

Survey of the relationship between radiological technology students' modalities of interest and their level of understanding of technical terms -Questionnaire survey of RT students-

診療放射線技師を目指す学生における専門用語の理解度と興味あるモダリティーの関連性に関する実態調査 —診療放射線技師学生のアンケート調査—

【原著】

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Key words: radiological technology students, radiological technologist education, modalities of interest, questionnaire survey

【Abstract】

Purpose. This study aimed to investigate the relationship between students' modalities of interest in clinical practical training during radiological technologist education and their degree of learning for those modalities. **Methods.** The target is 2019 fourth-year students of Suzuka University of Medical Science. The same questionnaire survey was administered to participating students before and after clinical training. In the first part of the questionnaire, students ranked the modalities of radiological technologists' duties by their level of interest. The second part of the questionnaire assessed their learning level for each modality. In this study, the technical term for each modality was presented individually, and participants' level of understanding of these technical terms was defined as the learning level for that modality. **Results.** The modalities of the radiological technologists' work in which students were most interested were general radiography, computed tomography, and magnetic resonance. The interest in these modalities did not change between before and after clinical training. Students' learning levels were particularly high in the modalities of interest. **Conclusion.** We investigated changes in students' interest in modalities attributable to clinical practical training during radiological technologist education and identified the relevance of the degree of learning for those modalities. We aim to use these data to inform educational improvements.

【要旨】

診療放射線技師を目指す学生における、専門用語の理解度と興味あるモダリティーの関連性について、また臨床実習教育を行うことでその関連性の変化を検討した。対象は鈴鹿医療科学大学の2019年度の4年生である。臨床実習前後に取得したアンケート内容は、技師業務のモダリティーについて興味ある順にランク付けを行うこと、各モダリティーの専門用語を1つずつ提示しその専門用語の理解度を調査した。学生が興味あるモダリティーは一般撮影・CT・MRであり、本モダリティーへの関心は臨床実習を介しても変化はなかった。各モダリティーの理解度は興味あるモダリティーに関して高かった。診療放射線技師教育の臨床実習に起因する学生の興味あるモダリティーと、各モダリティーに対する学習度の関連性について評価できた。

1. Introduction

In Japan, universities that train radiological technologists provide fourth-year education. In the Department of Radiological Technology at Suzuka University of Health Sciences, all specialized subjects related to radiological technologists' clinical practice are acquired by the end of the third year, and students then advance to the fourth year. During the fourth year, students return to their hometown from

May to August, and are offered clinical training at a local hospital. Every year, all fourth-year students choose specialized subjects to guide their clinical practice. We were interested in students' perceptions relating to three specific points. First, we assessed students' interest in modalities involved in the practice of a radiological technologist during clinical practice after covering all specialized subjects in on-campus training. Second, we evaluated whether students' modalities of interest had changed after they received clinical education from radiological technologists during their clinical training. Third, we investigated whether students' learning levels differed between modalities of interest and those in which they

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were not interested. We thought that as clinical training offers opportunity to understand the importance of clinical work that cannot be experienced through on-campus training¹⁾, there may be differences in students' modalities of interest between before and after clinical training. Clarifying these three points will build understanding of students' modalities of interest and weak parts of learning, which can be used to guide student education. Therefore, the purpose of this study was to investigate the relationship between students' modalities of interest in clinical practical training and their degree of learning for those modalities.

2. Materials and Methods

2-1. Targets

The present questionnaire survey targeted 2019 fourth-year students at Suzuka University of Health Sciences, Department of Radiological Technology Science (100 students: 69 men, 31 women). The questionnaire survey was conducted both before and after clinical training (two times in total). The questionnaire was completed via the campus portal system. All personal information was anonymized and discarded. Informed consent was obtained from all participating students. In addition, this study was approved by the Ethics Committee of the Suzuka University of Medical Science.

