



## Impact Measurements of Training Programs for Local Government Personnel Using Disaster Response Competency Profile Indices

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### Abstract

While many training programs for disaster management officers were conducted throughout Japan, there is not enough research that prove the effect of training programs. Therefore, we tested the efficiency of “professional training course on disaster management” conducted at the Disaster Reduction and Human Renovation Institution (DRI), where many disaster management officers take training programs all over Japan.

For testing, we used the instrument named “Disaster Response Competency Profile Indices (DRCPI)”, which consisted of three competency clusters with 1) operational competency, 2) management staff competency (i.e., information/intelligence analysis, planning), and 3) incident commander competency.

After the training in 2017, we found that the developed competencies vary with the level of training course. At the same time, we found that only the table-top exercise program did not show any development of participants’ competency. Considering the research outcome, we tried to improve the contents of the table-top exercise program to develop competencies.

As a result, we set up study group conducted with DRI researchers and municipal government officials who had experienced disaster response to develop new type of table-top exercise for training in 2018. In this study group, we developed table-top exercise which replicate thinking process of disaster response experts. After the training in 2018, we tested the efficiency of improved exercise with DRCPI and found that two of three competencies (operational and incident commander competency) were developed with the participants.

*Keywords: Training Programs, Disaster Response Competency Profile Indices (DRCPI), Impact Measurement.*

### 1. Introduction

With disasters occurring frequently in Japan, disaster prevention training programs for local government officials are being implemented all over the country, and the development of disaster response human resources is an urgent issue. Disaster prevention training is conducted by various training organizations and administrative organizations, but few studies monitor the results and effects of such disaster prevention training. Tierney et al (2001) also mentioned the importance of evaluating the training as “the Federal government should evaluate both disaster exercises and actual disaster response activities.” [1].

Furthermore, it is also a problem that there are few researches that distinguish between “correlation” and “causality” during monitoring.

According to Nakamuro et al. (2017), “states where one of two things is the cause and one is the result” are said to be causal. On the other hand, “the two things are related, but the two are not related to the cause and effect” says that there is a correlation [2].

The effect was not necessarily obtained because of the training, and the effect may have been obtained even without the training. However, very few studies have properly discussed the causal relationship between “training and effect”. Since the effects of the training are likely to be affected by “factors other than the training,” there is a need to compare “the situation where training was conducted” with “the situation where training was not conducted (counter-factual situation)” in order to measure the training effect correctly. Counter-factual situation refer to scenarios that did not actually occur, such as “what would have happened if I did not do XX”. Since counter-factual situation cannot be observed, it is only possible to actually create



comparable groups and replace counter-facts with plausible values. After all, it can be said that there is almost no research that verifies the effects of disaster prevention training and exercises using “scientific evidence”. In addition, the scale used to measure the effectiveness of training and exercises varies from organization to organization, and there is almost no research on whether the validity of the scale is examined using a validated scale.

## 2. Previous Research

### 2.1 Previous research about training related papers

There are several papers that study the theme of disaster prevention training, but most of the papers that verify the effectiveness of the training program are surveyed only “after” the training. At present, comparative surveys on “before and after” training courses are limited.

Taniguchi et al. (2008) evaluated after action reviews of participants in the table-top training conducted by local government [3]. Ota (2010) evaluated the effectiveness of lectures and exercises for firefighters with questionnaires after training [4]. Sakamoto et al. (2006) evaluated the table-top training for firefighters with conducted study meeting and a questionnaire survey after training[5].

In addition, Koshiyama et al. (2006) evaluated the educational effects of disaster management training conducted for local government staffs with questionnaire surveys after the training [6].

In the above research, detailed analysis was conducted by the investigation after these disaster management trainings and exercises, but it was not possible to measure how much the ability was improved before these trainings.

Terumoto et al. (2011) evaluated the educational effects of disaster management training conducted for local government staffs with a total of three questionnaire surveys on the before the training , immediately after the training, and several months after the training [7]. This is a valuable study that measures the change of ability before and after training, however, no study has been conducted to replace counter-facts (control groups) to identify the effects of "training", and no analysis has been conducted on the possible effects of external factors other than training.

From the above, it can be said that the research targeting the control group using a scale that has been validated as a measure of the effectiveness of disaster prevention training is a new study.

