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PROFESSIONAL SATISFACTION AMONG STUDENTS AND GRADUATES FROM KAU RADIOLOGIC SCIENCES BSC PROGRAM ON NUCLEAR MEDICINE TECHNIQUE COURSES

Afnan M. F. Darwesh[1]

[1]Department of Radiologic Sciences, Faculty of Applied Medical Sciences, King Abdulaziz University, Jeddah, Saudi Arabia

ABSTRACT

Introduction: Nuclear medicine (NM) technologists must remain current with the latest advancements in radiopharmaceuticals, procedures, and diagnostic techniques. Therefore, educational programs must evolve to adequately prepare students both theoretically and practically for their future careers. Gathering student feedback is essential for enhancing course quality and ensuring high levels of student satisfaction.

Objectives: This study aimed to evaluate students' perceptions of NM technique courses in King Abdulaziz University's (KAU) Radiologic Sciences program. It focused on improving the learning experience and assessing the effectiveness of these courses in preparing students for a career in NM and licensure examinations.

Methods: An online survey was distributed to current students and graduates of the KAU Radiologic Sciences BSc program, targeting those in their third year and beyond. The survey, developed using Google Forms, included 15 questions on demographics and professional satisfaction.

Results: The survey included 46 participants, 56.5% of whom were female. Over 60% rated the theoretical content of the NM technique courses as excellent or good, indicating a positive perception. However, more than 50% rated the practical sessions as average, poor, or very poor, suggesting a need for improvement. This may correlate with over 50% feeling only average or poorly prepared for a career in NM. Interest in the NM modality or a master's program was low, with only 8.7% expressing interest in NM compared to higher interest in magnetic resonance imaging (MRI), computed tomography (CT), and ultrasound, and 41.3% showing little to no interest in pursuing a master's degree. Regarding the effectiveness of the courses for Saudi Commission for Health Specialties (SCFHS) exam preparation, 56.5% selected "not applicable," indicating that they had not taken the SCFHS exam. In contrast, 21.8% rated the courses as effective, while 21.7% rated them as average or below. Overall, 56.5% reported satisfaction with the courses.

Corresponding Author
Afnan M. F. Darwesh, Email: amdarwesh@kau.edu.sa

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Conclusion: Students were satisfied with the theoretical content, but the practical components need improvement. Many students felt only average or poorly prepared for a career in NM, likely due to limited hands-on experience, which may contribute to the low interest in NM careers or postgraduate degrees. To enhance the learning experience, more practical opportunities should be integrated into the curriculum. A follow-up survey should assess the impact of these changes on course quality and student interest in NM.

Keywords: satisfaction survey, NM courses, learning quality, clinical education

1. INTRODUCTION

Nuclear medicine (NM) is a rapidly evolving discipline that necessitates ongoing education for NM technologists. Staying up to date in the field is essential to keep pace with advancements in radiopharmaceuticals, procedures, analysis, and the expanding range of diseases now diagnosable through nuclear imaging [1, 2]. For instance, cardiac imaging with technetium-99m pyrophosphate has recently shown promising results for diagnosing transthyretin amyloid cardiomyopathy, thereby enhancing diagnostic accuracy and treatment planning [3, 4].

NM technologists play an important role in advancing the field of NM. Their direct engagement with patients enables them to explain procedures, answer questions, and provide patient care throughout the imaging process [5]. To meet the growing demand for NM technologists and ensure they remain current with the latest knowledge and skills, it is essential for them to engage in self-education after graduation. Additionally, they must receive the best possible education during their undergraduate and postgraduate studies, with an emphasis on both theoretical knowledge and practical, hands-on experience [6, 7].

