LEARNING PREFERENCES AND COMPETENCIES OF RADIOLOGIC TECHNOLOGY INTERNS ON GENERAL RADIOGRAPHY

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ABSTRACT

*Radiologic Education has substantially changed throughout the years and has certain advancements that have left the country catching on. It has transitioned from analog to digital imaging, which considerably left developing countries behind. Consequently, general radiography practices are assumed to differ from the previous years. Employing a sequential explanatory research design, the study looked into the radiologic interns' competencies in specific parameters such as preparation, patient care and management; positioning; and image acquisition and processing. Using a researcher-made questionnaire, 50 radiologic interns from four academic year batches were invited to participate in the study. Interpreted responses are cross-referenced through the interview data that were gathered from 12 participants, equally representing each batch. The study also probed the interns' general learning preference using the VARK questionnaire. Both of the questionnaires underwent Cronbach Alpha Test of Reliability. The data was probed and analyzed using Regression Analysis; to which the research findings gave an inference that the learning preferences positively affect the clinical competencies of the radiologic interns, providing the institution a broader perspective on improving the interns' educative capacity. It also strengthens the Radiologic Technology program, giving importance to the three generated themes: **R**ehearsals of procedures, **A**pplication more than Theories, and **D**emonstration of Skills.*

Keywords: Imaging, Radiologic Technology, Analog, Digital, Radiography

INTRODUCTION

Radiology reaches its 126th year. It has gained popularity among Filipino high school graduates, picking up enrollment in different colleges as one of the chosen courses. Professors and instructors alike have been stepping up their pedagogy as medical imaging also progressed from Roentgen's machine to its first medical use in New Zealand, up to the recent colored X-Ray machines. Coping up to technology advancement, institutions can now improve radiologic technicians' general practices from analog to digital technology. The diversity of medical imaging's use and its fast advancement has led to different studies focusing on its teaching. Minston et al. (2013) have explored its medical use in dentistry and have found out the high accuracy of digital imaging compared to its analog counterpart. It was also noted that dental students were most confident in using digital imaging rather than analog. Focusing on radiology, South African radiologists showed concerns about the radiographer's transformation as they face technology's progression (Campbell, 2020). Hence, it has opened an opportunity to understand the weaknesses of radiologists as they enter the field. In addition to his prior findings, he was also able to discover the novice and experienced radiologic technologist's different roles concerning their working environment. They were leading to a relevant assumption that there are possible indifferences that radiologists may experience as they are trained and prepared in both, as newer technologies emerge through time.

In Asia, Date, and Ohkado (2018) explored and focused their study on improving the quality of the most profound and most requested initial diagnostics for pulmonary diseases. Chest X-Ray (CXR), as one of the physician's diagnostic tools, is often seen to help detect Tuberculosis and other respiratory infections and diseases. For this reason, continuing education and education throughout the course should be conducted to improve the quality of images, specially in developing countries. Furthermore, Date and Ohkado (2018) also noted that images' quality is enhanced, particularly in the limited opportunities that Filipino RTs are experiencing. Thus, the Philippines' radiologic education is deemed necessary for improvement to maintain quality images though present in a resource-restricted environment.

To illustrate a clear picture of the Radiologic Technology Education in the Philippines, the Commission on Higher Education (CHED) has stated policies, standards, and guidelines to guide the program. In their released memorandum, CHED memorandum no. 7 series of 2018 noted that the program should be able to uphold and meet the needs of the fast-paced advancements of its practice. In doing so, how the radiologic technicians learn as the center of the program provides them the confidence and efficiency in patient care and management. Moreover, section 7 (CHED, 2018) emphasized performance indicators that focus on the specialized skills that students should master. Similarly, it has been long proposed and published by Georgia University (1990) the different set of skills and standards that every technician should be adept with in possible changes and technological advancements.

