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THE IMPACT OF RADIOLOGY STUDENTS' UNDERSTANDING OF BASIC PHYSICS COURSES ON THEIR ACHIEVEMENT IN RELATED SPECIALIZATION SUBJECTS

[1]Halima Hawesa, [2]Mahasin G. Hassan
[1], [2] Department of Radiological Sciences, College of Health and Rehabilitation Sciences, Princess Nourahbint Abdulrahman University, Riyadh, Saudi Arabia.
[1]Hhaweso@pnu.edu.sa, [2]mghassan@pnu.edu.sa

***Abstract*-Background and objectives:** Understanding fundamental physics concepts enables radiologists, radiologic technologists, and other experts in medical imaging to improve imaging techniques, accurately interpret images, and assure patient safety. It also has a critical role in proficiency, problem-solving, critical thinking, and the ability to apply physics principles to real-world situations.There is increasing concern that radiologists are not receiving a proper education in physics and that their ability to comprehend medical imaging technology will be hampered if they do not understand the fundamentals and applications of physics. This research aimed to investigate the correlation between radiology students' comprehension of basic physics courses and their performance in specialized radiological subjects. By identifying the impact of foundational physics knowledge on specialization subjects, we can enhance the educational strategies in radiology programs, ultimately improving the quality of radiological practice.

Methods: This cohort study was conducted at Princess Nourahbint Abdulrahman University. The study involved 70 bachelor's students in the Department of Radiological Sciences. The sample includes 41 students in the Diagnostic Radiology program who studied Computed TomographyPhysics as a basic course in level four and Advanced CT protocols as a specialized course in level six. Moreover, the study recruited 29 students in the Ultrasound Imaging program who studied Ultrasound Physics in level four as a basic course and Doppler Ultrasound Physics in level five as a specialized course. Data were collected retrospectively through academic records to assess students' performance in specialized radiological subjects. The grades for these four courses were collected for the two groups.IBM SPSS was used to assess the difference between the mean of students' grades.

Results: The mean ± standard deviation for students' grades in both programs in specialized courses were higher than the basic level courses(*86.2 ± 4.9 vs. 89.3 ± 4.7* in Diagnostic Radiology, *83.3 ± 7.42 vs. 90 ±4.6* in Ultrasound Imaging). The paired sample t-test results revealed a significant difference between basic courses and specialized ones(*P- value <.001*).

Conclusion: Educational institutions and Medical Imaging programs should prioritize the design and delivery of comprehensive physics courses to ensure that students have a solid understanding of the fundamental principles. Providing additional support or resources to students who struggle with basic physics concepts can help them bridge the gap and gain a better understanding of specialized courses. Finally, a solid foundation in basic physics helps students succeed in learning the complexities of specialized courses in the field of Medical Imaging.

Keywords: Impact, radiology, understanding, physics.

1. Introduction

Physics is crucial for understanding radiological concepts in medical radiology. This information has an impact on a radiology department's tripartite mission: patient care, teaching, and research (1).

As radiology students proceed into their specialist topics, they must have a firm basis in basic physics. Students can appreciate the underlying concepts and procedures used in radiological imaging and diagnosis by understanding the fundamental principles of physics. For starters, understanding basic physics allows students to understand how various imaging modalities, such as X-rays, Computed Tomography (CT) scans, Ultrasound, and Magnetic Resonance Imaging scanners, work (2,3,4).

Students can properly analyze and assess images

produced by these modalities if they grasp the fundamentals of radiation, electromagnetism, and wave behavior. Furthermore, understanding basic physics allows radiology students to assess image quality and identify any technical faults or artifacts. This comprehension is required for appropriate diagnosis and patient care. Furthermore, a solid understanding of physics aids radiologists in tailoring imaging techniques to reduce radiation exposure while preserving diagnostic efficacy (5,6,7,8).

There is increasing concern that radiologists are not receiving a proper education in physics and that their ability to comprehend medical imaging technology will be hampered if they do not understand the fundamentals and applications of physics. It is also suggested that in order to maintain the quality, safety, and economy of imaging operations, radiologists must possess a strong grasp of imaging technology in addition to honing their clinical acumen (9).

Previous studies have highlighted the importance of knowledge of physics in radiology education (10). However, limited research has specifically addressed the impact of a strong foundation in basic physics on success in radiological specialization subjects.

This research aimed to investigate the correlation between radiology students' comprehension of basic physics courses and their performance in specialized radiological subjects. By identifying the impact of foundational physics knowledge on specialization subjects, we can enhance the educational strategies in radiology programs, ultimately improving the quality of radiological practice.

