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Parameters Affecting Training Effectiveness: A Study of Wastewater Treatment Training in Politeknik Negeri Bandung

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Abstract
Training is one of many activities to improve the competencies of employees. Politeknik Negeri Bandung conducted wastewater treatment training for teachers from one of the vocational high schools in Bandung, Indonesia. To analyze the parameters influencing the training effectiveness of its training, this study employed quantitative research. Data regarding the demographics of respondents and respondents' perceptions about various parameters influencing the training effectiveness were gathered by a survey questionnaire. In addition, the paper-based final test was used to identify the understanding of trainees about the content provided, and further, the data was used for analyzing training effectiveness. The data were then analyzed by using the statistical package for social sciences software. The findings suggested that the respondents have positive perceptions of training materials, training atmosphere, training facilities, training plan and schedule, and presentation mode. The average value of the Likert scale ranges from 3.33 to 3.89 of 4. It reflected that wastewater treatment training satisfied the trainee's expectations from their point of view. Additionally, a positive linear correlation between the dependent parameter (training effectiveness) and five independent parameters could be inferred. The results of the study are valuable in encouraging organizations that hold training to take these parameters into account when carrying out similar training.

Keywords: Training Effectiveness, Training Materials, Training Atmosphere, Training Facilities, Training and Plan Schedule, Presentation Mode

1. Introduction

The Indonesian National Qualification Framework (IQF) Level 4 Equalization Program at Professional Certification Body at Politeknik Negeri Bandung for vocational high school instructors who have had more than 5 (five) years work experience was implemented in 2019. The educational qualifications of the instructors with high school diplomas were increased to the equivalent of level 4 of Indonesian National Qualification Framework. This program was followed in 2020 by detailed understanding activities pertaining to heat exchanger operation

and extraction, as well as spectrophotometric and UV/Visible analysis competence. Assessors who carried out the IQF level 4 equivalent competency test feel obligated to truly transfer the theoretical and practical knowledge that these vocational high school Instructors must possess so that those holding IQF Level 4 truly have competencies in accordance with the intended competencies (Budiastuti, et al., 2021).

This program was then continued in 2021. The principal of this vocational High School in Bandung, Indonesia proposed that the transfer of understanding of competence and improvement of insight be also given to teachers by adjusting the competence of teachers who are also assessors when carrying out competency tests for their students. The competence in question is the competence to operate wastewater treatment and matters related to the dangers of its operation. Due to pandemic conditions that were still worrying, this competency improvement activity was carried out online, both for theoretical understanding and practical understanding (Budiastuti, et al., 2022). For this reason, in 2022, these trainees hope that competency improvement can be carried out offline so that practical competencies (hard skills) can be obtained optimally. The teacher's wishes were welcomed by the principal who strongly supports the implementation of competency improvement activities for teachers, especially wastewater treatment competencies which have not been taught optimally at this school. So far, wastewater treatment material has only been inserted into related subjects and is not a separate subject that supports the competencies needed by students at vocational high school.

The effectiveness of training typically assesses by administering an exam to participants without taking into account training factors for instance training contents, training environment, facilities and materials, training schedule, and presentation style. It is critical to emphasis on the needs of participants when evaluating any training programs to ensure training effectiveness (Hajjar and Alkhanaizi, 2018). Based on this statement, the purpose of this study was to investigate the influence of the several factors to training effectiveness on a training program about wastewater treatment for vocational high school teachers based on the perspectives of participants and final examination results.

2. Method

This study employed quantitative research which produces numerical data by using a statistical method with aims to investigate the causal relationships and determine the strength and significance of the relationships (Apuke, 2017). There were independent parameters including training materials (TM), training atmosphere (TA), training facilities (FA), training plan and schedule (TPS), and presentation mode (PM) that was partially analyzed the relationship to training effectiveness (TF) as a dependent parameter.

2.1 Respondents of the Study

Participants in the wastewater treatment training that was held at Politeknik Negeri Bandung from July to August 2022, became the object of this study. The trainees work as teachers at one of the vocational high schools in Bandung, Indonesia. The number of trainees was 18 trainees and all of them filled out questionnaires. This indicates that the sample used was suitably representative.

