

Training Effectiveness Evaluation of Competency Test Materials Drafting for Person in Charge of Wastewater Treatment Operations (POPAL) Scheme

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Abstract— Training is one of the many initiatives to increase the level of expertise among teachers. Teachers from one of Bandung City's vocational high schools participated in drafting of competency test materials in the scheme of person in charge of wastewater treatment operation held by Politeknik Negeri Bandung. Training effectiveness is affected by numerous parameters, such as training materials, training environment, facilities, training schedule, and presentation style. So, this research is to investigate the effect of these parameters to the training effectiveness. A survey questionnaire was used to collect information, conducted among 20 participants, and the data were analyzed using statistical package for social sciences. After conducting validity, reliability test, and normality test, we applied correlation test and linear regression analysis. Our findings indicated that the training materials, training environment, facilities, training schedule, and presentation style have a positive linear association with training effectiveness.

Keywords— Parameters of training, training effectiveness.

I. INTRODUCTION

The Chemical Engineering Department has a Competency Test Site (TUK) for its three Study Programs. The TUK scheme of the D III Chemical Engineering Study Program and the D IV Cleaner Production Chemical Engineering Study Program is Heat Exchanger Operation and Extraction, while the TUK scheme of the D III Chemical Analysis Study Program is Validation of UV-Vis and AAS Spectrophotometric Test Methods. These two schemes are cluster schemes designed according to the competency needs of students in each study program according to the 2016 Curriculum in Semester 4 and above. The desired scheme in the market/field is an occupational scheme that can be recognized nationally in all places/workplaces in the fields of Chemical Engineering and Chemical Analysis throughout Indonesia. For this reason, a draft occupational scheme was designed by lecturers at the D III Chemical Engineering Study Program and the D IV Cleaner Production Chemical Engineering Study Program for this activity. The occupation scheme in question is the scheme for the Person in Charge of Wastewater Treatment Operations, abbreviated as POPAL. To be able to propose this POPAL scheme to the Indonesian National Professional Certification Agency (BNSP), it is necessary to create competency test materials (MUK) in each unit competency of the proposed scheme.

The teachers at one of State Vocational High School in Bandung are POLBAN (Politeknik Negeri Bandung) partners

who have received increased competency in Wastewater Treatment material. This vocational high school has 4 departments, namely Industrial Chemistry, Analytical Chemistry, Textile Chemistry, and Pharmacy, where wastewater processing material needs to be taught to students. As a follow-up to the training they have received, they want to be invited to partner again in creating the MUK occupational scheme which they also need because these teachers act as assessors during competency tests for their students. The wishes of the vocational high school teachers were welcomed positively by their principal. The main reason is that this school also needs to develop their TUK scheme by proposing a new scheme where the proposal for a new scheme must start from creating a MUK according to the competency unit of the scheme to be proposed.

The effectiveness of training is often measured by providing an assessment to participants without taking into account training aspects such as training resources, training conditions, training establishments, training program and timetable, and presentation manner. To ensure training efficacy, it is vital to prioritize participant needs while reviewing any training program (Hajjar and Alkhanaizi, 2018). Based on this statement, the goal of this research was to explore the impact of numerous factors on training efficacy in Competency Test Materials Drafting for Person in Charge of Wastewater Treatment Operations (POPAL) Scheme, as perceived by participants.

II. METHOD

A. Research Model

The aim of this research was to analyze the parameters affecting the training effectiveness of drafting of competency test materials in the scheme of person in charge of wastewater treatment operation from participants' perceptions point of view. It was done by examining the relationship between the parameter of training program (independent variable) and training effectiveness (dependent variable). The independent variables included training resources (MP), training conditions (SP), training establishments (F), training program and timetable (JP), and presentation manner (CP). The conceptual model of this research which is shown in Figure 1. The parameters are defined as follows.

Training resources: Materials are presented in an orderly fashion, arranged well, and relevant to the participants' needs,

as well as trainer used practical activities to cover a wide range of material.