To provide the best education possible to NM technologists during their academic years, NM courses must be well-developed. Clearly defined learning objectives in courses are crucial, as they serve as a blueprint to guide lectures, practical sessions, and assessments [8]. Furthermore, clinical education in NM is essential for preparing students with the skills required to meet clinical demands. Before entering the professional field, students must develop both clinical and communication skills. They also need to perform various NM procedures, which include selecting appropriate dosages, positioning the patient, handling equipment, and processing images after the procedures are completed [7, 9, 10]. Thus, well-structured practical or clinical courses are essential for effective learning. When combined with relevant training, guidance, and accessible resources, these courses successfully help both teachers and students achieve the clinical or practical aspects of their education [8].

However, even with well-planned practical and theoretical components of a course, challenges during course delivery may still arise from the students' perspective. These challenges may not only relate to the courses themselves but also stem from students' lack of passion for NM or their preference for other imaging modalities. Studies have shown that student feedback has positively impacted teaching practices and improved the learning experience [7, 11, 12]. Given the significance of student perspectives, it is important to gather feedback on NM courses, as this promotes greater engagement in the educational process, which can lead to improved course delivery and potentially enhance enthusiasm for NM.

Thus, this study aimed to evaluate students' feedback and satisfaction with the NM courses included in their Radiologic Sciences BSc program. The objective of this study was to enhance students' learning experience and assess their perceptions of the effectiveness of NM courses in preparing them for a career in NM. Additionally, the study sought to understand how students view these courses concerning their ability to pass the licensure examination and effectively address related NM questions.

2. METHODS

An online survey was conducted among current students and graduates of KAU Radiologic Sciences BSc program to assess their feedback and satisfaction with NM courses. The study focused specifically on students in their third year and beyond, including graduates, as students in their first and second years do not engage in any NM technique courses.

The survey was developed using Google Forms and consisted of 15 questions created by the author. It included demographic questions as well as questions regarding professional satisfaction. Most survey questions were designed to be answered with a single option selection. However, several questions allowed respondents to select multiple options or provide their own answers.

A complete copy of the questionnaire can be found in the appendix. The study was approved by the Research and Ethics Committee of the Faculty of Applied Medical Sciences, and the questionnaire was sent electronically to respondents. The survey was conducted anonymously, and no personal information—such as names, email addresses, or phone numbers—was collected. Participants were permitted to complete the questionnaire only once. At the beginning of the questionnaire, participants were informed that their participation was entirely voluntary and that they could withdraw at any time. By proceeding with the questionnaire, participants provided their consent to participate.

3. RESULTS

A total of 50 responses were received from the questionnaire; however, four were excluded because the participants indicated "no" to the initial question about their status as current students or graduates of the KAU Radiologic Sciences BSc program, which was the target demographic. The final sample size was 46 participants, of whom 56.5% were female. The majority (80.4%) of participants were aged between 18 and 24 years. The demographic characteristics of the participants are presented in Table 1.

Table 1 Demographic theCharacteristics of Participants

Demographic Characteristics	Number of Participants	Percentage (%)
Gender		
Female	26	56.5
Male	20	43.5
Age (Years)		
18–24	37	80.4
25–30	3	6.5
30–35	4	8.7
35–40	2	4.3
Above 40	-	-
Current Educational Status		
Completed 3rd year	18	39.1
Completed 4th year	13	28.3
Graduated (completed internship year)	15	32.6

The students were asked to assess the timing and scheduling of the NM technique courses, as well as the quality and relevance of the theoretical content and the timing and structure of the practical sessions. The survey question regarding the practical sessions was followed by an opportunity for students to provide suggestions for improvement. Additionally, the respondents evaluated how well the NM technique courses prepared them for a career in the field. Table 2 displays the ratings given by the students for these aspects. Most respondents (67.4%) rated the timing and scheduling of the NM technique courses as excellent or good, while over 60% rated the quality and relevance of the theoretical content similarly.