2.2 Instrument of the Study

The instruments used were a questionnaire and a paper-based final test. The questionnaire was developed by referring to the study of Hajjar and Alkhanaizi (2018) with minor modifications. The first part of the questionnaire was to get information about the demographics of respondents (4 indicators). In addition, the second part of the questionnaire was to ask respondents about their perceptions of several training program parameters including TM (4 indicators), TA (4 indicators), FA (3 indicators), TPS (3 indicators), and PM (4 indicators). The degree of agreement among the respondents to the questionnaire's questions was measured using Likert-type scales. The questionnaire's scale ranged from 1 for strongly disagreeing to 4 for strongly agreeing. Furthermore, a paper-based final test was developed by each trainer for six modules to identify the understanding of trainees. The modules consist of coagulation and flocculation, sedimentation, filtration, reverse osmosis, aerobic waste treatment, and

anaerobic waste treatment. The final test score was used as primary data for training effectiveness (TF). The scale of the final test score was based on 1 = 50-60, 2 = 60-70, 3 = 70-80, and 4 = 80-100.

2.3 Data Analysis Techniques

The statistical package for social sciences (SPSS) software was used to analyze the data. The following are the steps in data analysis.
1. Instrument Test
    a. Validity Test
    The validity test aims to find out whether the questions in the questionnaire can describe what will be studied. The validity test was conducted by comparing the value of the r table against the value of the r count. If the value of the r table is smaller than the r count, it can be inferred that the questionnaire statement meets the validity test. In this study, a validity test was carried out using the Pearson correlation.
    b. Reliability Test
    The reliability test aims to measure the reliability of the questionnaire, which is indicated by the consistency of respondents' answers to questions in the questionnaire. The formula applied to test this instrument is the formula of Cronbach's alpha. If the value of Cronbach's alpha > 0.70, it is stated as reliable.
    The questions in the questionnaire were expressed by the following codes:
    TM 1: Training content is delivered in a good sequence
    TM 2: Training content is well organized
    TM 3: The trainer provides comprehensive training content in the form of theory and practice
    TM 4: The topics covered are relevant to the trainee's needs

    TA 1: The training place is conveniently located
    TA 2: There is adequate space for all trainees
    TA 3: Training space free of noise
    TA 4: There are comfortable seats for all trainees

    FA 1: The laboratory is equipped with adequate equipment
    FA 2: Practicum materials are available as needed
    FA 3: The practicum instructions have clearly presented the work procedure

    TPS 1: The schedule of the training program is clear and thorough
    TPS 2: The allocated time is adequate
    TPS 3: The training program's goals and objectives are clear

    PM 1: Trainers use audiovisual aids
    PM 2: Trainers communicate dynamically, fluently, and vigorously
    PM 3: Trainers engage the trainees during the training program
    PM 4: Trainers create a conducive and interesting training atmosphere

2. Analysis Prerequisites Test
    Analysis prerequisites test was carried out by using the normality test. The normality test aims to ensure whether the residual value is distributed or not. For small sample sizes, it is better suited to utilize the Shapiro–Wilk test for the normality test. For the data to be considered normal, the significant result of the Shapiro-Wilk test must be greater than 0.05.

3. Hypothesis Test
    The strength of a relationship between two parameters-the independent parameter and the dependent parameter-was determined using correlation analysis. In addition, the influence of independent parameters on a dependent parameter was also determined using regression analysis. The research hypothesis is as follows.
    H1: what is TM that has a positive correlation with TF?
    H2: what is TA has a positive correlation with TF?

H3: what is FA has a positive correlation with TF?
H4: what is TPS has a positive correlation with TF?
H5: what is PM has a positive correlation with TF?

3. Results

3.1 Demographic of Respondents

The demographics of the respondents are of interest to the researchers in this section. Demographics are quantifiable statistics about a specific population. Demographic mapping is essentially a practice of generalizing population characteristics. This research work includes demographic characteristics such as age, gender, educational level, and work experience.

3.1.1 Age of Respondents

Out of the total sample of 18 teachers, the majority (66.7%) were found to be between the ages of 26 and 45, indicating that they have the potential to work for a longer period of time and can focus on training and development. According to Table 1, there was no sample that was between the ages of 18 and 25 years old, and 33.3% were over the age of 45.

Table 1: Age of Respondents

Age	Response	Percentage
Between 18-25	0	0.0
Between 26-45	12	66.7
Above 45 years	6	33.3
Total	**18**	**100.0**

3.1.2 Gender

According to the Table 2, female respondents exceeded that of male respondents, 13 to 18 teachers of various designations. Table 2 indicates that 72.2% were females and 27.8% were males.

Table 2: Gender

Gender	Response	Percentage
Male	5	27.8
Female	13	72.2
Total	**18**	**100.0**

3.1.3 Educational Level of Respondents

Table 3 shows the educational level of the respondents. It means that 22.2% of the participants hold postgraduate degrees, while 77.8% hold undergraduate degrees. These findings suggest that this region has a good number of well-qualified and skilled teachers, which can have a greater impact on students' academic performance.

