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Original Article

Evaluation of Comparison Performance of Construction Safety Competency Training Methods for Construction Workers

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Abstract *- Based on the issuance of Circular Letter of the Director General of Construction Development No.107/SE/Dk/2020 on Guidelines for Guiding Construction Worker Competencies for the New Normal Period and Circular Letter of the Minister of Public Works and Public Housing No. 02/IN/M/2020 on Protocols for Preventing the Spread of Corona Virus Disease 19 (Covid-19). This research is related to empowering construction service technical guidance on the construction safety management system. Through the Instruction of the Minister of Home Affairs Number 52 of 2022, the method may change to conventional methods or offline (face-to-face) construction service empowerment activities. Therefore, to find the correct method and what factors can influence the improvement of participants' competence in the Construction Safety Management System Technical Guide. The results of this study will be a recommendation for the Makassar Region VI Construction Service Center to implement the Construction Safety Management System Technical Guidance activities. In this study, the data analysis method is quantitative descriptive data analysis. Based on the analysis results with multiple linear regression equations using SPSS Version 25 software, the regression analysis between the independent and dependent variables is not significantly correlated. In the offline method, the R2 value is 41%. For the online method, the R2 value was 26%, and for the hybrid method, the R2 value was 27%. In other words, the offline method is the most effective and efficient in implementing the Makassar Region VI Construction Service Center's Construction Safety Management System Technical Guidance activities.*

Keywords *- Competency training, Construction safety management system, Hybrid, Multiple linear regression, Offline, Online.*

1. Introduction

The construction industry contributes significantly to a country's economy [1]. It is encouraged because the construction industry absorbs a large workforce and encourages other industries [2,3]. Unfortunately, the construction industry is still facing challenges, one of which is the safety aspect. Increased work accidents in the construction industry have also increased injury rates and economic losses [4]. The construction industry has a high risk of work-related injuries and is considered one of the most unsafe industries worldwide [5,6]. One of the main factors causing the low level of work safety in the construction industry is the need for more safety training [5,7].

Several previous studies have proven that safety training improves worker safety competence. Safety training and competence significantly influence employee participation and engagement [8]. In addition, other findings show that both training methods can instil safety knowledge and awareness in workers. However, a more engaging training method will be more effective in delivering training outcomes [9].

Makassar Region VI Construction Services Centre is part of the Directorate General of Construction Development, which is responsible to the Ministry of Public Works and Public Housing in Indonesia as the person in charge of implementing training within the Ministry of Public Works and Public Housing. The Directorate General of Construction Development has two programs to achieve its strategic targets: the Vocational Education and Training Programme and the Management Support Programme. In the Vocational Education and Training Programme, the strategic target is increasing competent and professional vocational human resources in the construction sector, while the second strategic target in the management support program is increasing management support and other technical tasks [10].

Rules related to certification obligations for Indonesian construction workers have referred to Law No. 2 of 2017 concerning Construction Services, which states that every construction worker must follow work skills or work expertise certification [11]. The data shows that the distribution of

construction workers holding skilled labor certificates in 2021 has been unevenly distributed according to the proportion of their needs. Sumatera Island is 382,616 (49.59%), Java Island is 187,890 (24.35), Kalimantan Island is 44,605 (5.78%), Sulawesi Island is 99,145 (12.85%), and Maluku and Papua Island are 29,433 (3.81%) [12].

The issuance of Circular Letter of the Director General of Construction Development No. 107/SE/Dk/2020 concerning Guidelines for Guiding the Competence of Construction Workers in the New Normal Period and Public Work and Housing Ministerial Instruction No. 02/IN/M/2020 concerning Protocols for Preventing the Spread of Corona Virus Disease 19 is part of the overall policy to realize construction safety at every stage of construction carried out both by the government, local governments, SOEs, and private or joint investments.

One of the fundamental reasons for this research is based on the issuance of the Circular Letter of the Director General of Construction Development No.107/SE/Dk/2020 concerning Guidelines for Guiding the Competence of Construction Workers for the New Normal Period and Public Work and Housing Ministerial Instruction No. 02/IN/M/2020 concerning Protocols for Preventing the Spread of Corona Virus Disease 19 (Covid-19). The Makassar Region VI Construction Services Centre requires training methods to switch from offline methods partly to hybrid methods (combined offline and online) and entirely online.