Training condition: Training area is easily accessible, adequate, comfy, and noise-free.

Training establishment: Sufficient equipment is provided, and modules are given before the training is carried out.

Training program and timetable: The schedule is clear and detailed, sufficient time is allocated, as well as the objective and goals are well-defined.

Presentation manner: Trainer use audiovisual aids, communicates fluently, and includes participants during training.

Training effectiveness: The change in the understanding and skill of participants about drafting of competency test materials and materials related to the wastewater treatment operation.

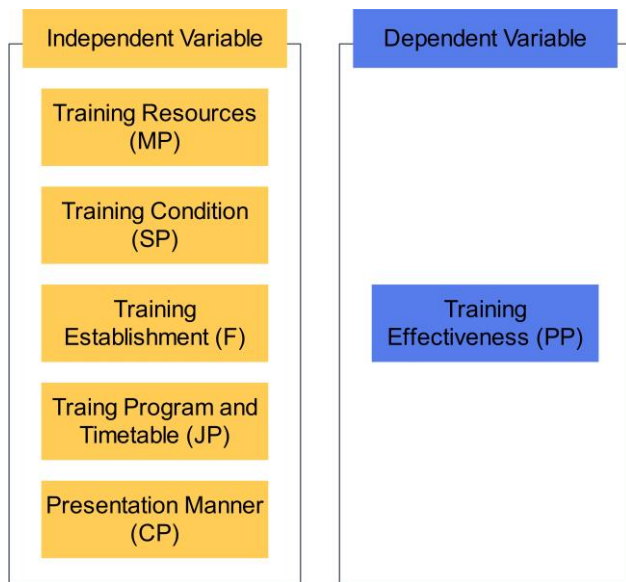


Fig. 1. The conceptual model of this research.

B. Respondents

The subject of this research was participants of drafting of competency test materials in the scheme of person in charge of wastewater treatment operation. The total participants were twenty teachers from a vocational high school in Bandung City, West Java, Indonesia. All participants filled the questionnaire.

C. Instrumentation

A questionnaire was prepared by referring to the research of Hajjar and Alkhanaizi (2018) with minor modification. The questionnaire contains several questions about parameters of training program, such as MP (4 indicators), SP (4 indicators), F (2 indicators), JP (3 indicators), CP (4 indicators), and participant understanding (PP) (6 indicators). The instrument of data collection was designed using a Likert-type scales. The scale on the questionnaire was from 1 (strongly opposing) to 4 (strongly agreeing).

D. Statistical Techniques

Techniques that are used for this research were validity test, reliability test, normality test, correlation test, and linier

regression analysis. The collected data were analyzed by using a statistical package for social sciences (SPSS) program.

III. RESULT

A. Demographic of Respondents

The respondents' demographics are of interest to the researchers in this area. Demographics are quantitative data about a certain population. Demographic mapping is an essential activity to generalize the population features of the study. This study analyzes the demographic information such as age, gender, educational level, and work experience.

Out of the total responders of 20 instructors, the majority (60%) were found to be between the ages of 26 and 45, implying that they possess the ability to work for a longer duration and can concentrate on training and development program. As indicated in Table 1, 5% of the sample falls between the ages of 18 and 25, with 35% beyond the age of 45.

TABLE I. Age of Participants.

Age	Response	Percentage
Between 18-25	1	5
Between 26-45	12	60
Above 45 years	7	35
Total	20	100.0

As shown in Table 2, female respondents outnumbered male respondents by 13 to 18, representing teachers of various specializations. Table 2 shows that 90% were female and 10% were male.

TABLE II. Gender of Participants.

Gender	Response	Percentage
Male	2	10
Female	18	90
Total	20	100.0

Table 3 displays the educational background of the poll participants. This indicates that 22.2% of participants possess postgraduate degrees and 77.8% possess undergraduate degrees. These data indicate that this school has a sufficient quantity of highly trained and skilled teachers, which can have a significant impact on students' academic achievement.

