences related to the aim of the study were identified and abstracted into codes. The codes were interpreted and abstracted into criteria and organised into tentative attributes i.e. latent analysis. Each criteria are illustrated with quotations from the data. The attributes and criteria considered were analysed according to any apparent similarities and differences. This is demonstrated by entering how well the result is represented in the material by entering the number of statements under the attribute. The results indicate how responsive the attribute is and represents the richness of the attribute.

Ethical considerations

Permission to carry out this study was given by the head of three universities and one university college in Sweden and the study was conducted according to the ethical standards and guidelines in the Declaration of Helsinki.24 A participant information sheet giving details of the study was enclosed together with the questionnaire, which was answered anonymously. Consent to participate was assumed on the basis of the return of the completed questionnaire.

Findings of the fieldwork

A quantification of the statements was done to obtain numerical values regarding the perception of the concept,31 and all statements were quantified to verify frequency. The five attributes were ‘An interdisciplinary area of knowledge’, which can be seen as an overarching attribute with 20.6% (n = 42) of 204 statements. The following attributes are presented according to the numerical values of statements. The attribute ‘To accomplishing images for diagnosis and interventions’ resulted in 27.9% (n = 57) ‘Mastering the medical imaging’ had 25.5% (n = 52), while ‘Creating a caring environment’ had 13.2% (n = 27) and ‘Enabling fruitful encounters’ 12.8% (n = 26) of 204 statements.

Additionally, the data were constructed such as to find the essential defining elements distinguishing the radiography concept, from similar concepts, and to formulate tentative attributes and criteria. All radiography students’ exemplified radiography with statements related to the practice level although some of them also identified radiography at an abstract level, as a subject within a discipline (Fig. 1).

An interdisciplinary area of knowledge (42 statements)

- Multifaceted subject with combination of caring and technology
- Integrates human and natural sciences
- Evidence-based and proven experience
- Radiographic process

Everything included in the X-ray imaging of the patient, e.g. nursing, imaging technology, pharmaceuticals, knowledge of anatomy (S 15).

A very interesting area where the radiographer and technology meet and the radiographer is mainly responsible for the entirety and the encounter (with the patient) is optimal. The patient is at the centre of attention, although the advanced technique can make the encounter challenging (S 7).

Evidence-based work with imaging, radiation protection, caring (S 24).

That means the foundation of my entire professional role where radiation protection, good images at a low radiation dose, image processing, image quality, radiation physics and to some extent diagnostics are included (S 28).

Accomplish images for diagnosis and interventions (57 statements)

- Making use of a diversity of radiographic methods as a basis for diagnosis
- Using radiation as a precondition for diagnosis
- Managing radiation in a responsible manner
- Operating a diversity of modalities
- Possessing necessary knowledge and skill

The images should show a patient’s anatomy and/or physiology to allow a radiologist to determine if pathology exists. Images should be taken according to predetermined criteria (S 53).

The art of preparing images for medical diagnosis by means of radiation (S 34).

The ability to produce an image as good as possible with consideration taken to radiation protection to both patient and staff (S 36).

Knowledge in how to depict the body; CT, MR and ultra-sound … evolving development of techniques (S 48).

Radiography means to me to have knowledge about medical examinations where the body is depicted either by radiation,
magnetic resonance or ultra-sound. It also means to have knowledge of how to manage radiation and how to behave in a context where it is used (S 49).

Mastering medical imaging (52 statements)

- Visualization of the body organs and functions
- Producing optimal images
- Utilizing different sources and advanced technology
- Having an awareness of the impact of radiation on patient and staff

Radiography can depict various organs and bones that you have in your body even small vessels and allows that if there are problems in the body it can be fixed.

- Taking x-rays to optimize images with parameters in order to get a good picture to start with (S 29).
- It is different contrast in the image “grey scale” that makes the reproduction of the organ possible and to have knowledge about how to reproduce different organs with X-ray, MR and ultrasound (S 47).

Radiography is an area that deals with radiation in a medical purpose, to get knowledge of how radiation can be used to do some good and also about the importance of protecting themselves and others from it (S 33).

Creating a caring environment (27 statements)

- Responding to patients’ expectations
- Being accountable for patients’ well-being
- Acknowledging patients’ vulnerability
- Enabling conditions for collaboration

To produce images that allow a radiologist to determine if there is any pathology (S 53).

