研究ノート

# 授業設計における事前テスト分析の重要性の検討

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# Examining the Importance of Pre-test Analysis in Lesson Design.

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本研究は、学生に本質的な健康管理を教えるために、実際の災害シナリオを取り入れた講義を行い、その効果を評価することを目的とした。2019 年 6 月に看護学科 2 年生 60 名を対象に災害時の避難生活における生理的ニーズと環境的ニーズを網羅した 11 問からなる事前テストを実施した。講義では環境的ニーズに重点を置いたため、事後テストの正答率が低くなった。事前テストで学生の理解度を把握し、その結果に基づいて講義のテーマを選定する教授方法が有効であることが明らかになった。

キーワード：Health Management Education, Instructional Design, ADDIE, Educational methods, University Students

## Ⅰ. Introduction

Japan is frequently struck by natural disasters, such as earthquakes. There have also been numerous large typhoons and flood damage due to climate change related to global warming in the recent past. The 2017 Japan Floods and typhoons in 2018 and 2019 and damage from heavy rain in Hiroshima in August 2014 and July 2018 are just some of the recent disasters in Japan that have caused great damage across the archipelago[1)]. Natural disasters inevitably threaten human health and lives. Residents of affected communities in Japan must take temporary shelter and live in designated public halls and local schools[2)], 92.1% of which are designated as spaces for evacuation shelters in the event of natural disasters[2),3),4)].

However, evacuation shelters in Japan are not adequately equipped to meet The Sphere Project Humanitarian Charter and Minimum Standards in Humanitarian Response[5)].

Helping evacuees to adjust to changes in their environment, provision of water and food, human waste removal and ensuring health, safety and hygiene are some of the functions demanded in evacuation shelters[5),6)]. The importance of knowledge and techniques in surgical, internal, and emergency medicine and psychiatry increases in evacuation shelters[3),7)].

Therefore, the present study aimed to give a lecture simulating a real disaster that occurred in the past to teach students health management and to assess the efficacy of such lecture. We developed a health management program that can be introduced to students in their earlier years of nursing school. The content was kept to basics, and a disaster that would be easy for students to imagine and associate with was selected so as to be practical for introducing disaster nursing. Students were to imagine the environmental hygiene of the evacuation shelters and details were kept easy to understand in the lecture. The program was constructed along the ADDIE model of instructional design (ID)[8)]. The ADDIE model is a basic learning support environment process model that shows the flow of educational activities, and is derived from the initial letters of Analyze, Design, Develop, Implement, and

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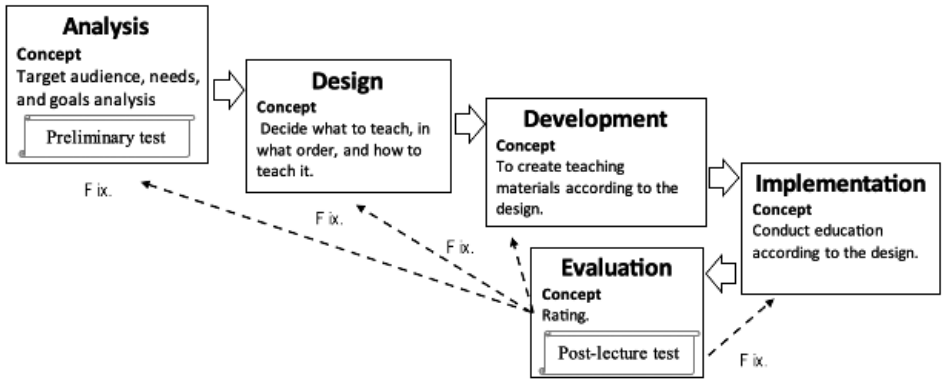


Figure 1　Lecture structure based on the Analysis, Design, Development, Implementation, and Evaluation model (ADDIE).

Evaluate. With the aims to optimize efficiency of lecture content, we administered a test related to health assessment during disasters that would apply knowledge in fundamental nursing two weeks before the lecture (hereinafter, the preliminary test) and performed a needs analysis. The needs analysis corresponds to analysis (Analysis) in the ADDIE model, thus, we sought to evaluate the lecture details and assess the learning outcomes. Understanding the learners' actual situation in relation to the learning objectives is very useful for the design and development of the lessons. Based on the results of the class test, the content of a 90-minute lecture on flooding was designed and developed.

The class was implemented (Implement) and the effectiveness of the method was evaluated (Evaluate) from the scores of the preliminary and post-lecture tests at the end of the class.