TABLE III. Educational Level of Participants

Educational Level	Response	Percentage
Bachelor	14	70
Postgraduate	6	30
Total	20	100.0

Teacher tenured status revealed that 85% had over five years of teaching experience, 11.1% have 3-5 years of teaching experience, and no one have less than 3 years of experience. This conclusion suggests that teachers have adequate knowledge and comprehend how to increase productivity through training and growth.

TABLE IV. Work Experience

Educational Level	Response	Percentage
Less than 3 years	0	0.0
3-5 years	3	15
More than 5 years	17	85
Total	18	100.0

B. Data Analysis

The validity test is performed at the start to determine whether the items on the questionnaire accurately represent what will be examined. A reliability test determines whether or not the responder can consistently answer the questionnaire's questions. Weighted mean, Pearson's r, and regression were the statistical tools used in this investigation. The weighted mean was used in this study to calculate the central tendency across all aspects of the questionnaire. Similarly, a correlation test was used to investigate the relationship between the independent parameters (MP, SP, F, JP, and CP) and the dependent parameter (PP). Furthermore, linear regression was used to explore the effect of the independent variables on the dependent parameter. In this investigation, regression is necessary to investigate the relationship between independent factors and the dependent parameter. Furthermore, standard deviation was assigned to the questionnaires to assess the trainees' perceptions on a variety of topics. The findings of each statistical test were as follows:

Table 5 demonstrates the validity test result of each statement instrument contains 18 statements derived from five parameters: including training resources (MP), training conditions (SP), training establishments (F), training program and timetable (JP), presentation manner (CP), and training effectiveness (PP). The total value of the r table is less than the r count, with the r table value of 0.5368 at a significance level of 0.01, implying that the entire questionnaire statement passes the validity test.

TABLE V. Validity Test Results

Parameter	Indicator	Pearson Correlation	Significance	Result
(MP)	MP1	.829	< .001	valid
	MP2	.939	< .001	valid
	MP3	.789	< .001	valid
	MP4	.829	< .001	valid
(SP)	SP1	.614	.004	valid
	SP2	.939	< .001	valid
	SP3	.939	< .001	valid
	SP4	.939	< .001	valid
Facilities (F)	F1	.939	< .001	valid
	F2	.843	< .001	valid
(JP)	JP1	.939	< .001	valid
	JP2	.805	< .001	valid
	JP3	.939	< .001	valid
(CP)	CP1	.697	< .001	valid
	CP2	.939	< .001	valid
	CP3	.930	< .001	valid
	CP4	.939	< .001	Valid
(PP)	PP1	.886	< .001	Valid
	PP2	.823	< .001	Valid
	PP3	.886	< .001	Valid
	PP4	.886	< .001	Valid
	PP5	.809	< .001	Valid
	PP6	.809	< .001	Valid

Table 6 indicates based on the reliability test, all the statement instrument items provided on the study parameters, including training resources (MP), training conditions (SP), training establishments (F), training program and timetable (JP), presentation manner (CP), and training effectiveness (PP), are considered reliable considering all of them have Cronbach alpha results > 0.70.

TABLE VI. Reliability Test Result

Parameter	Cronbach Alpha	Standard Cronbach Alpha	Result
MP	.898	.700	reliable
SP	.903	.700	reliable
F	.833	.700	reliable
JP	.959	.700	reliable
CP	.911	.700	reliable
PP	.977	.700	reliable

The lopsidedness and kurtosis of the parameters in the current research must be explored. The Shapiro-Wilk test for normalcy is best appropriate for small sample sizes, such as the one used in this research at 20 sample. While performing hypothesis testing, it is crucial to assess the data's normalcy because irregular distribution has a significant impact on the overall outcome. For the data to be declared normal, the Shapiro-Wilk test must have a statistical value greater than 0.05. A significance value less than 0.05 indicates that the data deviates significantly from a normal distribution. The Shapiro-Wilk test findings (Table 7) show that all samples scored greater than 0.05 and had values as follows: .622, .619, .569, .491, .622, .614, showing that all samples are within normal distribution.

