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Transformative Learning Interventions On Radiographers Behaviour In The Context Of Improving Radiation Protection Culture In Indonesia

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ABSTRACT

Objective: This study was structured with the aim of analyzing the effect of transformative learning interventions on the behavior of radiographers regarding patient safety in the context of increasing radiation protection culture.

Methods: This study was designed using the first phase of research, namely a cross sectional survey. Meanwhile, the second phase of the research was a quasi-experimental study with a nonequivalent control group design. Data analysis used t-test, non-parametric statistics, and linear regression.

Research results: This study shows that the first stage of radiographer knowledge value is still low with an average of 52.1%. Meanwhile, the results of the second phase of the study showed that there was a significant difference in safety performance between the treatment group and the comparison group after the intervention (p=0.028). There was no significant difference in CRWB in the treatment group before and after the intervention (p=0.061). There was a significant difference in patient safety practices between the treatment group and the comparison group after the intervention (p=0.002). The novelty of this research is that in the context of increasing radiation protection culture, safety performance, effective communication, and introspective radiographers can be improved by transformative learning interventions through critical reflection training, where effective communication is able to predict safety compliance behavior.
Conclusion: Through this, it can be concluded that the transformative learning intervention only affects the behavior of safety performance and patient safety practices but has no effect on the radiographer's CRWB.

Keywords: transformative learning, radiographer, radiation protection culture, patient safety

INTRODUCTION

Since the use of Multidetector Computed Tomography (MDCT) technology in the 1990s, the clinical application of CTScan has become more widespread, such as Angiography. CT Scan also replaces some of the examinations performed by Nuclear Medicine such as examination of the Liver-Gallbladder and Lung (Hricak et al., 2011). The use of MDCT is what contributes to the increase in radiation dose. In this study, it was shown that technically MDCT produces a 69% higher dose to adjacent tissue (overbeaming) compared to Single-Detector CT (Thornton et al., 2003). The use of MDCT tends to cover a wider area of the organ and thinner slices(Tsapaki et al., 2018)(Frush & Applegate, 2004).

Many CT scans are unjustified and the causes include inadequate referrals and the quality of referral information (Ifani et al., 2021). Referrals are a key source of information that allows radiographers and radiology specialists to provide good quality services, including using the appropriate modality for the patient. Radiology services in carrying out the diagnosis process involve many health professions, the process describes teamwork between the clinical team and the radiology team. Disruption of the relationship between personnel and communication can have an impact on patient safety(Hricak et al., 2011).

Radiographers are the first health workers and often interact with patients in radiology installations, they are in a leading position to identify cases of repeated examinations, suspected suspicious examinations, and patients who have undergone the same examination, and can also discuss requests for examinations. radiology with referring physicians (Ifani et al., 2021)(Strudwick & Day, 2014). In complex work conditions, radiographers are challenged to not only need instrumental knowledge, especially those related to patient safety, but also knowledge that helps them be able to communicate effectively and be introspective in their interactions with other health professionals in radiology services.