The assessment of the timing and structure of the practical sessions in the NM technique courses revealed mixed feedback from participants. While 43.5% rated the practical sessions as excellent or good, 41.3% rated them as poor or very poor. Furthermore, when given the opportunity to provide suggestions for improving practical sessions, more than 50% of respondents selected all available options. These options included more hands-on activities, real-world applications, a greater variety of practical exercises, and additional

Table 2 Participant Ratings of Nuclear Medicine Technique Courses

Question	Excel-lentNo. (%)	GoodNo. (%)	Aver-ageNo. (%)	PoorNo. (%)	Very Poor No. (%)
Timing/scheduling of NM course	16 (34.8)	15 (32.6)	9 (19.6)	5 (10.9)	1 (2.2)
Quality and relevance of theoretical content	18 (39.1)	11 (23.9)	8 (17.4)	6 (13)	3 (6.5)
Timing and structure of practical sessions	9 (19.6)	11 (23.9)	7 (15.2)	15 (32.6)	4 (8.7)
NM courses' effectiveness in preparing you for a career in this field	11 (23.9)	11 (23.9)	13 (28.3)	8 (17.4)	3 (6.5)

time for practical sessions. Additionally, two respondents recommended incorporating more practical sessions and simulations of hospital examinations. In terms of the courses' effectiveness in career preparation, only 47.8% of participants rated them as excellent or good.

Participants were also asked about their passion for pursuing a career in NM and whether they were more interested in other career options. Only 28.2% identified as passionate or very passionate about pursuing a career in NM, while the majority (41.3%) remained neutral, and 30.4% were slightly passionate or not passionate at all. Regarding alternative career options, Figure 1 illustrates participants' interests in pursuing different fields. MRI emerged as the most popular choice among students, with 32.6%, followed by CT at 23.9% and ultrasound at 21.7%. In contrast, only 8.7% expressed interest in NM. Notably, no respondents selected mammography or general X-ray as options.

The survey also included a question regarding interest in applying for a master's degree program in NM and positron emission tomography/CT (PET/CT) offered by the Radiologic Sciences Department at KAU. The responses indicated that 34.8% of students expressed a positive interest, while 23.9% remained neutral. In contrast, 41.3% showed little to no interest in applying for the master's degree.

Furthermore, the survey included two questions regarding SCFHS exam. Participants were asked whether they passed the exam on their first attempt and whether the NM technique courses effectively prepared them for the NM exam questions. For the first question, 76.1% indicated "not applicable," meaning they had not taken the test, while 17.4% reported that they passed on their first attempt, and 6.5% stated that they did not pass. Regarding the second question, 56.5% answered "not applicable," indicating that they had not taken the SCFHS exam and therefore could not respond. In contrast, 21.8% rated the courses as effective or highly effective, while 8.7% rated them as moderately effective. Additionally, 13% indicated that the courses were either minimally effective or not effective at

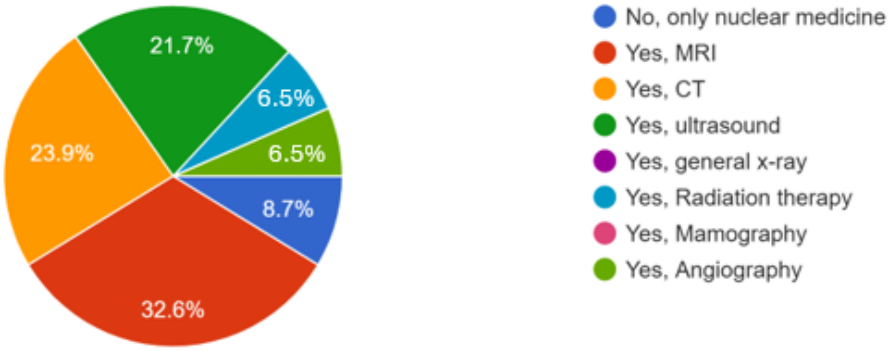

Figure 1 Participants' interests inalternative career options in medical imaging

all in preparing them for the SCFHS NM-related exam questions.

Finally, the last question in the survey assessed participants' overall satisfaction with the quality of education received in the NM technique courses. Figure 2 illustrates participants' overall satisfaction levels in NM technique courses. The results indicated that a significant portion of respondents (56.5%) were either satisfied or highly satisfied, while 28.2% identified as either minimally satisfied or not satisfied at all.