2. Methods

2.1 Study Design, Area, Participants, and Data Collection

This cohort study was conducted at Princess Nourahbint Abdulrahman University (PNU). This study involved 70bachelor’sstudents in the Department of Radiological Sciences. The sample includes 41 students in the Diagnostic Radiology program who studied CT Physics (Code: RAD 222) as a basic course in level four and Advanced CT protocols (Code: RDI 332) as a specialized course in level six. Moreover, the study recruited 29 students in the Ultrasound Imaging programwho studied Ultrasound Physics (Code: RUS 220) in level four as a basic course and

Doppler UltrasoundPhysics (Code: RUS 326) in level five as a specialized course. Data were collected retrospectively through academic records.

2.2 Data Analysis

Data were analyzed using the IBM SPSS Statistics 29 program, using descriptive statistics (mean ± standard deviation (SD)) and a statistical test, the paired-sample T-test, to compare

wo means,RAD 222 and RDI 332 for students in Diagnostic Radiology, RUS 220 and RUS 326, for students in the UT program.

2.3. Ethical Considerations

The study was approved by the institutional ethics review board at PNU (*IRB no. 24-0012).*This researchadhered to ethical guidelines and ensured the confidentiality and anonymity of participants.

3. Results

The study was conducted on 70 students between 18 and 22years old studying for their Bachelor's degrees in Radiological Sciences. Table 1 shows the means ± standard deviations (SD) for students' grades in their courses

Table 1: Students Grades Statistics (mean ± SD), N= 70.

Measurement	No.	Mean ± (SD)
RAD 222	41	86.2 ± 4.9
RDI 332	41	89.3 ± 4.7
RUS 220	29	83.3 ± 7.42
RUS 326	29	90 ± 4.6

The table shows that students' grades in specialized courses were higher than in basic courses for both groups, which indicates a positive or upward effect.

A paired sample t-test was employed to measure the difference between students' grades in basic and specialized courses in both programs.The difference was considered significant if the P-value was less than 0.05, Table 2.

Table 2: Difference between students grades in basic and specialized courses.

		Paired Differences							Significance	
					95% Confidence Interval of the Difference					
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	One-Sided p	Two-Sided p
Pair 1	RAD 222–RDI 332	-3.12195	4.03569	.63027	-4.39577	-1.84813	-4.953	40	<.001	<.001*
Pair 2	RUS 220-RUS 326	-6.72724	5.10523	.94802	-8.66917	-4.78532	-7.096	28	<.001	<.001*

* *Significant difference*

The P-value for the paired sample t-testindicated that there is a statistically significant difference in mean grades between the two courses (basic and specialized).

4. Discussion

Understandingfundamental physics concepts enables radiologists, radiologic technologists, and other experts in medical imaging to improve imaging techniques, accurately interpret images, and assure patient safety.It also has a critical role in proficiency, problem-solving, critical thinking, and the ability to apply physics principles to real-world situations. Basic CT physics establishes the foundation for understanding the fundamental concepts of CT imaging. It includes fundamental principles such as X-ray production, attenuation, and image reconstruction using algorithms like filtered back projection. In comparison, advanced CT procedures employ more sophisticated techniques, technologies, and applications to suit specific clinical and diagnostic requirements. It involves multiple phases, capturing images at different time points during contrast enhancement. Advanced CT protocols address specific clinical demands, including cardiac CT, perfusion investigations, and dual-phase liver imaging. Each methodology is designed to obtain comprehensive information specific to the targeted anatomy or disease.

Concerning students' results, it is shown that Diagnostic Radiology students' grasp of basic CT physics course influences their performance in Advanced CT protocols significantly (P-*value* <*.001*), which is an important part of their academic success and professional competency.

Basic ultrasound physics involves understanding the fundamental principles and concepts that govern the generation, transmission, and reception of ultrasound waves in medical imaging,while Doppler ultrasound physics specifically focuses on the principles of Doppler ultrasound, which is used to assess blood flow and detect movement within the body.

Understanding Basic Ultrasound Physics is critical for using Doppler ultrasound properly because Doppler is an extension of these fundamental principles with a specific emphasis on studying blood flow patterns within the body.

According to our results, students' grades in Doppler physics change significantly based on their performance in basic physics, which implies a correlation between their understanding of fundamental physics principles and their ability to grasp the more specialized Doppler ultrasound physics.

5. Conclusion

Educational institutions and Medical Imaging programs should prioritize the design and delivery of comprehensive physics courses to ensure that students have a solid understanding of the fundamental principles. Providing additional support or resources to students who struggle with basic physics concepts can help them bridge the gap and gain a better understanding of specialized courses. Additionally, providing practical, hands-on experiences and clinical rotations can further reinforce the application of physics knowledge in real-world scenarios, contributing to the overall success of diagnostic radiology students.Finally, a solid foundation in basic physics helps students succeed in learning the complexities of specialized courses in the field of Medical Imaging.

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