### 2.2 Use of scales developed in previous research

Among the papers on a few training programs, Tatsuki (2008) used the “Disaster Response Competency Profile Indices”, which validity and reliability were verified in the “theoretical”, “structural / internal”, and “external” consideration stage.[8].

Specifically, the validity of the content has been confirmed at the theoretical consideration stage.

In the structural and internal consideration stages, internal consistency reliability was confirmed, and Cronbach's  $\alpha$  coefficient, which measures how consistently subjects responded to the scale item group, was secured. As for Cronbach's alpha coefficient, the reliability of the operation scale (.877), the management staff scale (.891), and the incident commander scale (.920) are secured.

At the external consideration stage, the validity of the construct was confirmed by Multitrait-Multimethod confirmatory factor analysis. (Convergent validity and discriminative validity were satisfied as a result of examination by Structural Equation Modeling.)

In addition, the results of the experiments in groups divided by DRCPI showed that the level of disaster management performance of the participants ‘group was predicted in advance.

It means that the predictive validity has also been confirmed.

The Disaster Response Competency Profile Indices (hereinafter referred to as DRCPI) is a screening instruments that assess disaster response competencies and to be able to quantitatively grasp the disaster response competencies for each task. These competencies are identified on the surveys of personnel who have engaged in emergency response for past disasters with high-performance.

In this study, we will measure the effectiveness of the training program using DRCPI, which validities has



been proven in previous research. In the process of categorizing and structuring the characteristics of high performers in disaster response, three major characteristics were found. The first relates to job execution and operational items required for actual duties, the second relates to command support items such as information analysis, planning and resource management, and the third relates to organizational decision-making.

In order to relate these conceptual clusters to the standard emergency functions, Tatsuki (2008) used the Incident Command System as a template guideline. The first cluster corresponded to “operation competency”, the second cluster corresponded to “management staff competency”, and the third cluster corresponded to “incident commander competency”. The DRCPI consists of 32 competency scale items, including 10 items for operational competencies (Table 1), 10 items for staff competencies (Table 2), and 12 items for incident commander competencies (Table 3).

Table 1- Operation Competency Items

OP01	I not only do what I am told to do, but also initiate my own action if necessary.
OP02	I report my situation at every critical point when I engage in a mission.
OP03	I make my own judgement about what I can do in the current circumstances.
OP04	I know the direction toward which operation teams as a whole are geared.
OP05	I judge what my team can do according to the entire operation plan.
OP06	I can summarize aloud what is going on at the operation site.
OP07	I am prepared to come to work at any time.
OP08	I hang around and play with my team mates outside of the workplace.
OP09	I grasp the skill of each team member.
OP10	I make suggestions to my superior about matters that are beyond my job description.

Table 2 - Management Staff Competency Items

ST01	I use my own imagination to prepare for any possible risks in the situation.
ST02	I prioritize the management of such time consuming matters as personnel and vehicles before I make other on site decisions.
ST03	I communicate the information thinking how its recipients will react.
ST04	I sort and summarize various information provided at the time of crisis.
ST05	I pick up the most critical information according to the crisis situation.
ST06	I have an expert knowledge and understand professional jargon in emergency situation.
ST07	I can explain the situation effectively to those who have different backgrounds from me.
ST08	I can fully utilize personnel and material resources both within and outside the organization that I belong to.
ST09	I keep my cool so that I can make rational judgements about the situation.
ST10	I make suggestions to my superior commander when it is necessary.



Table 3 - Incident Commander Competency Items

IC01	I can give instructions quickly as an organization.
IC02	I understand the big picture and the movement of the whole site.
IC03	I can command the entire organization together.
IC04	I can control the field and move as the incident commander.
IC05	I can judge calmly when judge things in an emergency
IC06	I can give someone full authority.
IC07	I have strong physical and mental strength.
IC08	I have a loud voice.
IC09	I am positive.
IC10	I can consider and care for personnel.
IC11	I have a power to change the organization itself.
IC12	I can negotiate person-to-person with other organizations and departments.

### 3. Purpose

In this study, we examine the "Disaster Management Training Course" for local government officials conducted at the "Disaster Reduction and Human Renovation Institution (DRI)" in Hyogo Prefecture, Japan. The purpose of this study is to examine whether the higher the level of disaster response, the higher the competency scale score. Since the training course is separated according to the level of the participants, it can be verified by measuring the competency scale scores of the participants of each training course.