2-2. Survey items

The same questionnaire survey was administered before and after clinical training. The first part of the questionnaire asked participating students to rank each modality based on their interest. The six modalities representing radiological technologists' practice presented in the questionnaire were: general radiography (GR), computed tomography (CT), magnetic resonance (MR), nuclear medicine (NM), radiotherapy, and angiography. Mammography and X-ray TV inspections were included in GR. The work of radiological technologists

also involves ultrasound. However, ultrasound was excluded from the present survey because there were many facilities where radiological technologists did not perform ultrasound. We also investigated the reason students' chose their first-ranked modality using free description.

The second part of the survey covered students' learning level in relation to each modality. In this study, the technical term for each modality was presented individually, and students' level of understanding of these technical terms was used to define their learning level for that modality. To extract the terminology of each modality, we first set the difficulty level of explaining the terminology of each modality in three levels: easy, normal, and difficult. Of the three difficulty levels, in this study, we adopted technical terms extracted as "normal" as questionnaire material. For each technical term, students who could explain that term chose "A", students who knew the term but could not explain it chose "B", and students who did not know the term chose "C". The technical terms presented by each modality are shown in **Table 1**. The terminology was determined through consultation with faculty members in each specialized field, and technical terms with roughly the same level of difficulty were extracted.

2-3. Data processing

The modalities of interest were scored based on students' ranking. The scores for each modality are shown in **Table 2**. The score for each modality was calculated as the total score rate (%) of each modality by the following equation (1).

$$\text{Total score rate for each modality (\%)} = \frac{\text{Total score for each modality}}{\text{Total score for all modalities}} \times 100 \quad (1)$$

This total score rate was compared among modalities and for each modality before and after clinical training. Based on the learning

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Table 1 Technical terms presented for each modality

modality	general radiography (GR)	computed tomography (CT)	nuclear magnetic resonance (NMR)	nuclear medicine (NM)	radiation therapy	angiography
terminology	Jacobi line	maximum intensity projection (MIP)	diffusion weighted image (DWI)	autoradiography (ARG)	tissue maximum ratio (TMR)	seldinger

Table 2 Conversion of ranking to points

Rank	1st place	2nd place	3rd place	4th place	5th place	6th place
Score	6 point	5 point	4 point	3 point	2 point	1 point

level for each modality as recorded in the surveys, the recognition level and level of understanding of technical term for each modality were calculated using formulas (2) and (3).

$$\text{Recognition level (\%)} = \frac{A + B}{A + B + C} \times 100 \quad (2)$$

$$\text{Understanding level (\%)} = \frac{A}{A + B + C} \times 100 \quad (3)$$

The levels of recognition and understanding for each modality were compared for each modality and any changes before and after clinical training were evaluated. We also investigated students' free descriptions for the top three modalities of interest.

2-4. Statistical analysis

The Pearson chi-square test was used for statistical analysis of significant differences from the results of questionnaire surveys before and after clinical training. Using this significant difference test, the recognition level of technical term before and after clinical training was compared. In addition, we compared the level of understanding of technical term before and after clinical training.

3. Results

3-1. Survey collection rate

The questionnaire response rate before clinical training was 99% (69 men, 30 women), and the response rate after clinical training was

97% (67 men, 30 women).

3-2. Modalities of interest ranking

Figure 1 shows the results of the total score rate for each modality before and after clinical training. The total score rates before clinical training were 20.7% for GR, 21.9% for CT, 21.6% for MR, 11.9% for NM, 15.6% for radiotherapy, and 8.4% for angiography. The total score rates after clinical training were 16.5% for GR, 1.3% for CT, 20.5% for MR, 12.7% for NM, 16.2% for radiotherapy, and 12.8% for angiography. The top three modalities of interest for students both before and after clinical practice were CT, MR, and GR, in that order.