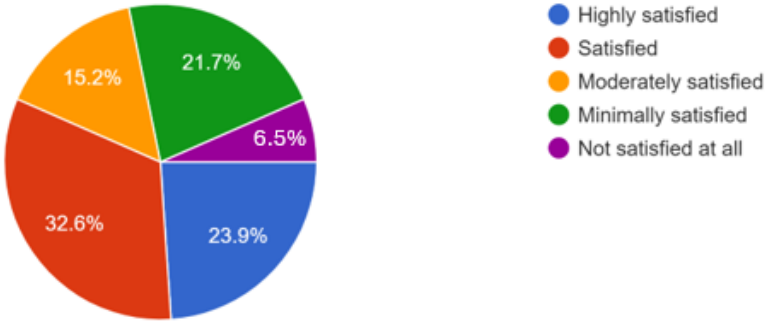

Figure 2 Participants' overallsatisfaction levels in NM technique courses

4. DISCUSSION

The quality of the NM technique courses within the Radiologic Sciences curriculum at KAU is crucial for ensuring that students are well-prepared to acquire the necessary competencies for clinical practice and their future careers. This study aims to evaluate students' perceptions of the NM technique courses offered by KAU's Radiologic Sciences program. Specifically, the study assesses both the theoretical and practical aspects of the courses, their effectiveness in preparing students for careers in NM, and how well these courses equip students to successfully pass the SCFHS examinations. Understanding students' perceptions and experiences regarding NM technique courses is important because it allows for identifying areas of strength in the courses and opportunities for enhancement.

From the results of this study, over 60% of respondents rated the timing and scheduling of the NM courses, as well as their theoretical content, as either excellent or good, while more than 17% rated them as average. This high level of satisfaction regarding the timing may be attributed to the introduction of the first NM course in the third year, following the completion of NM physics in the second year, along with foundational courses in anatomy and radiation protection. Furthermore, direct teaching in lectures emerged as a crucial factor influencing student satisfaction [13]. The overall high satisfaction rates reported by students indicate that most respondents feel very positive about the quality and relevance of the theoretical content provided in these course lectures.

Additionally, the practical component is essential in any medical course, and the NM course is no exception. Clinical education enables healthcare students to develop their skills and apply the theoretical knowledge gained in lectures [10, 14]. However, the results of this study indicate that there is room for improvement in the structure of the practical sessions for the NM courses, with over 50% of respondents rating the structure of the practical sessions as average, poor, or very poor. When asked for suggestions on how to improve, more than 50% of respondents selected all available options, indicating a desire for increased practical involvement in the course.

The main challenge to the practical component of the NM courses has been the absence of a dedicated radiopharmaceutical laboratory (hot laboratory) where students can practice the basic principles of radiolabeling and related radiochemistry tests. As a result, practical sessions have been held at KAU Hospital in collaboration with the NM department. However, this arrangement may not be entirely effective due to the large number of students, making it difficult to divide them into small groups. This limitation restricts their visits to only two or three per course each academic semester. Consequently, students may primarily participate in observational visits rather than gaining the hands-on experience required.

Additionally, the results of this study suggest that there may be a direct correlation between the practical sessions and how well the courses prepare students for a career in NM. Over 50% of respondents rated the courses as average, poor, or very poor in preparing them for a career in NM, indicating that the lack of hands-on experience may lead students to feel inadequately prepared for their future in this field.

Clinical exposure is crucial for developing students' skills in medical education [15, 16]. Therefore, enhancing hands-on experience and improving student satisfaction with clinical and practical sessions is important. Several solutions can be implemented to achieve this goal. Collaboration with multiple hospitals could provide students with the opportunity to visit NM departments and engage in real-life operations more than three times per course. Additionally, various methods should be employed to enhance the impact of clinical skills training. For example, integrating case studies, simulations, and problem-based learning can further enrich the educational experience [8]. Additionally, a recent study introduced the use of virtual reality simulation for hot laboratories to improve student familiarity with hot lab environments and reduce radiophobia [17].