The second purpose is to verify whether the effect (evidence) has been given to the participants for the labor (cost) spent on training. By observing the difference in the disaster management competency scale score between the participants (experimental group) and non-participants (control group) before and after the training, it is possible to verify whether the effect was due to the training participation. If there is no effect on the training, we should consider countermeasures.

### 4. Methods

#### 4.1 Overview and aims of the target training program

The training targeted for this study is "Disaster Management Training Course" conducted at the "Disaster Reduction and Human Renovation Institution (DRI)". These training courses are roughly divided into five courses. The "Basic (BA)" course is aimed at those with inexperienced staff members of the department in charge of disaster management and is a systematic course to mainly learn basic disaster management knowledge. The purpose is to extend all the capabilities of operation, command support, and incident command.

Then, there are two "Expert" courses, "Expert A (EA)" and "Expert B (EB)." These courses are aimed to improve disaster response knowledge and skills through examples and exercises. In these courses, participants will learn how to deal with disasters, especially considering command and coordination, as well as operation and command support. Participants are required to have a certain level of disaster response ability, so the level of participants is relatively high.

Next, the "Advanced (AD)" course is intended for members of the department in charge of disaster management who are expected to be executives in the future. This is a course to learn from past response cases and lessons that require policy decisions in the event of a disaster. As a person who assists the top of the municipality, the purpose is to improve the incident command ability mainly.

Finally, in the "Table-top Training of Disaster Management Headquarters" (hereinafter referred to as "table-top training") course, those who have completed any of the above EA / EB or AD courses, or who have been engaged in disaster management for more than 2 years. The above trainings are characterized by different levels depending on the course, from beginner to advanced level.



## 4.2 Target Personnel

DRCPI was implemented before and after training courses for 206 participants who took five courses in FY2017, "Basic", "Expert A", "Expert B", "Advanced" and "Table-top Training" as an experimental group. This time, we also asked 15 disaster management staffs from local governments who did not attend the any of the training courses to conduct the DRCPI as a control group.

The number of participants is 44 for the "Basic" course, 52 for the "Expert A" course, 51 for the "Expert B" course, 15 for the "Advanced" course, and 29 for the "Table-top Training" course.

The BA / EA (Spring) / EB (Spring) courses are held in June 2017, the EA (Autumn) / EB (Autumn) / AD courses are held in October, 2017, and the table-top training was held in December, 2017.

## 4.3 Cost for training operation

Researchers, secretariat staff, and supporters (students) are involved in the planning, operation, and implementation of the above training. Table 4 shows a trial calculation of how much man-day cost (the amount of work one person takes per day is defined as "one man-day" and defined as 8 hours) for training. "Advanced" and "table-top training" are 2 days, and "Expert A", "Expert B", and "Basic" are 4 days. By calculating the total number of days from the reward paid for staffs per day, "Expert A", "Expert B", and "Basic" were 13.9 man-days, and "table-top training" was 36.8 man-days. It is clear that the daily cost of "table-top training" is extremely high compared to other courses.

Table 4. Man-day cost for each training course

Course	Training Days	Times	Resarchers/ Supporters man- day needs	Outside lecturers man-day needs	Total man-day needs	Man-day needs per day
Advanced	2	$\frac{12h}{(2 \text{ days})}$	13	10	23	11.5
Expert A	4	$\frac{27h}{(4 \text{ days})}$	23	32.5	55.5	13.9
Expert B	4	$\frac{27h}{(4 \text{ days})}$	23	32.5	55.5	13.9
Basic	4	$\frac{27h}{(4 \text{ days})}$	23	32.5	55.5	13.9
Table-top training	2	$\frac{14h}{(2 \text{ days})}$	66	7.5	73.5	36.8

## 4.4 Procedure

The trainees were requested to fill in the DRCPI on the first and last days of the training. The time to fill out the DRCPI is the same as the time of the training course.

Non-participants were requested to fill in the DRCPI distributed by mail and fill out the DRCPI at the beginning (Monday) and at the end (Friday) of a week to investigate under similar circumstances. As a selection condition, we requested distribution to those who oversaw disaster management department in local governments and who had not participated "table-top training" in the past.

DRCPI's response was measured using the Leichhardt scale, with 5 points for "Fairly applicable", 4 points for "Rather applicable", 3 points for "I can't say or do not know.", 2 points for "Somewhat do not fit", and 1 point for "Not at all". The total score of the question answer is calculated.