3-3. Learning level for each modality

Figure 2 shows the results for the recognition level of technical term for each modality before and after clinical training. Before clinical

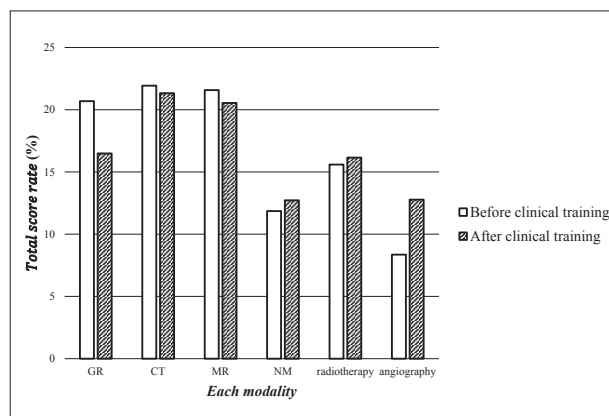


Figure 1 Results of the total score rate for each modality before and after clinical training

training, the recognition level of technical term for each modality were 91.9% for GR, 100% for CT, 100% for MR, 97.0% for NM, 97.0% for radiotherapy, and 51.5% for angiography. After clinical training, the recognition level for technical term for each modality were 97.9% for GR, 100% for CT, 100% for MR, 97.0% for NM, 97.0% for radiotherapy, and 90.7% for angiography. There was a significant difference in the recognition level of GR before and after clinical training ($p < 0.05$). In addition, there was a significant difference in the recognition level of angiography before and after clinical training ($p < 0.001$).

Figure 3 shows the results for the level of understanding of technical term for each modality before and after clinical training. Before clinical training, the level of understanding of technical term for each modality were 42.4% for GR, 43.4% for CT, 34.3% for MR, 38.4% for NM, 23.2% for radiotherapy, and 4.0% for angiography. After clinical training, the level of understanding of technical term for each modality improved to 83.5% for GR, 85.6% for CT, 83.5% for MR, 47.4% for NM, 61.9% for radiotherapy, and 49.5% for angiography. There was a significant difference in the recognition level before and after clinical training of GR, CT, MR, radiotherapy, and angiography ($p < 0.001$).

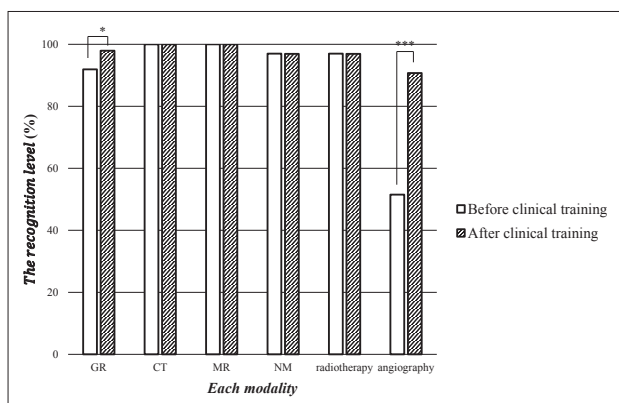


Figure 2 Comparison of recognition of technical terms for each modality before and after clinical training

The Pearson chi-square test was used for the significance test.
* : $p < 0.05$, *** : $p < 0.001$

3-4. Free description of reasons for first choice of modality

For the top three modalities of interest, we investigated the free descriptions of why students' ranked these as their first choice. Before clinical training the free descriptions of students who chose GR included comments such as "I am interested in mammography" and "the basics of radiological technologist work is GR." For CT, the comments included "main work of radiation work" and "CT is a convenient and important examination." Comments relating to MR included "I actually experienced MR through on-campus training and deepened my desire to be involved in MR in the future." After clinical training the descriptions of students who chose GR included comments such as "I felt that GR was a basic modality in the work of radiological technologist and that it should be learned first through clinical training." For CT, the comments included "there was enthusiasm taught by the person in charge of CT in clinical practice" and "I was able to operate CT during clinical training." For MR, the comments included "I felt the fun of MR by listening to MR imaging technicians about the imaging principle."