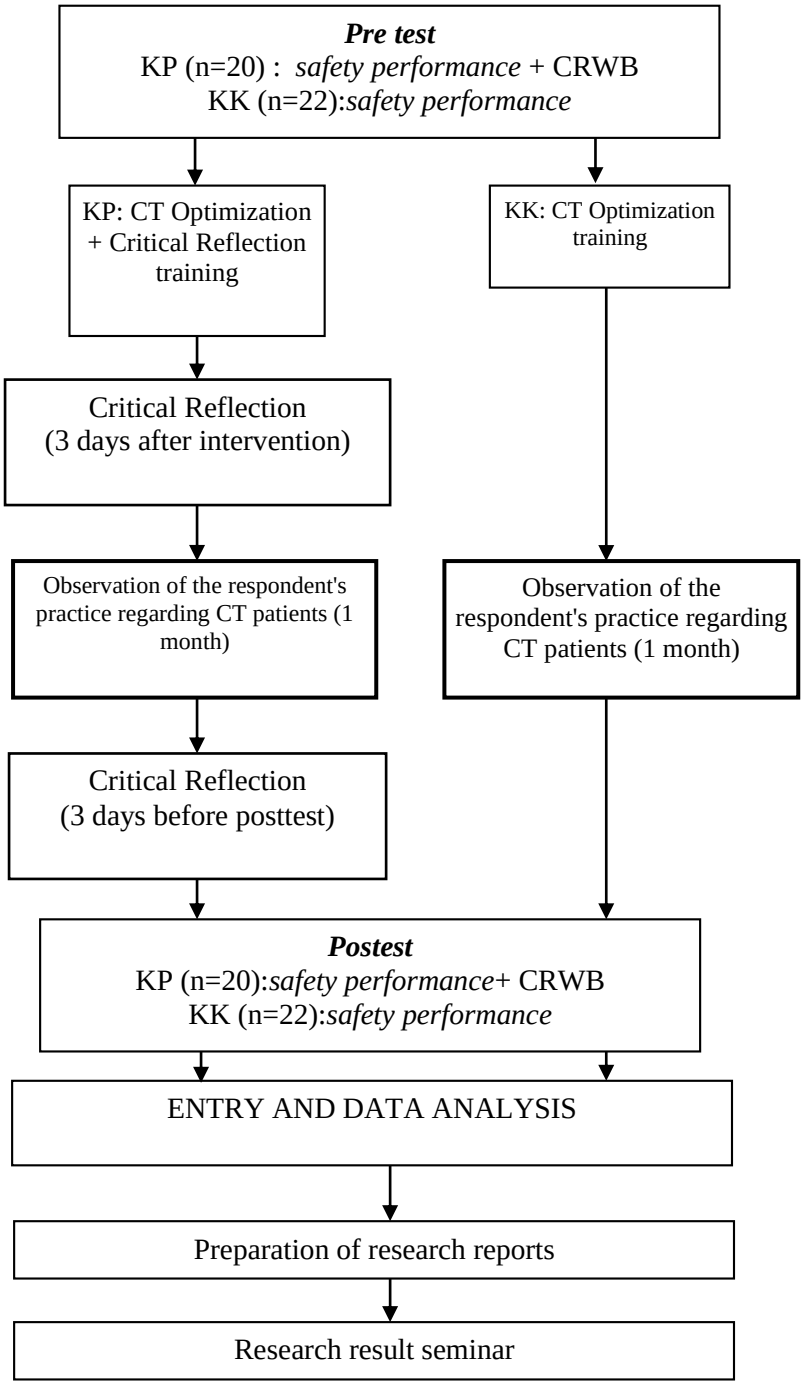
To develop metacognitive skills, it is not enough to use learning methods that only focus on cognitive abilities such as cognitive learning or constructivism, but learning that is able to produce perspective transformation, namely transformative learning which is adult learning (Mezirow, 1996). Transformative learning helps a person reinterpret his own experience by changing the frame of reference so that new experiences result from what is already known, experienced or learned (MEZIROW, 2011). The role of the radiographer today is in facing increasingly complex work challenges, especially those related to patient safety (Williams, 2001)(Brenner & Hall, 2007).

Currently, there is not much research on radiographers related to transformative learning or critical reflection. Based on the results of previous studies, critical reflection is evaluated or assessed frequently in the field of education such as doctors (Mamede & Schmidt, 2005)(Baernstein & Fryer-Edwards, 2003)(Learman et al., 2008)(Ritunga et al., 2018), nurses (Williams, 2001), physiotherapist (Larin et al., 2005), or pharmacist (Lonie & Desai, 2015). Critical reflection does not only occur in formal classrooms or the world of education, but can also take place in the workplace which is known as CRWB or Critically Reflective Work Behavior (van Woerkom & Croon, 2008).