The lead sentence to the operation competency items is as follows: "Assuming that you are working as a member of each department of the Disaster Management Headquarters or as a member of each department."

Next, the lead sentence for the management staff competency items is as follows: "Assuming a situation where you are in charge of coordination and planning as a team leader whose team that makes an action plan".

Finally, the lead sentence to the incident commander competency items is as follows: "Assuming that you



are the headquarters and will be acting as a leader (disaster management supervisor) who supervises and coordinates all departments and groups. "

Participants will be asked to answer questions assuming items that do not apply to their current position. For example, most basic trainees are new to disaster management work, and there are few opportunities for commanding and coordinating work in disaster response. On the other hand, the advanced students are those who act as chiefs of staff such as crisis management supervisors, so it is thought that there are few opportunities to perform operation tasks. The survey was conducted assuming that the participants themselves were in positions to handle these three types of jobs.

## 5. Results

### 5.1 Results of repeated measures ANOVA

We performed repeated measures analysis of variance to examine the relationship between the disaster management competency scale score and changes over time before and after training.

We set each competency scale score as an objective variable and analyzed the interaction of "time" (before and after attending) and "time × course" (BA, EA, EB, AD, Table-top training, Non-participants) as explanatory variables. As a result of analysis (Table 5), all had statistically significant differences below the 5% level. In other words, before and after the training, the change of each student's competency score for each course was found to be statistically significant.

Next, we set each disaster response competency scale score as the objective variable, and set course (BA, EA, EB, AD, Table-top training, Non-participants) as an explanatory variable. As a result of analysis (Table 6), all had statistically significant differences below 1% level. In other words, the differences among the six courses (BA, EA, EB, AD, Table-top training, Non-participants) were found to be statistically significant.

Table 5. Results of repeated measures ANOVA (intrasubject)

Objective Variance	Source	Type III Sum of Squares	df	Mean Square	F	Significance
operational competency	time	222.1	1	222.1	30.9	0.000
	time * course	244.4	5	48.9	6.8	0.000
	error (time)	1435.8	200	7.2		
management staff competency	time	839.4	1	839.4	93.6	0.000
	time * course	187.9	5	37.6	4.2	0.001
	error (time)	1793.0	200	9.0		
incident commander competency	time	741.8	1	741.8	63.1	0.000
	time * course	306.8	5	61.4	5.2	0.000
	error (time)	2352.8	200	11.8		





Table 6. Results of repeated measures ANOVA (inter-subject)

Objective Variance	Source	Type III Sum of Squares	df	Mean Square	F	Significance
operational competency	intercept	442359.7	1	442359.7	13777.2	0.000
	course	848.3	5	169.7	5.3	0.000
	error	6421.6	200	32.1		
management staff competency	intercept	386402.5	1	386402.5	11210.9	0.000
	course	1536.7	5	307.3	8.9	0.000
	error	6893.3	200	34.5		
incident commander competency	intercept	564566.7	1	564566.7	7132.6	0.000
	course	2516.8	5	503.4	6.4	0.000
	error	15830.7	200	79.2		

## 5.2 Results of Estimated Marginal Means Chart

We introduced by an estimated marginal means chart by repeated measures analysis of variance (Figures 1). On all competency scales, AD (advanced) courses, which are advanced disaster responders, are ranked high, followed by EB (expert B) or EA (expert A) courses. It is clear from this figure that the higher the level of disaster response, the higher the competency scale score. Also, since BA (Basic) comes in the lower rank, it can be read that the competency scale score is lower for disaster response beginners.