Table 3: Educational Level

Educational Level	Response	Percentage
Bachelor	14	77.8
Postgraduate	4	22.2
Total	**18**	**100.0**

3.1.4 Work Experience

Teacher tenure indicated that 88.9% have more than 5 years of teaching experience, 11.1% have 3-5 years of teaching experience, and none have little experience or less than 3 years of experience. This finding indicates that teachers have sufficient experience and understand how to improve their productivity following training and development.

Table 4: Work Experience

Educational Level	Response	Percentage
Less than 3 years	0	0.0
3-5 years	2	11.1
More than 5 years	16	88.9
Total	**18**	**100.0**

3.2 Data Analysis

The validity test is implemented at the beginning to find out whether the questions on the questionnaire can describe what will be studied. Reliability test is used to determine whether the respondent can answer the questions in the questionnaire consistently. Weighted mean, Pearson's r, and regression were the statistical instrument that applied in this study. The weighted mean was applied in this study to calculate the central tendency on every aspect of the questionnaire. Similarly, correlation test was applied to determine the connection involving the independent parameters (TM, TA, FA, TPS, and PM) and the dependent parameter (TF). Furthermore, linear regression was implemented to investigate the influence of the independent parameters on the dependent parameter. In this study, regression is required to inspect the connection of independent parameters to the dependent parameter. In addition, standard deviation was assigned to the questionnaires to measure the trainee' perceptions of various aspects. The results of each statistical test performed are as follows:

3.2.1 Validity Test

Table 5 shows that each statement instrument has a total of 18 statements originating from 5 parameters, namely training materials (TM), training atmosphere (TA), training facilities (FA), training plan and schedule (TPS), and presentation mode (PM). The overall value of the r table is smaller than the r count, where the r table value is 0.468 at a significance value of 0.05 so that it can be presumed that the whole questionnaire statement instrument meets the validity test.

Table 5: Validity Test Results

Parameter	Indicator	R_{count}	R_{table}	Result
Training Materials (TM)	TM1	.723	.468	valid
	TM2	.759	.468	valid
	TM3	.867	.468	valid
	TM4	.765	.468	valid
Training Atmosphere (TA)	TA1	.630	.468	valid
	TA2	.650	.468	valid
	TA3	.785	.468	valid
	TA4	.692	.468	valid
Training Facilities (FA)	FA1	.545	.468	valid
	FA2	.785	.468	valid
	FA3	.759	.468	valid

Training Plan Schedule (TPS)	TPS1	.759	.468	valid
	TPS2	.742	.468	valid
	TPS3	.777	.468	valid
Presentation Mode (PM)	PM1	.742	.468	valid
	PM2	.867	.468	valid
	PM3	.867	.468	valid
	PM4	.855	.468	valid

3.2.2 Reliability Test

Table 6 shows that all the statement instrument items submitted on the research parameters, namely training materials (TM), training atmosphere (TA), training facilities (FA), training plan and schedule (TPS), and presentation mode (PM) are called reliable because all have Cronbach alpha results > 0.70

Table 6: Reliability Test Result

Parameter	Cronbach Alpha	Standard Cronbach Alpha	Result
TM	.876	.700	reliable
TA	.727	.700	reliable
FA	.840	.700	reliable
TPS	.857	.700	reliable
PM	.886	.700	reliable

3.2.3 Normality Test

The lopsidedness and kurtosis of the parameters in this study need to be investigated, Shapiro-Wilk test for normality test is the most appropriate for small sample size, this study sample size is only 18. When conducting hypothesis testing, it is critical to test the normality of the data for the reason that abnormal distribution of data has a large impact on the overall result. For the data to be considered normal, the statistic value of the Shapiro-Wilk test must be larger than 0.05. In case the significance value is less than 0.05, it is indicated that the data differs extensively from a normal distribution. The Shapiro-Wilk test results (Table 7), with all samples scoring larger than 0.05 and values as follow .638,.609,.845,.595,.676, and.697, indicating that all samples are deemed within normal distribution.