This research relates to the empowerment of construction service's technical guidance on construction safety management systems. The abovementioned regulations require changes in the methods applied during the pandemic. Apart from revoking the status of the Enforcement of Restrictions on Community Activities through the Instruction of the Minister of Home Affairs Number 52 of 2022, the method may change to conventional methods or offline (face-to-face) construction service empowerment activities. Changes in this method certainly require a comprehensive study of the effectiveness of each method. It is essential for practical training activities by the Makassar Region VI Construction Services Centre. The results of this study will be a recommendation for implementing the Construction Safety Management System Technical Guidance activities.

2. Literature Review

Based on Law No. 13 of 2003 Chapter I Article 1 Paragraph 2, t is expressed that labor is each individual who can do work to create merchandise and or administrations to meet their claim needs and those of the community. By definition, labor is the population that's of working age. A country's public can be divided into labor and non-labor. The population is classified as labor on the off chance that the populace has entered working age. The working age limit in Indonesia is 15 to 64 a long time ancient [13]. The government, through Article 70, Law no two, the Year 2017, discusses the competency requirements of labor in the construction sector, which is marked by certification of work competence. It is affirmed that every construction worker in the construction sector must have a Work Competency Certification. Certificates of expertise and skills are proof of competence possessed by the workforce, so expertise and skills need not be doubted in their competence in carrying out responsibilities [14].

Training is one of the efforts to improve the quality of employees [15]. Significant changes in learning have occurred, where learning packaged face-to-face in the classroom has turned into Distance Learning. Almost all online media are utilized and empowered to succeed in the implementation of distance learning, better known as online learning (learning in the network) [16]. Distance learning is a learning method that continues to be developed by teachers and educators. Various ideas are implemented to ensure that learning activities continue despite no face-to-face session. Technologies like the Internet, smartphones, and netbooks are now widely used to support distance learning [17].

Training is an activity carried out with the aim that individuals can achieve specific abilities to realize the goals of an organization [18]. Trainers play an essential role in training programs' smooth running and success. That is why it is necessary to choose expert, qualified, and professional trainers.

3. Materials and Methods

In this study, the data analysis method used is quantitative descriptive. The data obtained will provide helpful information in this study, so it will be processed and analysed first so that it can be the basis for decision-making. Primary data from the Makassar Region VI Construction Services Centre is the percentage rate of passing participants, which will be compared using offline, online, and hybrid methods.

Furthermore, the questionnaire was distributed to respondents who were participants in the Construction Safety Management System technical guidance. The questionnaire will measure participant satisfaction with the participant's post-test assessment. The independent variable is participant satisfaction in the form of Material Mastery (X1), Delivery of Explanation (X2), Infrastructure (X3), Organizing Organization (X4), Service (X5), Facilities (X6), Recommendations (X7) and the dependent variable is Post Test Score (Y). Answers from respondents are in the form of a Likert scale with a rating scale of 3 = good, 2 = sufficient, and 1 = insufficient.

The data collection results will be continued with a data processing validity test and reliability test to measure whether a questionnaire is valid. The validity test is carried out to determine whether the instruments or variables in the research

questionnaire are correct. The reliability test is carried out to decide how distant the estimation is to staying steady when measuring two or more times against the same side effects utilizing the same measuring device.

After it is known that the data is valid and reliable, the multiple linear regression testing stages continue by conducting the T-test and F-test and measuring the coefficient of determination. The tool that will be used is SPSS software version 25. The implementation of the Construction Safety Management System Technical Guidance in 2019 to 2022 was obtained from the Makassar Region VI Construction Services Centre. The recapitulation of the implementation data is divided into each year in which there are three methods of implementing activities, namely offline, online, and hybrid methods. Furthermore, data processing will be carried out using quantitative analysis of profile formation. The resulting statistical data describes the data that has been processed. Below is a recapitulation of data on implementing technical guidance on construction safety management systems.