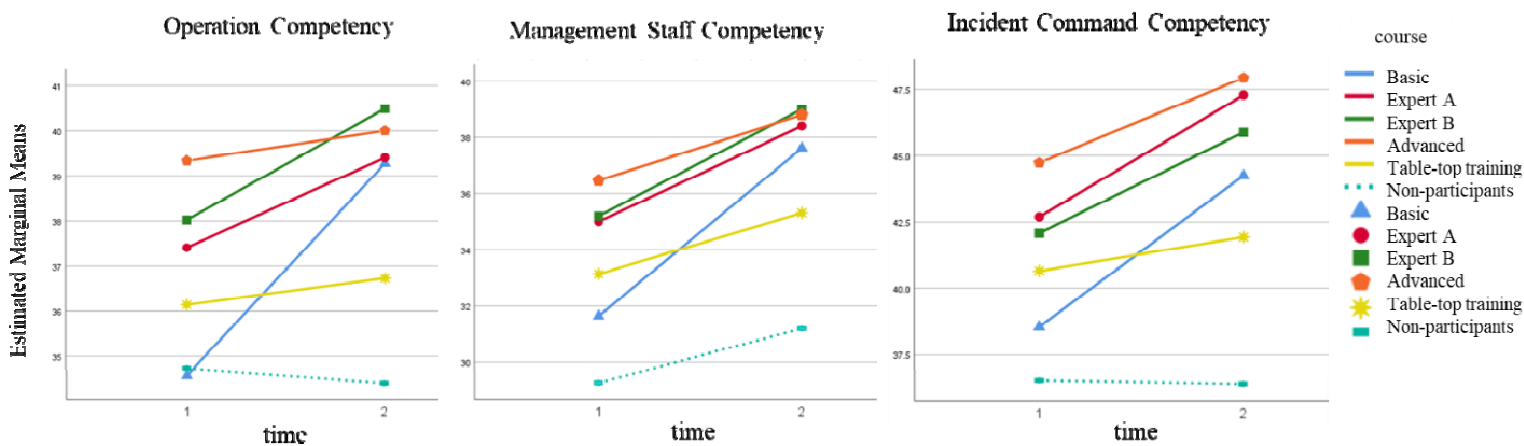


Figure 1 - Estimated Marginal Means Chart by Repeated Measures Analysis of Variance

## 5.3 Analysis of differences by multiple comparison test

Looking at Figures 1 of the before and after comparison introduced above, the competency scale scores of the trained group (experimental group) are higher after training than before training. As far as we can see from these results, the training effect increased the score and judged that the result was effective. However, in fact, this alone could not consider the effect of natural changes (trends) that occur over time. Therefore, we performed a difference analysis of the differences by multiple comparison test.(Table 7)

First, in operation competency, only the "basic" course showed a significant difference at the 5% level ( $p < .05$ ) compared to the difference between non-participants.



Next, in terms of management staff competency, it was also found that there was a significant difference at the 5% level ( $p < .05$ ) in the "Basic" course only, compared to the difference between non-participants.

Lastly, in terms of incident commander competency, there was a significant difference at the 5% level ( $p < .05$ ) in the "Basic", "Expert A", and "Expert B" courses, compared to the difference between non-participants. The "Advanced" course showed a significant tendency at the 10% level ( $p < .1$ ), compared to the difference between non-participants.

Table 7. Results of difference analysis by multiple comparison test

Comparison with control group	method	course	mean difference	standard error
Operation_dif	Tukey HSD	Basic	-5.038 **	1.133
		Expert A	-2.333	1.111
		Expert B	-2.804	1.113
		Advanced	-1.000	1.384
		Table-top training	-0.920	1.205
Management Staff_dif	Tukey HSD	Basic	-4.044 **	1.266
		Expert A	-1.471	1.241
		Expert B	-1.871	1.244
		Advanced	-0.400	1.546
		Table-top training	-0.239	1.347
Incident Command_dif	Games-Howell	Basic	-5.838 **	1.040
		Expert A	-4.730 **	0.911
		Expert B	-3.937 **	1.026
		Advanced	-3.333 *	1.083
		Table-top training	-1.409	0.748

\* :  $p < 0.1$  \*\*: $p < 0.05$

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From here, we would like to examine the second purpose of study ( "to examine whether the effect (evidence) has been given to the participants for the labor (cost) spent on training" )

In the "Basic" course, it can be said that there was a sufficient effect from the fact that all the competencies of operation, management staff and incident command were improved.

Next, in the "Expert A" and "Expert B" courses, it can be said that there was a sufficient effect for course targeting participants, who intended to improve the incident command competencies. This is because the participants of the expert course originally have high ability in operation and management staff competencies.

Third, in the "Advanced" course, it can be said that there was some effect since some tendencies of





improvement in the incident command competencies showed.

On the other hand, the “table-top training” course was originally expected to improve the competencies of management staff and incident command, but it was found that there was no improvement at all with no effect.

## 6. Discussion

### 6.1 Discussion on training effectiveness

In the case of "Basic", the subject was for newcomers, and there were many items to learn from contents about knowledge, skills, and attitudes about disaster management. Although the training program has a lot of basic contents, this course covered a wide range of matters from operation to management staffs, so that greatly linked to the improvement of the effect.