Table 7: Shapiro–Wilk Tests

	Statistic	df	Significance
TM	.638	18	.000
TA	.609	18	.000
FA	.845	18	.007
TPS	.595	18	.000
PM	.676	18	.000
TM	.697	18	.000

3.2.4 Perception of Respondents on Each Parameter

Table 8 shows how respondents felt about each parameter. Each statement was evaluated by computing their mean and standard deviation. The details were represented in Table 6. The findings indicate that the participants are satisfied with the training materials from the training programs, agreed on the TA, approved on the FA, agreed on

the TPS, had a positive perception of the speakers' presentation mode when operating training programs, and the trainees test results as the training effectiveness parameter is comply with the questionnaire response.

Table 8: Perceptions of Respondents on Each Statement of Questionnaire

Question	M	SD
TM1	3.78	.428
TM2	3.78	.428
TM3	3.78	.428
TM4	3.83	.383
TA1	3.33	.594
TA2	3.61	.502
TA3	3.83	.383
TA4	3.89	.323
FA1	3.83	.383
FA2	3.83	.383
FA3	3.78	.428
TPS1	3.78	.428
TPS2	3.61	.502
TPS3	3.78	.428
PM1	3.56	.616
PM2	3.78	.428
PM3	3.78	.428
PM4	3.72	.461
TF1	3.22	1.114
TF2	2.78	.732
TF3	3.28	.461
TF4	3.17	.985
TF5	3.72	.461
TF6	3.56	.511

3.2.5 Correlation Test

The significance of the linear relationship involving independent and dependent parameters was determined using a correlation test. Table 7 shows that all independent parameters, TM, TA, FA, TPS, and PM, have a positive connection with training effectiveness. As shown in Table 9, the independent parameters (TM, TA, FA, TPS, and PM) and the dependent parameter TF have statistically significant correlations.

   a. The linear correlation of TM and TF show a fair positive value ($r = .504^*$, $p = .033 < .05$), can be interpreted as significant.
   b. The linear correlation of TA and TF have a good positive value ($r = .811^{**}$, $p = .000 < .01$), can be interpreted as significant.
   c. The linear correlation of FA and TF shows a fair positive value ($r = .490^*$, $p = .039 < .05$), can be interpreted as significant.
   d. The linear correlation of TPS and TF display a good positive value ($r = .636^{**}$, $p = .0005 < .01$), can be interpreted as significant.
   e. The linear correlation of PM and TF indicate a fair positive value ($r = .544^*$, $p = .020 < .05$), can be interpreted as significant.

Table 9: Correlation Between Training Effectiveness with Each Independent Parameter

		TM	TA	FA	TPS	PM
TF	R	.504*	.811**	.490*	.636**	.544*
	Significance	.033	.000	.039	.005	.020

3.2.6 Linear Regression Analysis

This section investigates how substantial each of the independent parameters (TM, TA, FA, TPS, and PM) explains the result of the dependent parameter, TF. Furthermore, it simplifies the impact of each parameter on TF. To accomplish this, the coefficient of determination and test its significance, as well as construct the regression line and review its slope need to be done. R^2 denotes the change of the dependent parameter Y by explained it as the portion of the independent parameter X. The coefficient of determination (R^2) as the result of the linear regression linking independent and dependent parameters is shown in Table 10. The result in training effectiveness can be defined by a significant portion of the result in training parameters: TM (25.4%), TA (65.7%), FA (24.0%), TPS (40.4%), and PM (29.5%). Finally, the regression line will determine whether there is enough indication that each of the independent parameter's TM, TA, FA, TPS, and PM implicate the result of the dependent parameter training effectiveness. Table 7 demonstrates that each independent parameter has a positive influence on training effectiveness (all coefficients are positive), and that this outcome is significant because each p value is less than 0.05, indicating that varied number of the predictor's value are resulted to difference in the dependent parameter value obtained. The regression lines' equation is defined as follows:

TF = 0.780+0.335TM,
TF = 0.218+1.208TA,
TF = 0.321+0.722FA,
TF= 0.224+0.770TPS,
TF = 0.268+0.694PM.

These findings indicate that the above-mentioned models' tests revealed a positive, significant connection of the studied parameters— TM, TA, FA, TPS, and PM —on the effectiveness of the training system.

Table 10: Coefficient of Determination Between Each Parameter and Training Effectiveness.

		TM	TA	FA	TPS	PM
TF	R^2	.254	.657	.240	.404	.295
	significance	.033	.000	.039	.005	0.02

Table 11: Coefficients of Each Parameter in a Regression Line.

		TM	TA	FA	TPS	PM
TF	Constant	.780	.218	.321	.224	.268
	Coefficient	.335	1.208	.722	.770	.694
	Coefficient significance	.033	.000	.039	.005	.020

4. Discussion

This wastewater treatment training had a goal to improve the competencies of teachers from one of the vocational high schools in Bandung, Indonesia. This is in line with the opinion of Karim et al. (2109) that the training program is one of the crucial factors in improving people's performance. To identify the parameters influencing the training effectiveness of its training, a survey was conducted on trainees.