As Florentino et al. (2019) further described, Filipino interns' degrading clinical competence due to the lack of workforce and equipment in both the institutions and the hospitals; the academe is left fighting in producing competent needed staff of the medical field. As a result, providing evidence that the theory-practice gap (Leach & Tucker, 2018) exists in the radiologic area. In this regard, the teaching modality and learning style is critical to the possible increase in competence. Doing so assures the building of confidence, critical thinking, problem solving skills, and values formation as the program is revised and carefully designed to help the students develop their full potential. With the pertinent articles and studies that described the Philippines' educational environment, the researchers employed this sequential explanatory research to analyze the radiologic technology interns' competencies in general radiography. Moreover, the study focused on the interns' learning preference on each of the competencies in general radiography, such as preparation, patient care and management, positioning, and image acquisition and processing. Moreover, the study explores the learning preferences of the interns focusing on their style identification, particularly visual, auditory, reading and writing, and kinesthetic. Hence, the study serves as its prime in radiologic education, possibly providing initial data; relevant to improving the institution's pedagogical approaches and strategies. All this, to prepare the interns in the journey to the real medical world.

OBJECTIVES OF THE STUDY

This study aimed to infer the learning preferences and competencies of the Radiologic Technology Interns on general radiography.

In accordance, the study sought to attain the following specific objectives:

1. Identify the general radiography competencies of the radiologic interns in terms of:
    1.1 Area of Preparation;
    1.2 Patient Care and Management;
    1.3 Positioning; and
    1.4 Image Acquisition/ Processing
2. Determine the learning preference do the radiologic interns employ to master the clinical competencies and practices in terms of:
    2.1 Area of Preparation;
    2.2 Patient Care and Management;
    2.3 Positioning; and
    2.4 Image Acquisition/ Processing
3. Discern the extent of radiologic intern's learning style and clinical competencies.
4. Propose methods for the data to improve the radiologic technology education program.

METHODOLOGY

The study got 50 participants and 12 interviewees that came from four batches of radiologic interns. All quantitative study participants were purposely selected through total enumeration sampling method. Each represented the radiologic interns from academic years 2016-2017, 2017-2018, 2018-2019, and 2019-2020. They were given the freedom to participate in the said study. Furthermore, the interview participants were equally divided to represent each batch. In addition to this, the interview participants were chosen following Guest, Bunce, and Johnson's (2006) study that 12 interviewees will produce data saturation. Hence, in precedence, the interviewees were given an invitation letter and were assured that responses would be kept in utmost confidentiality and be used only for research purposes.

This study used two types of data gathering procedures, the conduct of interview and online survey. A semi-structured interview is conducted with 12 radiologic interns. While the online survey questionnaires were completed using Google Forms for the radiologic interns who have finished the program from 2016-2020.

The study's data analysis used researchers-made questionnaire to assess the radiologic interns' competencies, practices, and learning preferences. The questionnaire underwent validation through different experts in the field, a grammarian, and a statistician. In addition to this, Cronbach's alpha test for reliability was utilized to identify the various items' reliability, resulting in a VARK questionnaire at 0.990 and a clinical competency questionnaire at 0.974; both interpreted excellent.

All the pertinent quantitative data were processed through the use of descriptive statistics and Regression Analysis. In this accord, the different factors are assessed from their specific differences from each other. In addition to this, the study also utilized factor analysis to look into the correlation between the two sets of variables. In this way, the data concluded the learning preferences of the students specific for each practice.

On the other hand, the qualitative data was coded and thematically analyzed by the researchers. To eliminate bias from the coding process, an inter-coder was asked to look into the generated themes.

RESULTS AND DISCUSSIONS

Demographic Profile of the Respondents

Table 1
Respondent's Year of Graduation

	Frequency	Percent	Valid Percent	Cumulative Percent
2016-2017	9	18.0	18.0	18.0
2017-2018	10	20.0	20.0	38.0
2018-2019	11	22.0	22.0	60.0
2019-2020	20	40.0	40.0	100.0
Total	50	100.0	100.0	

The study was able to generate responses from the previous radiologic interns of the institution. It comprises 18 percent graduates of 2016-2017, 20 percent graduates of 2017-2018, 22 percent graduates of 2018-2019, and 40 percent graduates of 2019-2020. Accordingly, it determines the graduates' clinical competencies and learning preferences.