TABLE VII. Shapiro-Wilk Tests

Parameter	Statistic	df	Significance
MP	.622	20	<.001
SP	.619	20	<.001
F	.569	20	<.001
JP	.491	20	<.001
CP	.622	20	<.001
PP	.614	20	<.001

Table 8 displays in what manner participants responded regarding each parameter. Each assertion was assessed by calculating the mean and standard deviation. The discoveries show that participants were pleased with the training resources from the training programs, agreed on the SP, approved on the F, agreed on the JP, had a favorable impression of the speakers' presentation manner when operating training programs, and the trainees' understanding as the training effectiveness parameter are consistent with the questionnaire responses.

TABLE VIII. Perceptions of Respondents on Each Statement of Questionnaire

Question	M	SD
MP1	3.75	.44426
MP2	3.85	.36635
MP3	3.80	.41039
MP4	3.75	.44426
SP1	3.60	.50262
SP2	3.85	.36635
SP3	3.85	.36635
SP4	3.85	.36635
F1	3.85	.36635
F2	3.75	.44426
JP1	3.85	.36635
JP2	3.80	.41039
JP3	3.85	.36635
CP1	3.65	.48936
CP2	3.85	.36635
CP3	3.80	.41039
CP4	3.85	.36635
PP1	3.75	.44426
PP2	3.70	.47016

Question	M	SD
PP3	3.75	.44426
PP4	3.75	.44426
PP5	3.70	.47016
PP6	3.70	.47016

The significance of the linear relationship between independent and dependent parameters was assessed using a correlation test. Table 7 reveals that all independent characteristics (MP, SP, F, JP, and CP) have a positive relationship with training effectiveness (PP). Table 9 shows that there are statistically significant relationships between the independent parameters (MP, SP, F, JP, and CP) and the dependent parameter TF.

- Parameter MP and PP have a significant positive linear correlation ($r = .789, p = <.001 <.01$).
- Parameter SP and PP display a significant positive linear correlation ($r = .753, p = <.001 <.01$).
- Parameter F and PP show a significant positive linear correlation ($r = .800, p = <.001 <.01$).
- Parameter JP and PP exhibit a significant positive linear correlation ($r = .708, p = <.001 <.01$).
- Parameter CP and PP demonstrate a significant positive linear correlation ($r = .789, p = <.001 <.01$).

TABLE IX. Correlation of Training Effectiveness with Each Independent Parameter

		MP	SP	F	JP	CP
PP	R	.789	.753	.800	.708	.789
	Significance	<.001	<.001	<.001	<.001	<.001

The next section will be explored about in what way each of the independent parameters (MP, SP, F, JP, and CP) contributes to the outcome of the dependent parameter, PP. Additionally, it simplifies how each parameter affects PP. To achieve this, the coefficient of determination must be calculated and tested for significance, as well as the regression line and its slope. R2 represents the change in the dependent parameter Y by explaining it as a fraction of the independent parameter X. Table 10 displays the coefficient of determination (R2) obtained from linear regression of independent and dependent factors. A large fraction of the training characteristics can be used to characterize training effectiveness: MP (28.6%), SP (44.5%), F (20.9%), JP (33.7%), and CP (48.4%). Finally, the regression line will assess whether there is sufficient evidence that each of the independent parameters' MP, SP, F, JP, and CP influence the dependent parameter training efficacy. Table 7 shows that each independent parameter has a positive influence on training effectiveness (all coefficients are positive), and that this result is significant because each p value is less than 0.05, indicating that changing the number of predictor values resulted in a difference in the dependent parameter value obtained. The regression line equation is defined as follows:

$$PP = 0.936 + 0.172MP,$$

$$PP = 0.916 + 0.189SP,$$

$$PP = 0.920 + 0.163F,$$

$$PP = 0.837 + 0.197JP,$$

$$PP = 0.936 + 0.172CP.$$

The study found a substantial positive correlation between

the metrics evaluated (MP, SP, F, JP, and CP) and the training system's efficiency.