According to the results of the survey, trainees satisfied with the training material (TM), agreed on the training atmosphere (TA), approved of the training facilities (FA), agreed on the training plan and schedule (TPS), as well as had a positive perception of the speakers' presenting mode (PM). The average value of the Likert scale ranges from 3.33 to 3.89 of 4. It reflected that the training program satisfied the trainee's expectations from their point of view. It occurred because this training program was held by considering the needs of trainees that had delivered at the evaluation meeting of the previous year's training program. The trainees suggested to have offline training as a continuation and follow-up of the online training program that was implemented in 2021. These results are supported by the study of Brimstin and Hester (2015) that the evaluation of a training program is to identify how the program can be improved. Besides that, the training effectiveness depends on well design and implementation

of a good training program (Farjad, 2012). This training was held based on the results of the previous year's evaluation and was well prepared by involving lecturers and laboratory staff who are experienced in the field of wastewater treatment.

TM and training effectiveness has a fair positive linear correlation (r = .504*, p = .033 < .05). This implies that there is a positive influence of TM on training effectiveness. It occurred because the training content was easily understood by trainees and further can improve their performance. In this training program, trainers delivered training content in a good sequence and provided comprehensive training content in the form of theory and practice. In addition, the topics about wastewater treatment are very important for the trainees and can improve their knowledge and skills. It is similar to the view of Driskell (2012) as well as Punia and Kant (2013), in which the training content affects the training outcomes.

TA and training effectiveness has a good positive linear correlation (r = .811*, p = .000 < .05). This implies that there is a positive influence of TA on training effectiveness. It occurred because the training program was carried out in the laboratory in which the capacity was sufficient and the atmosphere was comfortable. As pointed out by Hutchins (2009), the training atmosphere has significant character in training transfer. In addition, Venkatesh and Speier (2000) pointed out that a training atmosphere positively helps to enhance workability.

FA and training effectiveness (r = .490*, p = .039 < .05) as well as TPS and training effectiveness (r = .636**, p = .0005< .01) have a fair positive linear correlation. These imply that there is positive influence of FA on training effectiveness as well as TPS on training effectiveness. The results correspond to the statement Shakila (2014), which reviews that the training will be effective if all of these conditions such as the training plan and training facilities are satisfied provided. In this program, a pre-training meeting was conducted before the implementation of the main training to explain the plans and schedules according to the time of the trainees and to convey practical instructions before the laboratory activities are carried out.

PM and training effectiveness has a fair positive linear correlation (r = .544*, p = .020 < .05). This implies there is a positive influence of PM on training effectiveness. This result is in line with the study of Alshuwairekh (2016) that the parameter of the trainer is positively correlated to the employee's performance. According to Lin and Shariff (2016), the quality of the trainer will have an impact on how effective the training program is. In this training program, all trainers have competence in the field of wastewater treatment and have experience as a lecturer of wastewater treatment practicum, so the training was conducive and interesting. Based on Mohanty et al. (2019), the success of a training program can be achieved because the trainer can explain the program objectives, training materials, and benefits; encourage the trainees to be involved during the training program; enlighten the ideas and clarify misunderstandings; do the excellent presentation; answer the question clearly; and use audio-visual aids.

The coefficient of determination for the linear regression between TM and training effectiveness is 0.254, TA and training effectiveness is 0.657, FA and training effectiveness is 0.240, TPS and training effectiveness is 0.404, and PM and training effectiveness is 0.295. These findings show that the independent parameter TM explained 25.4% of the variation in the training effectiveness, the independent parameter TA explained 65.7% of the variation in the training effectiveness, the independent parameter FA explained 24.0% of the variation in the training effectiveness, the independent parameter TPS explained 40.4% of the variation in the training effectiveness, and the independent parameter PM accounted for 29.5% of the variation in the training effectiveness.

5. Conclusion

The findings imply the respondents or trainees have positive perceptions of TM, TA, FA, TPS, and PM. It can be concluded that the training program held by Politeknik Negeri Bandung for teachers from one of the vocational high schools in Bandung met their expectations. Additionally, it found that there is positive linear relationship between the training effectiveness as a dependent parameter and the five independent parameters (TM, TA, FA, TPS, and PM). The results of the study are valuable in encouraging organizations that hold training to take these parameters into account when carrying out similar training.

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