Table 2
Years Employed

	Frequency	Percent	Valid Percent	Cumulative Percent
0	1	2.0	3.6	3.6
1	1	2.0	3.6	7.1
1	1	2.0	3.6	10.7
1	12	24.0	42.9	53.6
2	4	8.0	14.3	67.9
3	3	6.0	10.7	78.6
4	3	6.0	10.7	89.3
5	2	4.0	7.1	96.4
8	1	2.0	3.6	100.0
Total	28	56.0	100.0	
Missing	22	44.0		
Total	50	100.0		

Table 2 displays that most of the respondents are currently employed in the different respectable hospitals and medical clinics located in the country. This presents a high qualification of the respondents in terms of their learning and progress in the field.

1. **General radiography clinical competencies of the radiologic interns in terms of Area of Preparation, Patient Care and Management, Positioning, and Image Acquisition/ Processing**

Identifying the acquired competencies is the primary objective of different institutions. Since this is a part of every tertiary program curriculum, it is good to understand and identify which competencies the students perform best in their internship program. Similarly, as general radiography focused on the clinical competencies; the respondents evaluated themselves as to what clinical competencies do. They perceived they have a high acquisition of knowledge.

Table 3
Descriptive Statistics of General Radiography Clinical Competencies

	Mean	Std. Deviation	1	3	4	4	5	6	7	8
1. Area of Preparation	4.07	0.64	.616**	.451**	.552**	.504**	1			
2. Patient Care and Management	4.03	0.75	.528**	.418**	.428**	.431**	.641**	1		
3. Patient Positioning	3.89	0.76	.407**	.302*	.408**	.386**	.751**	.735**	1	
4. Image Acquisition/Processing	3.91	0.72	.566**	.483**	.613**	.572**	.580**	.690**	.671**	1
9. Overall Competencies	3.97	0.63	.602**	.471**	.570**	.540**	.843**	.885**	.909**	.846**

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 3 highlights the descriptive statistics of the radiologic interns' general radiography clinical competencies. The interns tend to have a high level of clinical competencies on all five factors, with a mean value between 3.89 and 4.07. Specifically, it can be interpreted that in competencies of the area of preparation and patient care and management, the interns perceived themselves to be proficient; while competent in specific competencies such as patient positioning and image acquisition/ processing. Overall, the respondents evaluated themselves to be proficient in the given clinical competencies.

2. Learning preference of the radiologic interns employ to master the clinical competencies and practices

The radiologic interns' learning preferences vary from each other, especially in their pursuit of mastering the clinical competencies required of them. As a result, the data shows the different learning preferences of the interns based on competency.

Table 4
Descriptive Statistics of the Learning Preferences

	Mean	Std. Deviation	1	3	4	4	5	6	7	8
1. Visual	3.97	0.78	1							
2. Auditory	3.88	0.78	.876**	1						
3. Reading	3.90	0.84	.870**	.923**	1					
4. Kinesthetic	4.11	0.81	.813**	.860**	.878**	1				

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Descriptive statistics, including mean and standard deviations, were acquired and presented in the above table. Radiologic interns learning preferences are more of a kinesthetic learner (M= 4.11, SD=0.81) and less to be auditory learners (M=3.88, SD=0.78). While the learners are perceived to be kinesthetic learners, the learning preferences are significantly correlated (ranged from r=.813 to r=.923) to one another, as well as to be significantly correlated to all factors of clinical competencies (ranged from r=.302 to r=.616)

Four separate regression analyses were performed to investigate how learning styles positively affect clinical competencies. In predicting the dominant learning style preference that affects the learning competencies, the beta coefficients provide the effect of each of the four learning styles of radiologic interns.

2.1 Relationship between Learning Style and Clinical Competency in terms of Area of Preparation

Visual, auditory, reading, and kinesthetic learning style together accounted for approximately 41% of the variance in learning competency in terms of 'area of preparation' (${R_{adj}}^2 = .412$), F(4.45)=9.580, p<.05. The visual learning style was a significant predictor of learning competency, t(45)=3.240, p<0.050, which accounted for 19% of the variance in learning competency in terms of area of preparation not accounted for by other learning competency factors (r_p=.435) and uniquely accounted for 13% of the variance in learning competency in terms of area of preparation (r_{sp}=.355). Holding other variables constant, the study found that visual learning style positively affected learning competency in terms of 'area of preparation.' It was estimated to increase by about 0.647 points.