4. Results and Discussion

4.1. Participant Pass Rate

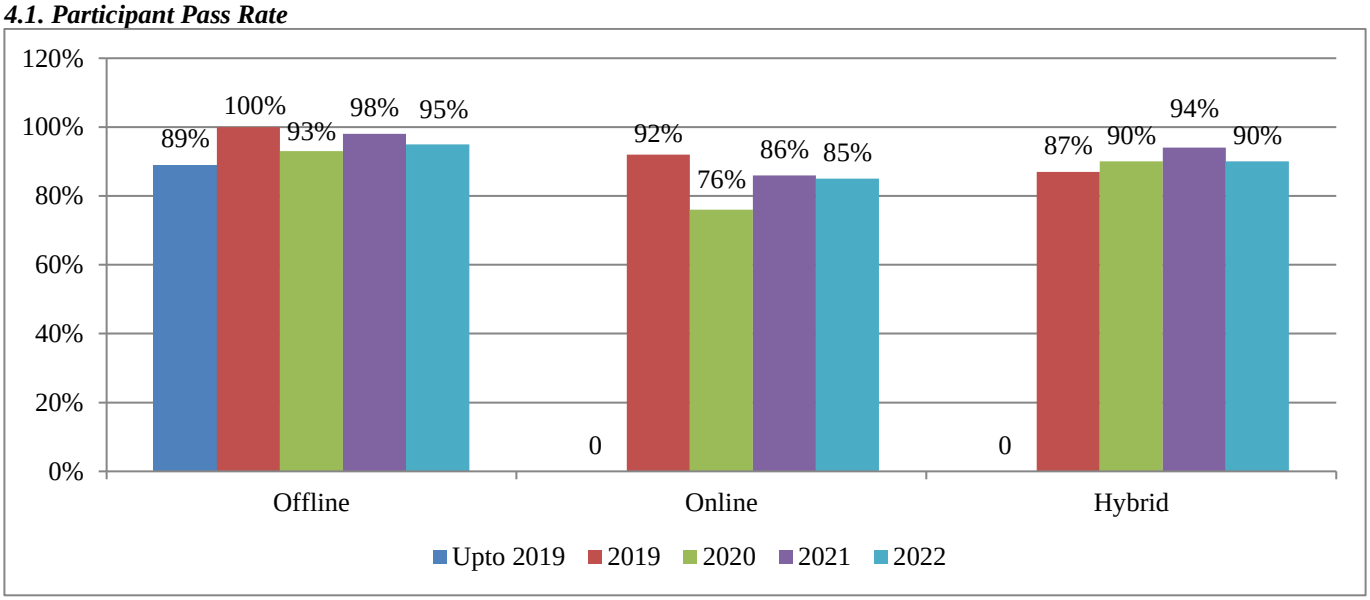

Fig. 1 Percentage of pass rate

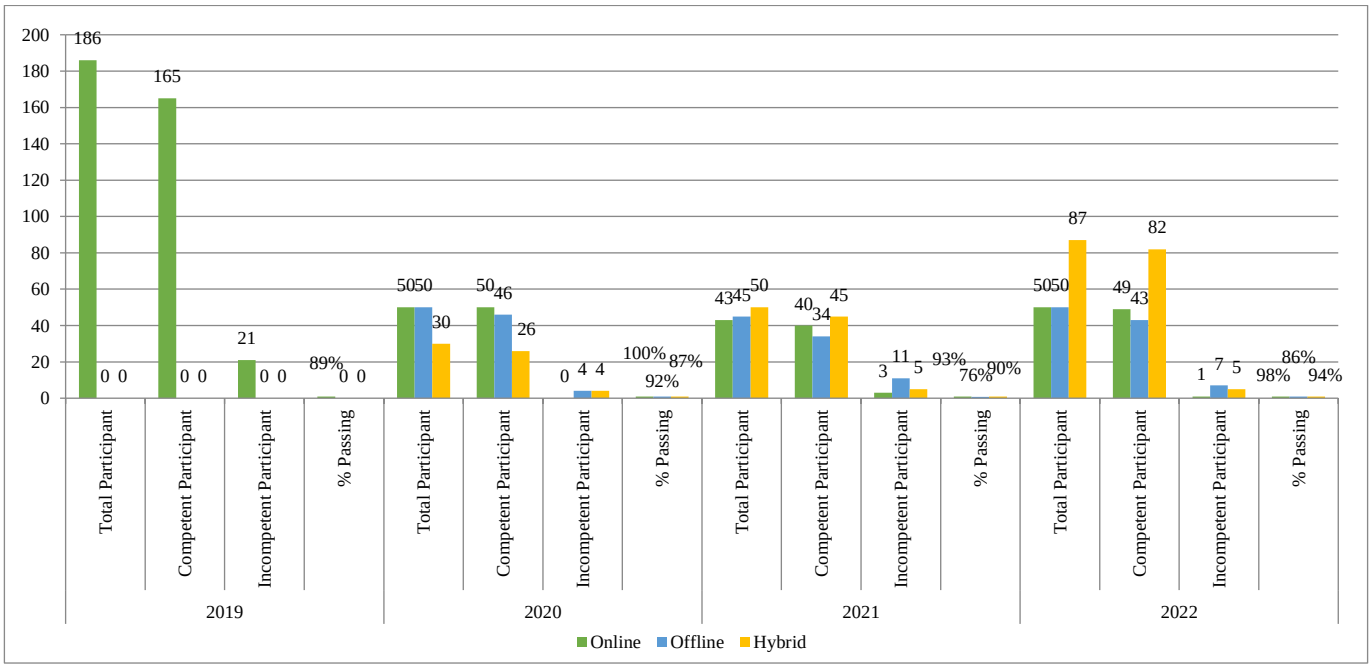

Fig. 2 Recapitulation of the implementation of technical guidance for construction safety management system 2019-2022

In 2019, there were 186 participants. Those declared competent were 165 people, and who were not competent were 21 people. In 2019, all Construction Safety Management System Technical Guidance activities used offline methods, so activities with online and hybrid methods had zero value. In 2020 the number of participants was 130 people. Those declared competent were 122 people (offline method 50 people, online method 46 people, and hybrid method 26 people), and those who were not competent were eight people (offline method zero people, online method four people, and hybrid method four people).

In 2021, there were 138 participants. Those declared competent were 199 people (offline method 40 people, online method 34 people, and hybrid method 45 people), and those who were not competent were 19 people (offline method three people, online method 11 people, and hybrid method five people).

Furthermore, in 2022 the number of participants was 187 people. Those declared competent were 174 people (offline method as many as 49 people, online method as many as 43 people, and hybrid method as many as 82 people). Those who were not competent were 13 people (offline method, as many as one person; online method, as many as seven people; and hybrid method, as many as five people).

The average pass rate of participants is highest by applying the offline method, with a value of 95%. For the average value of the pass percentage using the hybrid method, the value is 90%. Then, the average pass percentage value using the online method is 85%. The highest pass rate was implemented in 2020, and the lowest pass rate has been implemented in 2021.

4.2. Descriptive Statistical Test Results

The factors influencing the Technical Assistance Training of Construction Safety Management Systems are obtained from several journals in the table 1 below. Based on the Descriptive Test Results, an overview of data distribution with offline, online, and hybrid methods by researchers is obtained, namely: In the offline method with 200 respondents, the highest Mean value is found in the Material Mastery (X1) and Organizing Organization (X4) variables, which is 2.80, with a minimum value of one, while the maximum value is three and a standard deviation of 0.248. The lowest Mean value is found in variables X5 and X6, which is 2.76 with a minimum value of one, while the maximum value is three, and the standard deviation is 0.451 and 0.483, respectively.