METHOD

This study uses several design stages.

Table I. Method Design.



Description:

KP = Treat Group

KK = Comparison Group

CRWB = Critically Reflective Work Performance

Intervention Program (Module Trial)

Based on the results of Phase I research, it was concluded that the results of the safety climate measurement indicated that there were aspects that still needed to be improved, namely the leadership commitment aspect (63.1%) and the non-punitive response aspect (62.9%). Meanwhile, the results of the survey on respondents' knowledge regarding dose comparisons and CT Scan parameters are also still low on average. Based on the results of the Phase I research, in the context of increasing radiation protection culture in CT Scan services, an intervention program for respondents is needed in the form of training that does not only emphasize cognitive aspects. The aim of this intervention is to integrate the respondent's learning through experience with theories and techniques to form new knowledge frameworks, new behaviors and new insights. Encouraging respondents to question why they learned certain information, involves an interest in self-knowledge, i.e. knowledge of self-reflection. As contained in the standard of behavior for radiographers, self-reflection is part of the behavior of radiographers in the aspect of basic knowledge where this becomes the capital to develop new knowledge and skills through the practice of lifelong learning.

The process of developing training materials is preceded by conducting a literature study related to the foundation of transformative science to determine what materials will be provided in the training. The literature study focuses on the basic strategy of transformative science and critical reflection practices to improve safety performance. From the results of studies of various literatures and the results of discussions with experts, the researchers determined the strategy chosen in the transformative learning intervention was the strategy proposed by Cranton (Kaiser et al., 2013). The five transformative learning strategies according to McGonigal are implemented in training into various learning methods such as film screenings, discussions, knotting games, and feedback. This training is designed together with training that is to increase the technical ability of radiographers in the form of a workshop and each participant gets a certificate. The workshop was created with the theme: "Improving Radiation Protection Culture in CT Scan Services with an Optimization Approach". The participants in the workshop are researchers, Government Hospital Medical Physicists, and CTScan Application Specialists. All research respondents participated in the workshop together until before the break. The critical reflection training was only attended by the Treatment group as many as 20 people who had been selected by the researcher. In accordance with the transformative learning theory proposed by Mezirow, the critical reflection training material used is the learning strategy proposed by Cranton (2002):

1. **Creating an activating event**:shows a number of events that are completely different from what the person in question has believed, experienced, heard or read about.
2. **Articulating assumptions**: reveal the true meaning of the assumptions that people have been following for granted or which people are generally not aware of.
3. **Critical self-reflection**: carry out critical reflection in the sense of questioning or testing the correctness of existing assumptions regarding where the assumptions come from, what will happen if they follow them, and why they are considered so important.
4. **Openness to alternatives**:be open or open to other views that are different.
5. **Discourse**: involves evidence-based discussions, proven reasons, explored alternative views, and agreed-upon knowledge.

6. **Revision of assumptions and perspectives**:make changes to the assumptions or views that a person or society already has so that their attitude is more open and wiser.
7. **Acting on revisions**: take corrective actions, act, speak and think that are completely in line with the assumptions or views that have been transformed.

Then, the critical reflection training is divided into 3 sessions, namely: Session 1: Reflecting and Feedback Awareness; Session 2: Role Play Games "Chains & Stars of Life" and Session 3: Assertive behavior with 5 Gold Touches.

RESULT

Characteristics of Respondents

The following is a description of the characteristics of respondents based on age, gender, education, years of service, employee status, and radiation protection training.

Table 1. Characteristics of research respondents.