In terms of students' interest in pursuing a career in NM or enrolling in a master's degree program in NM or PET/CT, 30.4% reported being only slightly passionate or not passionate at all. Additionally, 41.3% showed little to no interest in applying for the master's degree. While personal preferences may play a role, the lack of practical sessions in NM courses could also be a contributing factor. Unlike MRI, CT, and ultrasound, which had the highest levels of interest among participants, the NM modality attracted only 8.7% interest. This low interest may stem from the absence of a dedicated NM laboratory in the Radiologic Sciences Department. In contrast, the department is equipped with MRI, CT, and ultrasound machines, allowing students to practice and meet the practical requirements of their courses. This availability likely influences students' interest in pursuing careers in these modalities. Hands-on experience has previously been shown to affect student interest [18].

The final two questions focused on the SCFHS exam and how effectively the NM technique course prepared students to answer NM-related questions on the exam. A significant portion of respondents (76.1%, or 35 participants) selected "not applicable" for the first question, indicating they had not taken the exam. As a result, it is challenging to draw reliable conclusions about the likelihood of passing on the first attempt. This response can be attributed to the fact that most respondents were students in their third or fourth year of the program and had not yet taken the test. Additionally, some graduates who completed their internships received licensure before the SCFHS implemented an exam for radiologic sciences technologists. Interestingly, only 25 students (56.5%) indicated "not applicable" for the second question, which asked whether NM technique courses effectively prepared

them for the NM questions on the SCFHS exam. This suggests that some students who responded "not applicable" for the first question chose to answer differently for the second question, indicating they considered the preparation provided during the course, including case studies and exam questions aligned with SCFHS exam criteria. While 21.8% rated the courses as effective or highly effective in preparing them for NM exam questions, 21.7% rated the course as moderately, minimally, or not effective at all. This indicates that additional measures are necessary to better prepare students for the SCFHS exam. Such measures should include regularly incorporating extra questions aligned with SCFHS exam criteria throughout the course, allowing students continuous practice.

Finally, by addressing the areas for improvement previously mentioned—such as enhancing practical sessions and SCFHS exam preparation—the overall student satisfaction with the course could be significantly increased. In the current study, 56.5% of students reported being satisfied or highly satisfied. However, a follow-up survey should be conducted after implementing these improvements to assess course quality and the student learning experience, ultimately aiming to boost student satisfaction levels. This next survey should specifically target recent graduates who have completed all NM technique courses and taken the SCFHS exam to draw more reliable conclusions about the courses' effectiveness in preparing students for the exam.

5. CONCLUSION

The evaluation of the NM technique courses within the Radiologic Sciences bachelor's degree curriculum is essential for delivering quality education and preparing students for careers in NM. Overall, students express satisfaction with the theoretical content of the courses; however, there is a notable need for improvement in the practical components. Many respondents report feeling average or inadequately prepared for a career in NM, which may be linked to the limited hands-on experience offered in the course. This limited practical experience could also explain the low interest in pursuing a career or postgraduate degree in NM. To enhance the student learning experience and satisfaction, more opportunities for practical involvement should be integrated into the course.

Given these findings, a follow-up survey should be conducted after implementing changes to improve the learning experience, with the goal of raising satisfaction levels and increasing interest in careers in NM.

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CONFLICT OF INTEREST

The author declares no conflict of interest

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REFERENCES

[1] Sloane C, Miller PK. Informing radiography curriculum development: The views of UK radiology service managers concerning the 'fitness for purpose' of recent diagnostic radiography graduates. Radiography. 2017;23:S16–22. doi:https://doi.org/10.1016/j.radi.2017.05.013.