Table 5
Relationship between Learning Style and Clinical Competency in terms of Area of Preparation

Model	B	SE	β	r_p	r_{sp}	t	p-value
(Constant)	2.185	0.388				5.635	.000*
Visual	0.647	0.200	0.785	.435	.355	3.240	.002*
Auditory	-0.671	0.261	-0.813	-.358	-.282	-2.570	.014*
Reading	0.416	0.252	0.540	.239	.181	1.654	.105
Kinesthetic	0.072	0.190	0.090	.056	.041	0.377	.708
Model Summary:							
R square adjusted Value							41.2%
ANOVA Results:							
F-Value							9.580
Sig. Value							0.000*
Obs.							50

Adapted from Bovermann, K., Weidlich, J., & Bastiaens, T. (2018). Online learning readiness and attitudes towards gaming in gamified online learning – a mixed-methods case study. International Journal of Educational Technology in Higher Education, 15(1), 27. https://doi.org/10.1186/s41239-018-0107-0.
*Significant at p<0.05

Auditory learning style was also a significant predictor of learning competency in terms of 'area of preparation,' t(45)=-2.570, p<.050, which accounted for 13% of the variance in learning competency in terms of area of preparation not accounted for by other learning competency factors (r_p=-.358) and uniquely accounted for 8% of the variance in learning competency in terms of area of preparation (r_{sp}=-.282). Holding other variables constant, the researchers found that the auditory learning style had a negative effect on learning competency in terms of 'area of preparation' and was estimated to decrease by about 0.671 points.

2.2 Relationship between Learning Style and Clinical Competency in terms of Patient Care and Management

Visual, auditory, reading, and kinesthetic learning style together accounted for approximately 23% of the variance in learning competency in terms of 'patient care management' (${R_{adj}}^2 = .229$), F(4,45)=4.641, p<.05. The visual learning style was a significant predictor of learning competency, t(45)=2.453, p<0.050, which account ted for 12% of the variance in learning competency in terms of 'patient care management' not accounted for by other learning competency factors (r_p=.343) and uniquely accounted for 9% of the variance in learning competency in terms of 'patient care management' (r_{sp}=.308). Holding other variables constant, the study found that visual learning style positively affected learning competency in terms of 'patient care management' and was estimated to increase by about 0.656 points.

Table 6
Relationship between Learning Style and Clinical Competency in terms of Patient Care and Management

Model	B	SE	β	r_p	r_{sp}	t	p-value
(Constant)	2.012	0.520				3.871	0.000*
Visual	0.656	0.268	0.680	0.343	0.308	2.453	0.018*
Auditory	-0.229	0.350	-0.237	-0.097	-0.082	-0.654	0.516
Reading	-0.064	0.337	-0.071	-0.028	-0.024	-0.191	0.850
Kinesthetic	0.134	0.255	0.144	0.078	0.066	0.527	0.601
Model Summary:							
R square adjusted Value							22.90%
ANOVA Results:							
F-Value							4.641
Sig. Value							0.003*
Obs.							50

Adapted from Bovermann, K., Weidlich, J., & Bastiaens, T. (2018). Online learning readiness and attitudes towards gaming in gamified online learning – a mixed-methods case study. International Journal of Educational Technology in Higher Education, 15(1), 27. https://doi.org/10.1186/s41239-018-0107-0.
*Significant at p<0.05

2.3 Relationship of Learning Style and Clinical Competency in terms of Patient Positioning

Table 7
Relationship between Learning Style and Clinical Competency in terms of Patient Positioning