Characteristics	N	%	Mean ±SD (min-max)
Age			
20-35 year	29	69	32,8 ± 6,6
36-50 year	13	31	(25 - 47)
Total	42	100	
Sex			
Men	17	40,5	
Women	25	59,5	
Total	42	100	
Education			
Diploma	37	88,1	
Bachelor	5	11,9	
Total	42	100	
Years of service			
<5 years	13	31,0	7,4 ± 4,1
5 - 10 years	18	42,9	(2 - 15)
>10 years	11	26,2	
Total	42	100	
Employee status			
Permanent	36	85,7	
Contract	6	14,3	
Total	42	100	
Radiation Protection Training			
Yes	10	23,8	
No	32	76,2	

Total	42	100	

Table 1 shows that the respondent's age is under 36 years more, namely 69% (n=29) where the average age of the respondents is 32.8 + 6.6 years. Female respondents are known to be more than male respondents 59.5% (n=25). The majority of respondents' education was diploma, namely 88.1% (n= 37) while the rest were undergraduate 11.9% (n= 5). The tenure of the respondents is 5-10 years which is the largest proportion of 42.9%, where the average tenure of the respondents is 7.4 + 4.1 years. Then, related to radiation protection training, it was found that 76.2% (n=32) of respondents admitted that they had never attended while the remaining 23.8% (n=10) had attended.

Overview of Patient Safety Climate

The description of safety comfort according to respondents' perceptions is measured based on several aspects, namely aspects of teamwork, non-punitive response, leadership commitment, error feedback and effective communication. Through the research results, it is shown the average value of the safety climate as measured by 42 respondents. Teamwork aspect got an average score of 81.1%, non-punitive response was 62.9%, leadership commitment was 63.1%, error feedback was 77.5%, and effective communication was 73.5%. The average value of the overall patient safety aspect is 74.3% (good category). Then, in the context of increasing radiation protection culture in radiology services where safety is a priority, the commitment aspect becomes important because the development of an organization's safety culture requires strong leadership aspects (Tsapaki et al., 2018).

Module Trial Intervention Program

Based on the results of Phase I research, it is known that the results of the safety climate measurement show that there are still aspects that need to be improved, namely the leadership commitment aspect (63.1%) and the non-punitive response aspect (62.9%). Based on the results of a survey of respondents in Phase I research, as many as 26 respondents (61.9%) stated that they had the right to justify the examination and the majority of them stated that the role of justification existed in all professions (23.8%). This shows that there are still respondents who do not understand the regulations regarding personnel responsibilities related to justification in radiology services.

Then, based on the results of the Phase I research, in the context of increasing radiation protection culture in CT-Scan services, an intervention program for respondents is needed in the form of training that does not only emphasize cognitive aspects. This intervention is related to the safety performance of respondents in CT-Scan services where aspects of clinical decision making, effective communication, and patient safety are important. To design the training, the researcher collaborates with an expert/motivator, namely the Master of Psychology to design the material. After determining the desired form of intervention, the researchers then developed training materials with experts/motivators.

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Table 2. Homogeneity test results for the treatment group and comparison group based on the patient safety climate and knowledge.

Variable	Community				P Value
	Treatment		Comparison		
	Mean	SD	Mean	SD	
Patient Safety Climate	49,0	7,8	47,7	6,6	0,586
Knowledge	25,6	4,8	24,5	6,5	0,574

Based on the results of the One-way ANOVA test, it is known that there are no differences in the characteristics of respondents in terms of age, gender, education, years of service, employee status, radiation protection training, patient safety climate and knowledge with p value > 0.05, which means the two groups are homogeneous or equivalent.

Relationship between Patient Safety Climate, Knowledge and Safety Performance

Through the results of research conducted, it is known that the safety performance model only connects the tested determinants and components. Knowledge and safety performance have a relationship, so that intervention on the knowledge variable through increased skills and training allows for an influence on the radiographer's safety performance.

The Effect of Transformative Learning Interventions on CRWB

In this study, only the treatment group measured the CRWB value because only the treatment group received the transformative science-based intervention. The difference in the CRWB value of the treatment group before and after the transformative science foundation intervention is shown in table 3 below.

Table 3. Differences in CRWB values of the treatment groups before and after the transformative learning intervention.