**Definitions of terms**

Sphere: A common term for the consensus on minimum standards that should be shared by all individuals and agencies providing humanitarian assistance to disaster- or crisis-affected populations[5].

## Ⅱ. Methods

Participants were students in their 2nd year of the nursing program. The disaster to be studied was selected among disasters that have hit Japan in recent years. We conducted a search for disasters that have resulted in 10 or more dead or missing people in 2000 or later, which totaled 33 climate disasters and five earthquakes[1]. Since Hiroshima prefecture is affected by frequent disasters related to landslides and heavy rain, we decided that the class would focus on heavy rain disasters and selected an incident of flood damage.

With the aims to optimize efficiency of lecture content, we administered a test related to health assessment during disasters that would apply knowledge in fundamental nursing two weeks before the lecture (hereinafter, the preliminary test) and performed a needs analysis.

Since the curriculum for nurse training involves teaching many things at the same time, it is necessary to check the retention of students' knowledge and ideas about the environment outside the hospital. Thus, lesson design was based on the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) model[9].The ADDIE model has been shown to be effective in terms of lesson construction and student engagement[10),11].

The needs analysis corresponds to A (analysis) in the ADDIE model[12], thus, we sought to evaluate the lecture details and assess the learning outcomes (Fig. 1).

### 1. Lecture outline

The processes before, during and after the lecture are schematized in Fig. 1. The lecture was given over a 90min class. A preliminary test was administered before it and the simulation settings and the content of the lecture were determined based on its results. Pre-testing allows you to assess students' actual performance against the lesson objectives. It also allows the teacher to ascertain the learner's level of understanding and confidence. This makes it necessary for teachers to understand learners to ascertain not only their level of understanding but also

their level of confidence in the learning process. For this reason, a simulation was set up with the content of health care in a shelter during a disaster, as a subject that can be considered with the students' existing knowledge now. In addition, the environmental conditions required in a shelter, i.e., space, noise management, ventilation, lighting, drinking water and bathrooms, were mentioned, and the class was designed and developed so that the students' existing knowledge of what is required in a living environment and the knowledge they have already acquired in their basic nursing classes can be applied to actual life in a shelter.

**1）Preliminary and post-lecture tests**

The 11 items in the questionnaire administered as the preliminary test two weeks before the lecture and the post-lecture test administered after the lecture before the end of class are displayed in Table 1 Questions [1)] to [7)] were related to the living environment and questions [8)] to [11)] were related to physiological needs such as meals, elimination, and sleep.

**2）Scenario**

In the scenario, rivers in the area flooded, requiring the students to evacuate to the shelter. Slides of maps showing the locations of the rivers in neighboring areas, and photos of actual flooded rivers and the gymnasium where the evacuation shelter would be located were shown with the descriptions of the simulations so that the students could picture the scene with realism. Information about the actual evacuation shelters that were set up in response to the damage from heavy rain in 2018 were collected through interviews to make a localized scenario adapted to Hiroshima prefecture. The details are given below.

All the university students evacuated to the middle school next to the university in response to an evacuation order for heavy rain that was announced during the class. Students would receive the minimum goods of a 500ml bottle of water and a blanket at upon initial arrival at the evacuation shelter and would not be distributed meals for students to envision how they would respond when water or food that they would need are unavailable. The simulation further assumed the worst-case scenario in which windows could not be opened due to long-lasting heavy rain and a power outage that would prevent the use of lighting and air conditioning.

**3）Lecture**

After describing the scenario, the requirements of an environment for evacuation life; that is, space, noise management, ventilation, lighting, drinking water and bathrooms were listed. The lecture would consist of reflection on a) students' pre-existing knowledge related to necessities in a living environment and b) knowledge from classes in fundamental nursing that they had already completed so that both sets of knowledge could be applied to life in actual evacuation shelters, with further emphasis on environment.

**A Study period**

June 12 to December 7, 2019

**B Ethical considerations**

This study was conducted in accordance with the Declaration of Helsinki and was approved by the Hiroshima University Research Ethics Committee (No. E-1778). It was explained to the students that participation was voluntary and there would be no penalty for declining to participate, such as a negative grade evaluation. The students indicated their consent to participate on a research cooperation form and deposited it into a collection box.

**C Participants**

Of the 60 2nd year students in the nursing program of University A in 2019, 57 aged 20 years and above who provided their consent to participate in the study were included in the analysis.

**D Methods of analysis**

The McNemar test was used to find whether differences in the number of correct responses for each question between the preliminary and post-lecture tests were significant.