Model	B	SE	β	r_p	r_{sp}	T	p-value
(Constant)	2.364	0.541				4.372	0.000*
Visual	0.399	0.278	0.409	0.209	0.185	1.432	0.159
Auditory	-0.754	0.364	-0.772	-0.295	-0.267	-2.072	0.044*
Reading	0.538	0.351	0.590	0.223	0.198	1.534	0.132
Kinesthetic	0.187	0.265	0.199	0.105	0.091	0.706	0.484
Model Summary:							
R square Value							18.40%
ANOVA Results:							
F-Value							3.760
Sig. Value							0.010*
Obs.							50

Adapted from Bovermann, K., Weidlich, J., & Bastiaens, T. (2018). Online learning readiness and attitudes towards gaming in gamified online learning – a mixed-methods case study. International Journal of Educational Technology in Higher Education, 15(1), 27. https://doi.org/10.1186/s41239-018-0107-0.
*Significant at p<0.05

Visual, auditory, reading, and kinesthetic learning style together accounted for approximately 29% of the variance in learning competency in terms of 'patient positioning' (${R_{adj}}^2 = .184$), F(4,45) = 3.760, p<.05. The auditory learning style was a significant predictor of learning competency, t(45)=-2.072, p<0.050, which accounted for 9% of the variance in learning competency in terms of 'patient positioning' not accounted for by other learning competency factors (r_p=-.295) and uniquely accounted for 7% of the variance in learning competency in terms of 'patient positioning' (r_{sp}=-.267). Holding other variables constant, we found that the auditory learning style negatively affects the learning competency in terms of 'patient positioning' and was estimated to decrease by about 0.754 points.

2.4 Relationship of Learning Style and Clinical Competency in terms of Image Acquisition/Positioning

Table 8
Relationship between Learning Style and Clinical Competency in terms of Image Acquisition/Positioning

Model	B	SE	Beta	Rp	rsp	t	p-value
(Constant)	1.813	0.435				4.165	0.000*
Visual	0.306	0.224	0.330	0.199	0.149	1.363	0.180
Auditory	-0.751	0.293	-0.809	-0.357	-0.280	-2.563	0.014*
Reading	0.740	0.283	0.855	0.364	0.287	2.621	0.012*
Kinesthetic	0.223	0.214	0.249	0.154	0.114	1.044	0.302
Model Summary:							
R square Value							41.40%
ANOVA Results:							
F-Value							9.665
Sig. Value							0.000*
Obs.							50

Adapted from Bovermann, K., Weidlich, J., & Bastiaens, T. (2018). Online learning readiness and attitudes towards gaming in gamified online learning – a mixed-methods case study. International Journal of Educational Technology in Higher Education, 15(1), 27. https://doi.org/10.1186/s41239-018-0107-0.
*Significant at p<0.05

Visual, auditory, reading, and kinesthetic learning style together accounted for approximately 41% of the variance in learning competency in terms of 'image acquisition/processing' (${R_{adj}}^2 = .414$), F(4.45) = 9.665, p<.05. The auditory learning style was a significant predictor of learning competency, t(45)=-2.563, p<0.050, which accounted for 13% of the variance in learning competency in terms of 'image acquisition/processing' not accounted for by other learning competency factors (r_p=-.357) and uniquely accounted for 8% of the variance in learning competency in terms of 'image acquisition/processing (r_{sp}=-.280). Holding other variables constant, the researchers found that the auditory learning style negatively affects the learning competency in terms of 'image acquisition and processing' and was estimated to decrease by about 0.751 points.

Reading learning style was also a significant predictor of learning competency in terms of 'image acquisition/processing,' t(45)=2.621, p<.050, which accounted for 13% of the variance in learning competency in terms of 'image acquisition/processing' not accounted for by other learning competency factors (r_p=.364) and uniquely accounted for 8% of the variance in learning competency in terms of 'image acquisition/processing' (r_{sp}=.287). Holding other variables constant, the researchers found that the reading learning style had a positive effect on learning competency in terms of 'image acquisition/processing' and was estimated to increase by about 0.740 points.

3. Discern the extent of radiologic intern's learning style and clinical competencies.

Multiple regression analysis was performed using the four learning styles as the independent variables and the overall mean of four learning competencies as the dependent variable to detect whether the four learning styles predict the overall learning competencies.