[2] Ramamoorthy N. Impact of nuclear medicine and radiopharmaceuticals on health-care delivery: Advances, lessons, and need for an objective value-matrix. Indian Journal of Nuclear Medicine. 2018;33:273–6. doi:https://doi.org/10.4103/ijnm.IJNM$_{5}$6$_{1}$8.

[3] Li W, Uppal D, Wang YC, Xu X, Kokkinidis DG, Travin MI et al. Nuclear imaging for the diagnosis of cardiac amyloidosis in 2021. Diagnostics. 2021;11. doi:https://doi.org/10.3390/diagnostics11060996.

[4] Paeng JC, Choi JY. Nuclear Imaging for Cardiac Amyloidosis: Bone Scan, SPECT/CT, and Amyloid-Targeting PET. Nucl Med Mol Imaging. 2021;55:61–70. doi:https://doi.org/10.1007/s13139-020-00681-4.

[5] Beegle C, Hasani N, Maass-Moreno R, Saboury B, Siegel E. Artificial Intelligence and Positron Emission Tomography Imaging Workflow:: Technologists' Perspective. PET Clin. 2022;17:31–9. doi:https://doi.org/10.1016/j.cpet.2021.09.008.

[6] Mihai OI, Self-Education, Lifelong, Learning. IJASOS. 2021;7:142–147.

[7] Bafaraj SM, Elkhadir AM. Evaluation of Diagnostic Radiography Technology Curriculum from the Graduates Perspective. Creat Educ. 2021;12:265–77.

[8] Sahu PK, Chattu VK, Rewatkar A, Sakhamuri S. Best practices to impart clinical skills during preclinical years of medical curriculum. J Educ Health Promot. 2019;8.

[9] Baird MA. Towards the development of a reflective radiographer: Challenges and constraints. Biomed Imaging Interv J. 2008;4.

[10] Shields M, Warren-Forward HM. The Impact of COVID-19 on First-Year Undergraduate Nuclear Medicine Students' Practical Skills Training. J Nucl Med Technol. 2022;50:166–73. doi:https://doi.org/10.2967/jnmt.121.262814.

[11] Mandouit L. Using student feedback to improve teaching. Educ Action Res. 2018;26:755–69. doi:https://doi.org/10.1080/09650792.2018.1426470.

[12] Al-Bashir M, Kabir R, Rahman I. The Value and Effectiveness of Feedback in Improving Students' Learning and Professionalizing Teaching in Higher Education. Journal of Education and Practice. 2016;7:38–41.

[13] Bell K. Increasing undergraduate student satisfaction in Higher Education: the importance of relational pedagogy. J Furth High Educ. 2022;46:490–503. doi:https://doi.org/10.1080/0309877X.2021.1985980.

[14] Ayatollahi J, Akhondimeybodi Z, Raeisyazdi MS, Hamidfar M, Shahcheraghi SH. Medical students' satisfaction from the clinical education processes in Yazd. J Med Res. 2021;7:195–8. doi:https://doi.org/DOI:10.31254/jmr.2021.7608.

[15] Tayade MC, Latti RG. Effectiveness of early clinical exposure in medical education: Settings and scientific theories - Review. J Educ Health Promot. 2021;10. doi:https://doi.org/10.4103/jehp.jehp$_{9}$88$_{2}$0.

[16] Ingale MH, Tayade MC, Bhamare S. Early clinical exposure: Dynamics, opportunities, and challenges in modern medical education. J Educ Health Promot. 2023;12.

[17] Marshall SK, Sirieak N, Karnkorn P, Keawtong V, Hayeeabdunromae A, Noomad N et al. Nuclear Medicine Radiological Hot Laboratory Simulation: A Mixed-Method Intervention Study on Immersive Virtual Reality for Sustainable Education. Applied Sciences. 2024;14. doi:https://doi.org/10.3390/app14125041.

[18] Holstermann N, Grube D, Bögeholz S. Hands-on Activities and Their Influence on Students' Interest. Res Sci Educ . 2010;40:743–57. doi:https://doi.org/10.1007/s11165-009-9142-0.