Next, the number of correctly answered questions were scored per student and the Wilcoxon signed-rank test was used to evaluate whether the differences in the number of correct responses before and after the lecture were

significant. The Bonferroni correction was used to correct the significance level or p-value, which may be required due to Type I errors of redundancy that may be noted in running tests multiple times. The p-value was changed from 0.05 to 0.0045 (overall error 0.05/11, which corresponds to the number of tests) to interpret test results. Software Statistical Language R version 3.2.4 (R Core Team 2016, R Foundation for Statistical Computing, Vienna, Austria) was used for analysis.

## Ⅲ. Results

### 1 Comparison: Preliminary and post-lecture tests

Results of the McNemar test for pre- and post-class changes in the number of correct answers for each test item.

The significance level was set at 0.0045, suggesting that there was a significant difference between the pre- and post-lesson periods for questions 1, 2, 3, 4, 7, 8, and 11.

The results of the evaluation at a significance level of 0.0045 indicated that there were significant differences between the pre- and post-lesson periods. For questions 7 and 11, there was a tendency for a large number of students to answer incorrectly after the class even though they answered the questions correctly before the class (Table 1) .

The results suggest that the number of students who answered correctly before the class tended to be higher after the class.

### 2 Comparison test results of changes in the number of correct answers to all 11 questions before and after the class

When evaluated at a significance level of 0.05, the results suggest that the number of correct answers increased significantly after the class (P value = 4.93E-8) (Table 2).

## Ⅳ. Discussion

The results of the students' pre-test and post-test suggest that their understanding of the lecture content deepened and the percentage of correct answers on the post-test increased for the questions explained in the lecture. Therefore, it was shown that it is effective to conduct a test prior to the lecture and analyze the students' level of understanding before designing the class.

We consider that the test results were good because students could easily visualize the social distance in daily life and environmental issues such as light intensity, noise, and humidity in their living environment. The students were also able to become aware of drinking water as it was distributed in the simulation.

However, many students gave incorrect answers to the questions about the color of the surroundings and sleeping in a shelter after the class because they had not actually experienced it.

The increase in the number of correct answers in the post-test is highly likely to be due to the fact that the pre-test was analyzed thoroughly, and the lessons were designed and developed from there. It is therefore very important to analyze the pre-test.

Though students have high interests in the topics of disasters and disaster-related experiences[13], they tend to have the mistaken belief that their community will not be harmed by a disaster[14]. Thus, conducting realistic simulations and supplementary learning that encourages engagement of pre-existing knowledge likely promotes stronger abilities of protecting community residents and themselves in the event of a disaster[15]. Pre-testing can be useful in designing and developing realistic simulations.

## Ⅴ. Conclusions

Conducting a pre-test and designing a class based on the results has the following advantages.

(i) Identifying learners' level of understanding and confidence: pre-testing enables the teacher to identify learners' level of understanding and confidence. This allows the teacher to understand not only the learner's level of understanding, but also the learner's level of confidence in the learning process, which is necessary for understanding learners.

(ii) Influence on the teacher's approach: understanding the learner's level of understanding and confidence in advance influences the teacher's approach in the classroom. Specifically, the results show that the class teacher has inaccurate and considerable difficulties in grasping and inferring about the learners' level of understanding and learners' characteristics.

(iii) Identifying students' realities in relation to the lesson objectives: by conducting a pre-survey, it is

Table 1 McNemar test results for changes in the correct number of responses after the lecture for various items of the test.

○ 1.Distance

| | After lecture correct | Incorrect answer | | Frequency | P-value:6.34.E-08 |
|---|---|---|---|---|---|
| Before class correct | 14 | 1 | Pre-instruction: incorrect solution → Post-instruction: correct solution | 34[59.65%] | |
| Incorrect answer | 34 | 8 | Pre-instruction: correct solution → Post-instruction: incorrect solution | 1[ 1.75%] | |

○ 2.Illuminance

| | After lecture correct | Incorrect answer | | Frequency | P-value: 2.30.E-10 |
|---|---|---|---|---|---|
| Before class correct | 2 | 1 | Pre-instruction: incorrect solution → Post-instruction: correct solution | 45[78.95%] | |
| Incorrect answer | 45 | 9 | Pre-instruction: correct solution → Post-instruction: incorrect solution | 1[ 1.75%] | |

○ 3.Noise

| | After lecture correct | Incorrect answer | | Frequency | P-value:3.64.E-05 |
|---|---|---|---|---|---|
| Before class correct | 0 | 0 | Pre-instruction: incorrect solution → Post-instruction: correct solution | 19[33.33%] | |
| Incorrect answer | 19 | 38 | Pre-instruction: correct solution → Post-instruction: incorrect solution | 0[0.00%] | |