Table 9
Relationship between Learning Style and Overall Clinical Competency

Model	B	SE	Beta	rp	rsp	t	p-value
(Constant)	2.094	0.386				5.428	0.000*
Visual	0.502	0.199	0.624	0.353	0.282	2.527	0.015*
Auditory	-0.601	0.260	-0.746	-0.326	-0.258	-2.316	0.025*
Reading	0.408	0.250	0.542	0.236	0.182	1.629	0.110
Kinesthetic	0.154	0.189	0.199	0.120	0.091	0.814	0.420
Model Summary:							
R square Value							39.00%
ANOVA Results:							
F-Value							8.830
Sig. Value							0.000*
Obs.							50

Note: Adapted from Bovermann, K., Weidlich, J., & Bastiaens, T. (2018). Online learning readiness and attitudes towards gaming in gamified online learning – a mixed-methods case study. International Journal of Educational Technology in Higher Education, 15(1), 27. https://doi.org/10.1186/s41239-018-0107-0.
*Significant at p<0.05

Visual, auditory, reading, and kinesthetic learning style together accounted for approximately 39% of the variance in overall learning competency (${R_{adj}}^2 = .390$), F(4.45) = 8.830, p<.05. The visual learning style was a significant predictor of learning competency, t(45)=2.527, p<0.050, which account ted for 12% of the variance in overall learning competency not accounted for by other learning competency factors (r_p=.282) and uniquely accounted for 8% of the variance in overall learning competency (r_{sp}=.282). Holding other variables constant, the researchers found that visual learning style positively affected overall learning competency and was estimated to increase by about 0.502 points.

Auditory learning style was also a significant predictor of overall learning competency, t(45)=-2.316, p<.050, which accounted for 11% of the variance in overall learning competency not accounted for by other learning competency factors (r_p=-.326) and uniquely accounted for 7% of the variance in overall learning competency (r_{sp}=-.258). Holding other variables constant, the researchers found that the auditory learning style had a negative effect on overall learning competency and was estimated to decrease by about 0.601 points.

Four variables of learning preferences, including visual, auditory, reading, and kinesthetic, were related to each clinical competency. The combined four learning preferences positively affect radiologic interns' in all four clinical competencies: area of preparation, patient care and management, positioning, and image acquisition/processing.

Visual learning preferences was a significant predictor for two clinical competencies: area of preparation and patient care and management. These findings indicate the respondents' responses when they were asked about how they were taught in school. The numbers generally support their response when some of the respondents uttered that they were taught in school *"by showing pictures and explaining the pictures"* to them. Another respondent emphasized that only by *"showing pictures did we know about the different topics."*

Auditory learning preferences was also a significant predictor for three clinical competencies: area of preparation, positioning, and image acquisition/processing. This is emphasized by the respondents when they illustrated that the *"professors explain the theories well."* Different respondents also support that they were given *"readings and was asked to explain it."* In other words, classes in radiography were mostly done through lectures and discussions of the professors and those in the field. While other respondents seem to learn from the teaching approach, some desired to have more laboratory activities as they mentioned, *"We were taught through lectures, videos, and presentations; but laboratory activities were limited."* Hence, the internship program supported the classroom lectures experienced by the students.

Though kinesthetic is found out to be the most dominant learning preferences, as it has the highest mean, it did not imply a significant predictor of the four clinical competencies. This numerical data is possible since the respondents' experience mostly visual and auditory learning techniques inside the classroom. However, as they embarked on the internship, they were exposed to their course work's reality as they recount that *"The best experience I have is when my professor in the field supervised me. It gave me more confidence in doing the procedure."* Other respondents also favored this as they shared that *"The best I experienced is that I was able to perform quick and correct procedures due to the number of patients."* However, not all experiences that are considered the best allowed the students to learn. The respondents were also generous to share that *"I had a faulty film exposure, but the experienced technicians were kind to help me fix it."* As a result, kinesthetic learning through the students' field practice contributed to their knowledge and understanding of the clinical competencies.