CRWB	Intervention				P Value
	Before		After		
	Mean	SD	Mean	SD	
Critical opinion-sharing	3,44	0,78	3,33	0,92	0,358
Opennes about mistakes	3,90	1,12	3,60	1,39	0,361
Asking for feedback	3,70	0,89	3,64	1,00	0,794
Challengegroupthink	3,09	0,86	3,28	0,98	0,067
Experimenting	3,18	1,06	2,88	1,07	0,133
Career take care	3,59	0,86	3,88	0,72	0,218
Total	91,9	11,8	91,6	11,9	0,061

Through the table, it can be seen that in general there is no significant difference regarding the Critically Reflective Working Performance of the Treatment group after intervention with transformative learning compared to before the intervention ($p = 0.061$). Meanwhile, based on each aspect of CRWB, it was also known that there was no significant difference between before and after the intervention ($p > 0.05$).

The Effect of Transformative Learning Interventions on Safety Performance

Based on the Kolmogorov-Smirnov normality test, the distribution of safety compliance data in the treatment group before and after the intervention were $p = 0.140$ ($p>0.05$) and $p = 0.200$ ($p>0.05$). The distribution of safety participation data in the treatment group before and after the intervention were $p = 0.200$ ($p>0.05$) and $p = 0.119$ ($p>0.05$). The distribution of safety performance data in the treatment group before and after each intervention was normal ($p = 0.200$). To test the difference between the two groups, the paired-samples t test was used, which showed that there was a significant difference in the mean value of safety compliance in the treatment group after the intervention ($p=0.004$). However, this value indicates a decrease in the average safety compliance value of the treatment group after the intervention. Meanwhile, in the safety participation of the treatment group, there was no significant difference even though there was an increase in the average value after the intervention ($p>0.05$).

Then, based on the Kolmogorov-Smirnov normality test, the distribution of safety compliance and safety participation data for both the treatment group or the comparison group after the intervention was not normal ($p<0.05$) so the Mann-Whitney U test was used. Distribution of safety performance data for the treatment group and the comparison group after each intervention a is $p = 0.200$ ($p>0.05$) so that the independent-samples t test is used, which shows that there is a significant difference in the mean value of safety compliance in the treatment group compared to the comparison group after the intervention ($p = 0.025$). There was also a significant difference in the mean value of safety participation in the treatment group compared to the control group after the intervention ($p = 0.032$).

Relationship between Safety Performance and patient safety practices

Through the results of this study, it is known that safety compliance has a relationship with all subvariables of patient safety practice with a correlation coefficient value, namely effective communication of r = 0.363 (p <0.05), introspection = 0.380 (p <0.05), and basic science with r = 0.306 (p<0.05). All correlations are positive, meaning that the better the effective communication, self-awareness and knowledge base, the better the radiographer's safety compliance. The value of the largest correlation coefficient with safety participation is = 0.556 (p<0.01).On the other hand, safety participation based on test results does not have a relationship with effective communication, introspection, and knowledge base. Then, in patient safety practice, there is a relationship between effective communication with introspection and the basis of knowledge, respectively, with a correlation coefficient of r = 0.580 (p<0.01) and r = 0.687 (p<0.01).

DISCUSSION

Patient Safety Climate

The results of research related to the measurement of patient safety climate in CT-Scan services, show that the lowest score is non-punitive response to error which gets an average value of 62.9% and leadership commitment (Supervisor/manager expectations/actions and actions). promoting safety) of 63.1%. From the results of the Spearman correlation test, these two elements have a strong correlation coefficient r = 0.767 (p <0.01). This means that there is a close relationship between the manager's lack of support for patient safety in the installation and blaming behavior when staff mistakes occur.

The results of this study are in line with the research conducted by Hellingset al (2007) on five hospitals in Belgium where the instrument used was HSOPSC. As stated by Reason that in order to create a good climate for a just report culture, especially regarding errors, the first thing that must be created is a just culture. It is known that in complex systems, there are always inherent errors. Errors in the system will sooner or later show their form through human actions (Radhakrishna, 2015).