As for "Expert A" and "Expert B", the participants must have at least two years (or more) or similar experience in the disaster management department as application conditions and have a certain level of ability.

As a result, there was no significant improvement in the skills they had from the beginning, such as operation and management staff competencies.

On the other hand, the ability of incident command was improved, so it can be said that the expected effect of training was implemented in “Expert” courses.

For the "Advanced" course, it is assumed that executives in disaster management departments are targeted, and no improvement was seen because the participants had a certain or better ability in operation and management staff competencies.

On the other hand, the ability of incident command was improved, so it can be said that the expected effect of training was implemented in “Advanced” course.

The problem is the “table-top training” course, which did not improve at all in any ability. The target level of table-top training is assumed to be about the same as "Expert A" and "Expert B." The training is intended to improve the capacity of management staff competency and incident command competency for the actual operation of the disaster response headquarters. However, there was no improvement in the ability to aim, so it is reasonable to think that there were issues with the contents of the training.

From the above discussion, we thought that there may be some hints on the difference in the training structure between the "management course" (“Basic” “Expert A” “Expert B” and “Advanced” )where the effect was seen, and the "special course" (the table-top training) where the effect was not seen.

First, the "Management Courses" has been held since the establishment of the center in 2002 and has a history of improvement over the years. It is thought that the quality has been improved by repeating the implementation and improvement.

Comparing the program in 2009 (H21) with 2017(H29), the general framework was not changed. However, the contents of lectures have changed according to the lessons and important issues from recent disasters. Lectures for 4 frames (75 minutes x 4) were newly replaced in Basic, Expert A, and Expert B.

On the other hand, comparing the program of “Special course (table-top training)” in 2009 (H21) with 2017 (H29), the contents have not been changed at all. Only some minimum modifications (such as the provision of situations) have been made,

In contrast to management courses, the contents of table-top training have not been changed according to the lessons and issues from recent disasters.

From these facts, it is considered that lectures/trainings which reflect lessons and issues from recent disasters is one of the factors that determine the effect.

In the case of table-top training, it is necessary to reflect the issues that occurred at the Disaster Management Headquarters, and it is desirable to provide a program that can acquire the knowledge, skills, and attitudes necessary for solving those issues. It is presumed that the content of the current program does not provide contents on solving problems that occurred at the Disaster Management Headquarters. Therefore, it is necessary to review it from the aim of the program. Setting goals that are appropriate for the tasks



required by the Disaster Management Headquarters should lead to enhanced training effects.

## 6.2 Discussion on training types :from “operation-based exercise” to “discussion-based workshop”

We considered the reasons “why table-top training” lack the effectiveness and came up with these result?”. The first reason is that the aims of training was not designed properly. The second reason is that the improvements were not made in accordance with recent disaster (lessons and issues from recent disasters). It is necessary to consider a new form of “table-top training” based on these reflections.

Considering the issue, we set up study group with municipal government officials who had experienced disaster response to develop new type of exercise which replicate thinking process of disaster management experts.

In the study group, discussions were held from the perspective of "what kind of person is needed at the Disaster Management Headquarters at the time of a disaster.". From the point of views of disaster management experts, we listed the abilities to improve at the table-top training.

- (1) Abilities to share the overall picture and scale (COP: Common Operational Picture) of the disaster.
- (2) Abilities to forecast and estimate the future from past disaster cases along the time axis and disaster phase.
- (3) Abilities to assess the situation in the devastated area while updating the COP.
- (4) Abilities to find and adjust bottlenecks which are not functioning well in disaster management.

We considered that the table-top training would be effective by designing to improve these abilities. In order to do this, the form of training also need to be changed from “ “operation-based exercise” to “discussion-based workshop”.

## 7. Conclusion

Regarding the purpose of the study, it was confirmed that the higher the level of disaster response ability, the higher the competency scale score. The validity of DRCPI was confirmed, which indicate that it could be used in future studies.

However, based on the results of the difference analysis, the problem is the “table-top training” course, which did not improve at all in any ability. The target level of table-top training is assumed to be about the same as "Expert A" and "Expert B." The training is intended to improve the capacity of management staff competency and incident command competency for the actual operation of the disaster response headquarters. However, there was no improvement in the ability to aim, so it is reasonable to think that there were issues with the contents of the training.

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