Two of the four dimensions of learning preferences, visual and auditory, significantly predicted overall clinical competencies. Visual had a positive effect on radiologic interns' clinical competencies, and it explained 12% of the variance of clinical competency. While auditory had a negative impact, and it explained 11% of the variance of clinical competency. These results were given emphasis when parallel research in Nigeria emphasized that radiography was highly dependent on practical demonstrations and that lectures and videos' use negatively affect the students' learning (Uche, Chimuanya, & Chigozie, 2019). Also, Ward and Makela (2010) mentioned that students of Radiography learn best once they are task-oriented. For this reason, the positive effect of the different learning preferences on the clinical competencies of the respondents.

4. Propose methods for the data to improve the radiologic technology education program.

The data drove out different insights that opened up opportunities to improve the young interns' changing learning preferences. Since it was observed that visual, reading and auditory learning preferences have a decline in the acquisition of clinical competencies as compared to that of kinesthetic learning, it is suggested that the 'teachable moments' as proposed by Thomas (2015) be integrated to settle out the unplanned opportunities in teaching the radiologic technology students. Hence, adapting and conceptualizing the program as fitted with the Filipino Generation Z students serves as the young radiologic technology students' scaffold. As the respondents mentioned that they would prefer to learn the general radiography clinical competencies by application and integration of "more practical examinations," "hands-on learning," "explore different strategies," "actual demonstrations," "exposure to different machines and procedures." Consequently, the students' experiences, reflection, knowledge, skills, and patient-empathy serve as a crossbar wherein kinesthetic learning serves as the primary foundation for learning the general radiography clinical competencies.

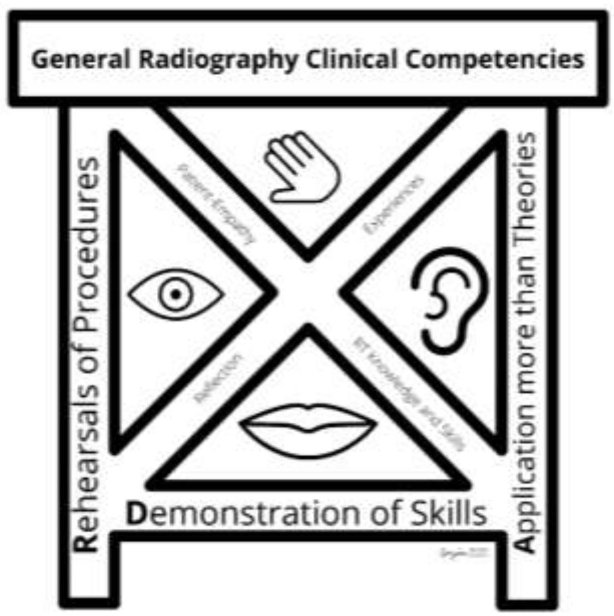

Figure 1: Filipinized 'Teachable Moments'

CONCLUSIONS

Learning the General Radiography Clinical Competencies is highly dependent on how the different strategies and pedagogies are conducted inside the classroom. Furthermore, based on the data, the following conclusions are drawn out:

1. The different batches of interns have described their acquisition of the general radiography clinical competencies to be proficient. Specifically, it was found that under the competencies of area and preparation and patient care and management, the interns consider themselves proficient. While in the areas of patient positioning and image acquisition/ processing, they consider themselves competent.
2. In terms of learning preferences, it was found that auditory and visual learning was a significant predictor of learning competency for preparation. Simultaneously, all learning preference serves as a learning predictor for patient care management, patient positioning, and image acquisition/processing.
3. The four learning preferences were found out to be positively affecting the radiologic interns' clinical competencies.
4. Lastly, the data suggests the use of the Filipinized 'Teachable Moments' as conceptualized from the generated themes of the research, namely: Rehearsal of Procedures, Demonstration of Skills, and Application more than theories as to the main scaffold in learning the different clinical competencies of general radiography.

RECOMMENDATIONS

The following recommendations are made for future considerations:

1. In addition to General Radiography, it is also good to measure the different competencies of the interns and students of the program about specialized imaging.
2. Different generations' learning preferences as their relationship with the different competencies based on CHED may be considered to serve as a data and tool in predicting the teaching strategies for coming years.
3. The utilization of the different learning preferences per area may be taken into

consideration specially inside the classroom. Additionally, it is suggested that more hands-on and laboratory activities take place before the actual intership program.