Hospital accreditation factors also influence the safety climate and attitudes to reporting medication errors, although they do not significantly affect management and leadership. Nurses' perception of the safety climate was positively correlated with their attitude towards reporting medication errors. Hospitals and their units should further develop a friendly and welcoming work environment that can eliminate nurses' fear of punishment. Therefore, management and leadership should support nurses who report their mistakes (Kim et al., 2016).

Effect of Transformative Learning on CRWB

In this quasi-experimental design research, transformative learning interventions were also designed as adult learning through critical reflection training that has been made a guide (Suprijanto, 2007). The results of critical reflection training will be measured through Critically Reflective Working Performance (CRWB) proposed by Van Woerkom and Croon (2008). Critically Reflective Working Performance which consists of six dimensions, namely Critical opinion-sharing, openness about mistakes, asking for feedback, challenging groupthink, experimenting, and career awareness. As is known, there are currently very few studies that measure quantitatively the results of critical reflection in the workplace context (Van Woerkom, 2004).

Based on the results of previous studies, critical reflection is evaluated or assessed frequently in the field of education such as doctors (Ritunga et al., 2018), nurses (Williams, 2001), physiotherapist or pharmacist. In physiotherapy, critical reflection has even been defined as a “higher-order” intellectual and affective activity in which physiotherapists engage critically to analyze and evaluate their experiences in order to lead to understanding and appreciating the way they think and work under conditions clinical.”

In this study, based on statistical tests, it was shown that in general there was no significant difference in CRWB in the treatment group after intervention with transformative learning compared to before intervention ($p = 0.061$). Meanwhile, based on each aspect of CRWB there was also no significant difference between before and after the intervention ($p > 0.05$).

Effect of transformative learning intervention on safety performance

The dimensions of safety performance in the safety performance model proposed by Griffin and Neal (2000) consist of antecedents (safety climate), determinants (knowledge/skills), and safety performance components that describe safety performance in the workplace. These components consist of task performance and contextual performance. When both are used to distinguish safety behavior, the terms are safety compliance and safety participation.

This research through the concept of safety performance rationale tries to use an experimental method with an intervention, namely transformative learning (MEZIROW, 2011)which is practically carried out through critical reflection training(McGonigal, 2005). Therefore, the results of this study indicate that the treatment group did not have a significant difference in safety performance between before and after the intervention ($p=250$). Meanwhile, the safety compliance component after the intervention experienced a significant decrease ($p= 0.004$). On the other hand, the results of the comparison of the treatment group and the control group after the intervention showed significant differences in which safety compliance ($p= 0.025$), safety participation ($p=0.032$), and safety performance ($p= 0.028$).

Through this research, it can be seen that the transformative learning intervention through critical reflection training has an effect on safety compliance, safety participation, and safety performance of the radiographer in the treatment group compared to the control group in the CT-Scan service.

The relationship between safety performance and patient safety practices

Through this study, it was found that there was a relationship between the safety compliance of radiographers and the practice of effective communication, introspection and the basis of radiographer's knowledge but not on safety participation. Then, based on the regression analysis that has been discussed, it was found that the aspect of effective communication is a predictor of safety compliance. This means that patient safety practices in CT-Scan services have a positive effect on perceptions of safety compliance. The radiographer's effective communication competence affects his professional competence.

It is known that poor communication in health services can have an impact not only endangering patient safety but can also cause death. That is why communication is an important point that is effective in saving patients. Then, in relation to safety compliance, the radiographer's communication in

this study is in the context of patient safety in CT-Scan services, namely the communication made by the radiographer to the patient himself and the referrer for diagnostic radio examinations (Portelli et al., 2016).

CONLUSION

Thus this study concludes that the transformative learning intervention only affects safety performance and patient safety practices but has no effect on CRWB radiographers.

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