TABLE X. Coefficient of Determination Between Each Parameter and Training Effectiveness.

		MP	SP	F	JP	CP
PP	R2	.622	.566	.640	.502	.622
	significance	<.001	<.001	<.001	<.001	<.001

TABLE XI. Coefficients of Each Parameter in a Regression Line.

		MP	SP	F	JP	CP
PP	Constant	.936	.916	.920	.837	.936
	Coefficient	.172	.189	.163	.197	.172
	Coefficient significance	<.001	<.001	<.001	<.001	<.001

IV. DISCUSSION

Training is an important activity to increase the level of expertise among teachers. The success of this training depends on many parameters. In this study, the aim is to analyze the practical parameters of the effectiveness of the preparation of solid test materials in the design that controls the waste treatment process from the perspective of the participants.

Firstly, we conducted validity, reliability, and normality tests. The results of validity test and reliability test showed that whole questionnaire statement instrument meets the validity test because value of r table (0.5368) is smaller than r count, and all statements are reliable because all have Cronbach alpha > 0.70. The result of the normality test showed that all samples are considered normal distribution. Based on the result of the Shapiro-Wilk test, all sample have score > 0.05. Next, we examined the relationship between the parameter of training program (independent variable) and training effectiveness (dependent variable) or identify the hypotheses was accepted or not.

According to the result of analysis, there is a linier positive association between MP and PP $r = .789, p = <.001 <.01, R2 = .622$). This indicates that good training material has positive affect to the training effectiveness. One of the reasons is that the training material was relevant to participants' needs, then it was easy to apply in their institution. In vocational high school, the competency about drafting of competency test materials is needed because they need to develop their professional certification institution. The other reason is that the trainer used practical activities during the training process. So, it can increase the transferability of the training material. The finding was in line with the result of Kraai and Mashau (2020), which highlight that relevant training material and practical activities have positive affect to training outcome.

There is a linier positive association between SP and PP ($r = .753, p = <.001 <.01, R2 = .566$). It indicates that the accessible, adequate, comfy, and noise-free training area has positive affect to the training effectiveness based on participants' point of view. It was in line with Punia and Kant (2013), Venkatesh and Speier (2000), and Mohanty et al. (2019) that training environment is one of factors for making training successful. There is a linier positive association between F and PP ($r = .800, p = <.001 <.01, R2 = .640$). In this training, sufficient presentation tools and attractive presentation media were provided, and module was given before the training was carried out. This finding suggests that providing sufficient

equipment and necessary resources can enhance training transfer (Nada and Putranto, 2024). The schedule is clear and detailed, sufficient time is allocated, as well as the objective and goals are well-defined

There is a linier positive association between JP and PP ($r = .708$, $p = <.001 < .01$, $R^2 = .502$). It indicates that the training schedule affected training outcome. It was aligned with the results of Budiastuti et al. (2023), emphasizing that well prepared schedule and goals resulted in a positive impact of training program. There is a linier positive association between CP and PP ($r = .789$, $p = <.001 < .01$, $R^2 = .622$). It indicates that the presentation style of the trainer affects the training transfer. It was aligned with research conducted in 2016 by Alshuwairekh, which found a positive association between trainee's performance and the trainer factor. Lin and Shariff (2016) emphasized that the training effectiveness is contingent upon the quality of the trainer. In this program, trainers have competency in this field of training. The trainers are competency test assessors and lecturers of the wastewater treatment course.

V. CONCLUSION

Based on the analysis, it can conclude that all training factors affect the training effectiveness. Furthermore, it was discovered that the five independent variables (MP, SP, F, JP, and CP) and the dependent variable, training effectiveness, have positive linear association.

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