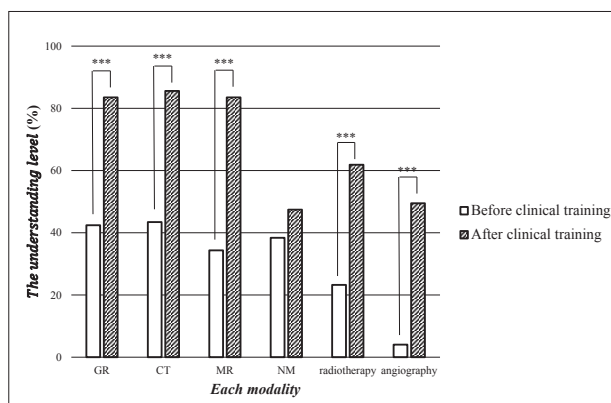


Figure 3 Comparison of level of understanding of technical terms for each modality before and after clinical training

The Pearson chi-square test was used for the significance test.
*** : $p < 0.001$

4. Discussion

In this study, we investigated changes in students' modalities of interest by clinical training education and the relationship between interest and the degree of learning for that modality. GR, CT, and MR were the modalities of most interest to students who had acquired all specialized subjects both before and after their clinical training. First, before clinical training, participants mentioned that these three modalities offered many opportunities to come into contact with the devices used in these modalities during the third-year of on-campus training. In this way, students could get a sense of actual clinical work by handling the relevant devices. In addition, it was thought that the students may have deepened their knowledge and become interested by studying the devices. GR was also popular with female students interested in mammography. However, our university does not have the devices used for the three modalities with the least interest (NM, radiotherapy, and angiography). Therefore, it is possible that students were not interested in these modalities because they had not handled the devices associated with these modalities. In addition, few lectures are given on angiography during on-campus education, and there is no on-campus practical training. As a result, angiography was not interesting to students, and was scored the lowest of the six modalities. Participatory training leads to more improvement in learning motivation and study compared with visit-type training, and has been reported to be effective²⁾. In addition, there are reports that participatory training also improves communication skills³⁻⁷⁾. We think that some kind of participatory training should be offered, even for modalities for which universities do not have the necessary equipment. The modalities of most interest to students after clinical training were those in which they had many opportunities to handle the devices during clinical training and be in-

involved in performing these modalities. Numerous clinical practice hospitals are able to perform imaging position or device operation in these modalities, meaning that these modalities were of most interest to students. In addition, it is thought that the enthusiasm of the radiological technologist instructor at the hospital who was in charge of students during their clinical training was also an influential factor. The enthusiasm of the instructor may also increase satisfaction with clinical practice⁸⁾. Some students were interested in modalities about which their instructors were enthusiastic. In contrast, clinical training in modalities of less interest to students tended to be those for which visit-type training was offered. These lower-level modalities were also taught with enthusiasm from instructors in clinical practice, but it is thought that students were more interested in participatory practice than in visit-type practice. At present, clinical training is limited to visit-type clinical training in some hospitals in Japan⁹⁾. However, participatory training is being promoted in current clinical training¹⁰⁾. There are many participatory clinical training sessions in clinical training for other medical occupations¹¹⁾. The instructor's leadership is indispensable for participatory training. The clinical training instructor needs to be able to understand students' acquisition of specialized knowledge and examine the content of the training¹²⁾. Participatory practical training has been promoted in all training modalities for radiological technologists. For all modalities, instructors are expected to improve their teaching skills and introduce participatory training, mainly in communication skills education, in both on-campus and clinical training. It is thought that students' motivation will increase through such high-quality clinical training.

Next, we considered students' learning level for each modality. Before clinical practice, the recognition of the technical term "Seldinger" used in angiography was 51.5%, which was the lowest value. Seldinger is a common term