- It means to respond to the person who needs and expects to get help with a firm diagnosis or treatment using X-ray.1
- To perform examinations in a good way so that patients do not need to be exposed to unnecessary discomfort (S 47).
- The short meeting that takes place between a radiographer and a human being is extremely important. A good treatment can make the patient feel safe and calm. Radiography is a way to get close to other people who need help here and now.12
- You should also be able to take care of the patient and able to communicate our knowledge in an easily understandable way and to collaborate between professionals and patients.46

Enabling fruitful encounters (26 statements)

- Focussing on the patient
- Familiarizing the patient with a technological world
- Closeness and presence
- Showing consideration

One should always think of the patient’s best, and perform examinations with the patient in focus despite the fact that you are in a technical environment (S 8).

Radiography is a technical world that the patient will be introduced in. The optimal image has to be taken while the patient should be the focus. It is a great challenge to conduct a patient-centred care. It is a high-tech care where both the latest technology and patient meet.6

- This short meeting that takes place between a radiographer and a patient is extremely important. A good encounter can make the patients feel safe and calm (S 12).
- To get the patient to feel safe during the short meeting in the X-ray department (S 37).

Redefinition of radiography in student radiographers’ context

As evidenced in the literature given above and the data from the questionnaires, the concept of radiography can be characterized as a complex phenomenon. The findings in the theoretical phase were compared to those found in the field work-phase. In this analytical phase, the researchers stepped back from the details of fieldwork and re-examined the findings in the light of the initial research focus.2 The theoretical part and empirical findings support the presence and importance of radiography as a concept in the radiographer student context.

Radiography is a versatile and complex area of knowledge combining technology and patient care, i.e. natural and human sciences. Radiography endeavours to build new knowledge on evidence, based on the radiography process. Mastering radiography involves preparation, performance and production of images of the human body. The context demands knowledge of the significance of habits and attitudes regarding responsibility and respect for radiation protection and patient safety. Moreover, radiography deals with imaging criteria and the importance of positioning the patient according to pre-set criteria. Radiography is also a social process of creating a caring environment in order to satisfy patients’ expectations and well-being. Further, radiography is often characterized by a short encounter, where closeness to and being present with the patient, as well as acting in a caring way while placing the patient in the centre of attention, are important. The ability to bring about fruitful encounters is necessary for offering individualized, safe and secure care related to radiographic examinations and interventions. The radiographer and the patient are both participants in radiography as a process, with attributes and criteria associated with the pre-, intra- and post radiographic phases. Collaboration is a precondition when the focus is on the patient.

The substance of radiography corresponds to the patient’s conditions, needs and circumstances by visualisation of bodily organs and functions while producing optimal images or enable a diagnosis.

Discussion

This concept analysis illustrates the power of the hybrid model, as the questionnaire supplied the theoretical analysis with valuable aspects for understanding and developing the concept of radiography. The study suggests that the hybrid model used is a versatile method for concept development and provides guidelines for research because of its stepwise nature.

The aim of this study was to analyse how students in Swedish radiography degree education understand the concept of radiography. The intention was to illuminate radiography as a concept and to fill the gap caused by the lack of empirical studies that explore students’ understanding of their major subject, radiography.

The current students perceive radiography as a synthesis and integration of knowledge from several disciplines, which according to several studies creates an interdisciplinary discipline.13,14 The concept has been identified, in literature and in empirical studies, as a concept of dualities consisting of two main aspects of knowledge, the natural sciences and the humanities,13 whereas other studies specify knowledge from nursing, medicine, physics and technology12,15. The present study suggests that radiography is a synthesis of natural and human sciences. According to the findings, radiography is a combination of five attributes related to patient care and the environment, image production with the mastering of methods and technological equipment, and safe use of radiation.

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The attributes and criteria describing radiography are all essential and interconnected, not necessarily linearly or hierarchically, but in both directions and simultaneously. The five attributes demonstrate the essence of radiography and the interdisciplinary nature.

The fieldwork phase indicates that the focus of radiography has a professional perspective that emphasizes humanistic aspects, which indicates a shift from a practical, technological perspective to a more professional one and, moreover, one that is clearly linked to the professional identity of radiographers. Radiography was not seen solely as being theoretical or practical; it includes both aspects and linked to the everyday work at a radiology department.

From the students’ perspective, the focal aspect in radiography is to find a balance between patient care, usage of advanced technology, creation of medical images and radiation protection, similar to findings from a radiation therapist perspective.19 This indicates an interaction among these, different from what has been indicated in empirical findings and the literature, where the technological perspective has dominated at the expense of the caring perspective.17,18 The attributes highlight the importance of patient-centred care, incorporating both patients’ participation and environmental conditions for an optimal examination, which have been seen in several studies.18,19,20 Furthermore, it can be argued that patient-centred care can be associated with diagnostic success and is thus synonymous with diagnostic success, according to Boot.38,39 This means that a shift from a more technologically perspective to a more holistic approach is evident. Nevertheless, studies argue that the image, and not the patient, is still at the centre of attention in clinical practice and hence to socialisation into adopting the habitual rules of the profession.40,41 Strudwick42 however suggests that the images are the long-term goal of radiography and that the short-term goal is the humanistic interaction needed to obtain the image.