○ 4.Room temperature

| | After lecture correct | Incorrect answer | | Frequency | P-value:2.99.E-07 |
|---|---|---|---|---|---|
| Before class correct | 3 | 3 | Pre-instruction: incorrect solution → Post-instruction: correct solution | 36[63.16%] | |
| Incorrect answer | 36 | 15 | Pre-instruction: correct solution → Post-instruction: incorrect solution | 3[5.26%] | |

○ 5.Humidity

| | After lecture correct | Incorrect answer | | Frequency | P-value:4.59.E-03 |
|---|---|---|---|---|---|
| Before class correct | 20 | 6 | Pre-instruction: incorrect solution → Post-instruction: correct solution | 22[38.60%] | |
| Incorrect answer | 22 | 9 | Pre-instruction: correct solution → Post-instruction: incorrect solution | 6[10.53%] | |

6.Temperature-humidity index

| | After lecture correct | Incorrect answer | | Frequency | P-value:1.00.E+00 |
|---|---|---|---|---|---|
| Before class correct | 0 | 1 | Pre-instruction: incorrect solution → Post-instruction: correct solution | 2[ 3.51%] | |
| Incorrect answer | 2 | 54 | Pre-instruction: correct solution → Post-instruction: incorrect solution | 1[ 1.75%] | |

7.Color

| | After lecture correct | Incorrect answer | | Frequency | P-value:8.56.E-04 |
|---|---|---|---|---|---|
| Before class correct | 21 | 22 | Pre-instruction: incorrect solution → Post-instruction: correct solution | 4[ 7.02%] | |
| Incorrect answer | 4 | 10 | Pre-instruction: correct solution → Post-instruction: incorrect solution | 22[38.60%] | |

○ 8.Water intake

| | After lecture correct | Incorrect answer | | Frequency | P-value:3.65.E-03 |
|---|---|---|---|---|---|
| Before class correct | 37 | 3 | Pre-instruction: incorrect solution → Post-instruction: correct solution | 17[29.82%] | |
| Incorrect answer | 17 | 0 | Pre-instruction: correct solution → Post-instruction: incorrect solution | 3[ 5.26%] | |

○ 9.Elimination

| | After lecture correct | Incorrect answer | | Frequency | P-value:1.08.E-02 |
|---|---|---|---|---|---|
| Before class correct | 29 | 6 | Pre-instruction: incorrect solution → Post-instruction: correct solution | 20[35.09%] | |
| Incorrect answer | 20 | 2 | Pre-instruction: correct solution → Post-instruction: incorrect solution | 6[10.53%] | |

10.Caloric intake

| | After lecture correct | Incorrect answer | | Frequency | P-value:1.18.E-01 |
|---|---|---|---|---|---|
| Before class correct | 5 | 14 | Pre-instruction: incorrect solution → Post-instruction: correct solution | 6[10.53%] | |
| Incorrect answer | 6 | 32 | Pre-instruction: correct solution → Post-instruction: incorrect solution | 14[24.56%] | |

11.Hours of sleep

| | After lecture correct | Incorrect answer | | Frequency | P-value:4.07.E-04 |
|---|---|---|---|---|---|
| Before class correct | 37 | 17 | Pre-instruction: incorrect solution → Post-instruction: correct solution | 1[ 1.75%] | |
| Incorrect answer | 1 | 2 | Pre-instruction: correct solution → Post-instruction: incorrect solution | 17[29.82%] | |

○ Discussed during the lecture

※ About exponential notation

P-values are expressed in exponential notation as 4.93E-8 where E means 10 and E-8 means 10 to the minus 8 power. E-8 means 10 minus 8.

Table 2 Comparison test results of pre- and post-class changes in the number of correct answers for all 11 item

| | **Before class** | | **After class** | | |
|---|---|---|---|---|---|
| variable name | Mean ± standard deviation | Median (25%-75%) | Mean ± standard deviation | Median (25%-75%) | P value |
| Number of correct answers | 4.263±1.59 | 4.000(3.000-5.000) | 6.561±1.753 | 7.000(5.000-8.000) | 4.93E-08 |

possible to identify students' realities in relation to the lesson objectives.

(iv) Leading to successful learning: the most important aim of educational assessment is to lead to successful student learning. In addition to the achievement of the learning objectives set in class, successful learning includes aspects such as the promotion of growth that fosters understanding of self and others, a deeper understanding of society, and the importance of health care for self and others.

These benefits enable teachers to assess learners' level of understanding and confidence, design lessons accordingly and provide effective education.

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