4. Further studies on the suggested scaffold's effects should be conducted and followed up inside the Radiation Technology Program's Classrooms.

REFERENCES

Bovermann, K., Weidlich, J., & Bastiaens, T. (2018). Online learning readiness and attitudes towards gaming in gamified online learning – a mixed-methods case study. *International Journal of Educational Technology in Higher Education*, 15(1), 27. https://doi.org/10.1186/s41239-018-0107-0.

Campbell, S. S., Morton, D., & Grobler, A. D. (2019). Transitioning from analogue to digital imaging: Challenges of South African analogue-trained radiographers. *Radiography*, *25*(2), e39-e44.

Commision on Higher Education. (2018). *Policies, Standards, and Guidelines for the Bachelor of Science in Radiologic Technology (BSRT) Program.* CHED – The Official Website of Commission on Higher Education. https://ched.gov.ph/wp-content/uploads/2018/07/CMO-No-07-s.-2018-PSG-for-BS-Radiologic-Technology.pdf

Date, T., & Ohkado, A. (2018). The role of continuing education in improving the quality of chest radiography images based on experiences in three Asian countries. *Health and Technology*, *8*(5), 411-418. https://doi.org/10.1007/s12553-018-0242-6

Felicen, S. S., Rasa, L. C., Sumanga, J. E., & Buted, D. R. (2014). Internship performance of tourism and hospitality students: Inputs to improve internship program. *International Journal of Academic Research in Business and Social Sciences*, *4*(6). https://doi.org/10.6007/ijarbss/v4-i6/923

Florentino, C. B., Gustilo, R. L., Jailani, H. U., Maceren, M. R., Periabras, N. O., & Alipio, M. M. (2019) The Clinical Competencies of Radiologic Technology Interns of Batch 2018-2019 on Radiological Science Modalities: Basis for Proposed Enhancement Program. https://www.academia.edu/40139502/The_Clinical_Competencies_of_Radiologic_Technology_Interns_of_Batch_2018_2019_on_Radiological_Science_Modalities_Basis_for_Proposed_Enhancement_Program

Georgia Univ., Athens. Dept. of Vocational Education. (1990). *Radiologgic Technology Program Guide.* ERIC- Education Resources Information Center. https://files.eric.ed.gov/fulltext/ED350453.pdf?fbclid+IwAR0Ugoiy6OHgqATWqdiv2b7HL6K_1ZUz71Md89PrjH0Q9sw9qywsPbb4i0w

Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough? *Field Methods*, *18*(1), 59-82. https://doi.org/10.1177/1525822x05279903

Leach, M. J., & Tucker, B. (2018). Current understandings of the research-practice gap in nursing: A mixed-methods study. *Collegian*, *25*(2), 171-179. https://doi.org/10.1016/j.colegn.2017.04.008

Minston, W., Li, G., Wennberg, R., Näsström, K., & Shi, X. Q. (2013). Comparison of diagnostic performance on approximal caries detection among Swedish and Chinese senior dental students using analogue and digital radiographs. *Swed Dent J*, *37*(2), 79-85.

Thomas, L. (2015) Critical Thinking and Clinical Reasoning in the Health Sciences. PA Facione and NC Facione (eds.). California Academic Press. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2703269/

Uche, C. H., Chimuanya, U. D., & Chigozie, O. F. (2019). Factors that affect Teaching and Learning among Undergraduate Radiography Students in two Nigerian Universities. *Journal of Radiography & Radiation Sciences.* http://www.jarnigeria.com/Factors~that~affect~Teaching~and~Learning~among~Undergraduate~Radiography~Students~in~two~Nigerian~Universities.html

Ward, P., & Makela, C. (2010). Radiography students' clinical learning styles. *Radiologic Technology*, *81*(6), 527-537.

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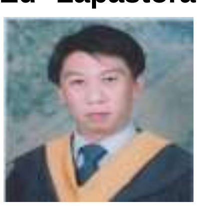

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