Included in the practical part is the mastery of the image and correct use of the versatile modalities in a constantly changing, highly technological area. The attributes highlight that the image, the visible product of the interaction between patients and radiographers, are the outcome of imaging technology and patient care. Strudwick43 claims that radiographic images can be seen as cultural artefacts. According to Larsson et al.,21 creation of medical images presumes knowledge and technical skills to master the advanced technology in combination with skills in patient care. Hence, it is suggested that to understand the imaging technology must place at its centre the perspectives of both patients and radiographers.21 In the fieldwork phase, the radiographers judge the image quality in relation to the examination, as they understand how various factors can affect the possibilities of attaining adequate image quality, an important professional responsibility according to Lundwall et al.10

This study suggests that part of the essence of radiography is to combine the utmost account of patient’s needs with optimized radiation to achieve an optimum medical image. These suggestions are supported by Lundwall et al.,10 as being viewed as a problem-solving process involving radiographers’ decision and choice of appropriate protocols on the actual modality. Furthermore, the radiation exposure level has to be kept as low as reasonably achievable, and all medical exposures must be justified.44

It has also been suggested that high technological environments can be isolating and depersonalizing and can distance radiographers from patients.22,23,41,42 Furthermore, Barnard24 indicates that this might not be the case because problems with technology may lie in personal choices about what humane and dignified care is. Furthermore, technology is a prerequisite to pursuing the profession and to performing radiographic examinations. The attributes serve to view and understand the patients from a human perspective, a patient-centred approach, as subjects with needs, assuming that they want to be involved in their examination and are willing to cooperate. In contrast, earlier studies have pictured the patient more as an impersonal object, an object of action in need of an examination or intervention.13,18,38 A caring environment was seen in this study as a significant dimension that promotes the wellbeing of the patient.

Studies show that a caring environment in a highly technological environment is characterized by communication and flexibility and, in order to be person-centred, involves adapting care with sensitivity.18,43 However, radiographers perceive care not only comprised of close relations between people but which includes the entire peri-radiographic process during preparatory phases and until the image is electronically forwarded.15,16,48 Our analysis indicates the importance of awareness of patients’ vulnerability and mediating a sense of security, similar to findings from Munn et al.15 Furthermore, to be able to deliver an effective service and for radiography to be integrated in the patient’s care pathway, it is important to collaborate with other professions, which requires teamwork and communication.50

This study suggests that an important task for radiographers’ is to ensure that the information provided is understandable and comprehensive. Information built on understanding can calm and support patients, even in a short space of time which is also supported by Bull and Fitzgerald.51 Furthermore, other studies show that a calming environment might reduce the risk that the patient feels neglected. The patient can experience reassurance when respected, understood and supported, and knowledge that someone is attentive to their needs is vital.12,52 Radiography is committed to providing quality care that is uncompromised and benefits the patient.19,45,49,53 In previous research, technological proficiency and patient care have been viewed as being opposite22 instead of important prerequisites for each other, as suggested in this study. Moreover, there is literature that states, that if an environment is combined with an educational research base that is not entirely dominated by science and technology, it has the potential to emphasize both patient-centred care and technical aspects.26 According to Eriksson,24 concepts in interdisciplinary approaches and applied research function more as a tool to seek answers to “how” questions, rather than extracting their substance. In previous research, knowledge production in radiography has mainly investigated the functional, technological and professional role of radiographers30 and more seldom as a subject in education. It is thus important to explore central concepts and to understand their meaning since this provides knowledge and substance that can guide the radiographer in everyday work.22 Since radiography, does not yet encompass sufficient theory, this study investigates the knowledge embedded in new diagnostic students’ understanding of the concept. Concept analysis can provide a knowledge base for developing the substantive-structure of the discipline49 and for practice it offers clarity and enables understanding, rather than merely the condition of knowing.52

Conclusions

The hybrid model used was a versatile model of concept development. It provided guidelines for the research in terms of how the concept is recognized in the education of radiography students and the attributes explain the contextual pattern used in Swedish radiographic education. The results of this study increase the understanding of what characterizes and subsequently clarifies the concept of radiography in a Swedish context. Moreover, a clarification can never be stagnant, and it is expected that the concept presented here will be challenged by other students and radiographers when more research is published, enabling further development and creating greater understanding.

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Conflict of interest statement

None.

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