in the clinical setting; however, because of the small number of lectures on angiography in our university, this term was less familiar for students. However, students learned about Seldinger through clinical practice, and the level of recognition of this term increased to 90.7% after clinical practice. Through clinical training, the recognition level of this term has increased significantly. Moreover, the recognition of the “Jacoby line”, which is a GR term, also increased after clinical training ($p < 0.05$). However, the recognition level of the Jacoby line before clinical training was 91.9%, and it is considered that the students who did not recognize it increased after learning the Jacoby line during clinical training. The technical term for other modalities had recognition levels of 90% or more before and after clinical training, which indicated that technical terms with almost the same difficulty were selected. However, students’ level of understanding of technical term for all modalities was lower than the recognition level. The level of understanding for technical terms increased through clinical training, and there was a significant increase in GR, CT, MR, radiography, and angiography ($p < 0.001$). In particular, the understanding level for angiography before clinical training was 4%, but improved to 49.5% after clinical training. The level of understanding of angiography-related technical term before clinical training was extremely low, which may also be attributable to the few angiography lectures at our university. Therefore, we should increase the number of lectures on angiography and offer more opportunities for students to study angiography. In addition, the knowledge gained from pre-clinical training lacks relevance to clinical training¹³⁾. It is necessary to educate the students so that the knowledge gained from pre-clinical training can be related to clinical training. The level of understanding of autoradiography (ARG), which was used as a terminology for NM examinations, was 38.4% before clinical training and 47.4% after

clinical training (n.s.). This percentage increase in understanding level was the lowest compared with other modalities. The ARG method is a quantitative test used for brain perfusion single photon emission computed tomography (SPECT). Many hospitals in Japan do not use the ARG method of brain perfusion SPECT in clinical training, meaning there would be no opportunity to study the ARG method, which may explain the low rate of increase in understanding. In addition, the level of understanding after clinical training for the most interesting modalities was 83.5% for GR, 85.6% for CT, and 83.5% for MR. The percentage of understanding level for these modalities was higher than the understanding level of modalities with less student interest. This suggests that students’ were learned more about their modalities of interest. Participatory training may therefore contribute to more improvement in learning motivation and studying compared with visit-based training.

In addition, the terminology of each modality used this time was examined and selected by the teachers. However, it should be noted that there is a possibility that the difficulty level of the technical term of each modality is not unified. In this research, we set the degree of difficulty of each modality terminology to “easy”, “normal”, and “difficult”, and adopted the term corresponding to “normal”. In the next research, we would like to consider a method of selecting words that are more consistent than this time.

In this questionnaire, we excluded ultrasonography. Currently in Japan, radiological technologists and clinical laboratory technologists are technicians involved in ultrasound. Ultrasound was excluded from the present study because few hospitals in Japan have radiological technologists performing ultrasound. However, ultrasound is one of the tasks of radiological technologists. In the questionnaire survey planned for next year, we intend to include ultrasound as an option. In addition,

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there were modalities for which good results could not be obtained by extracting technical terms. We aim to carefully examine the extraction of technical terms for the questionnaire survey planned for next year.

Our study showed that the most interesting modalities for students were GR, CT, and MR. These modalities also had high levels of learning. In hospitals in Japan, young radiological technologists can play an active role in any modality, and there is a need for multi-utility radiological technologists that can respond immediately, even if new equipment is introduced. The current work of radiological technologist continues to increase and become more complex¹⁴⁾. In addition, with the advancement of medical care, the technology expected of health care worker such as radiological technologist is increasing¹⁵⁻¹⁶⁾. Therefore, we want students to be interested in all modalities and study all modalities without bias. This means on-campus training and clinical training should include participatory training for all modalities. It is hoped that students' interest and willingness to learn will be increased by such changes. We want to contribute to the development of high-quality radiological technologists required by hospitals. Therefore, we plan to use this data to inform educational improvements.

As a future research topic, this study does not compare the results of the questionnaire with the student's basic academic ability. In the future, we would like to evaluate the relationship between the results of this questionnaire and basic academic ability. The results of this study are limited to students of Suzuka University of Medical Science. Since different schools have different teaching methods, the same research may produce different results at other schools. In the future, we would like to conduct research on student education that goes beyond the boundaries of schools through joint research with other schools.

5. Conclusion

The purpose of this study was to investigate the relationship between students' modalities of interest in clinical training and their level of learning for those modalities. Modalities of most interest to students were GR, CT, and MR, and the level of learning for these modalities was particularly high. We will improve our education program based on the results of the present questionnaire to contribute to the training of high-quality radiological technologists.

Data Availability

The data used to support the findings of this article are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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