Table 1. Mapping of previous research

No.	Variable Code	Factors	Previous Research
1	X1	Material Mastery	Edison (2022), Adin (2015), Hasibuan (2004)
2	X2	Delivery of Explanation	Adin (2015), Edison (2022), Hasibuan (2004)
3	X3	Infrastructure	Edison (2022)
4	X4	Organizing Organization	Edison (2022)
5	X5	Service	Hasibuan (2004)
6	X6	Facilities	Adin (2015), Edison (2022), Hasibuan (2004), Nita (2021)

Table 2. Validity test of offline, online, and hybrid methods

Method	Variable	Amount of Respondent	r_{count}	r_{table}	Result
Offline	X1	200	0,695	0,1388	Valid
	X2		0,673		Valid
	X3		0,729		Valid
	X4		0,516		Valid
	X5		0,558		Valid
	X6		0,527		Valid
Online	X1	123	0,693	0.1771	Valid
	X2		0,358		Valid
	X3		0,789		Valid
	X4		0,471		Valid
	X5		0,709		Valid
	X6		0,656		Valid
Hybrid	X1	153	0,733	0.1587	Valid
	X2		0,617		Valid
	X3		0,458		Valid
	X4		0,624		Valid
	X5		0,746		Valid
	X6		0,763		Valid

Table 3. Reliability test of offline, online, and hybrid methods

Method	Cronbach's Alpha	N of Items	Result
Offline	0,676	6	Reliable
Online	0,641	6	Reliable
Hybrid	0,718	6	Reliable

In the online method with 123 respondents, the highest Mean value is found in the Material Mastery variable (X1), which is 2.85. The minimum value obtained is one, while the maximum value is three, and the standard deviations are 0.504 and 0.440. The lowest Mean value is in the X2 variable of 2.20 with a minimum value of 1, while the maximum value is three and a standard deviation of 0.732.

In the hybrid method with 153 respondents, the highest Mean value is found in the Material Mastery variable (X1), which is 2.86. The minimum value obtained is one, the maximum value is three, and the standard deviation is 0.445. The lowest Mean value is found in the X2 variable of 2.50 with a minimum value of 1, while the maximum value is three, and the standard deviation is 0.640.

4.3. Validity Test

To determine the validity or suitability of the questionnaire used by researchers in measuring and obtaining research data from respondents. The basis for making decisions on the comparison validity test the value of rcount > rtable can be declared valid.

The table above shows that all indicators of each method have met the validity test requirements of ≥ 0.5, which means that all indicators used in this study are valid.

4.4. Reliability Test

It is done to determine how consistent the measurement results remain when measuring two or more times against the same symptoms using the same measuring instrument. The reliability test is carried out to determine whether the measuring instrument designed in the form of a questionnaire is reliable. According to [19], the questionnaire is said to be reliable if the Cronbach alpha value is > 0.6.

Based on the calculation of the reliability test using SPSS Version 25 software, Cronbach's Alpha value in Table 3 has a value > 0.6, so it can be concluded that each variable in the offline, online, and hybrid methods has good reliability.

4.5. Multiple Linear Regression Equation

According to [20], it is known that in multiple regression, the dependent variable is influenced by two or more independent variables so that the functional relationship between the dependent variable (Y), namely the Post Test Score with the independent variables, namely: Mastery of Material (X1), Delivery of Explanation (X2), Infrastructure (X3), Organizing Organization (X4), Service (X5), and Facilities (X6). For the multiple linear regression equation in the offline method, an equation is obtained as follows:

$$Y = 16.507 + 0.195X_1 + 0.142X_2 + 0.098X_3 + 0.260X_4 + 0.073X_5 + 0.393X_6$$

The constant value is 16,507, which means that if there is no change in the variables of Material Mastery, Delivery of Explanations, Infrastructure, Organization, Services, Facilities, and Recommendations (the value of X1, X2, X3, X4, X5, and X6 is 0), then the Post Test of participants in Bimtek SMKK is 16,507 units. The regression coefficient value of material mastery is 0.195, indicating that the better the Material Mastery given to participants, the higher the Post post-test score of participants. The regression coefficient value of explanation delivery is 0.142, indicating that the better the Explanation Delivery given to participants, the higher the Post-Examination Score of participants. The regression coefficient value of infrastructure is 0.098, indicating that the more infrastructure provided to participants, the higher the participants' Post-Examination Score. The mastery value of the material is 0.260, indicating that the better the organizing is done to the participants, the higher the Post-Examination Score of the participants. The value of material mastery is 0.073, indicating that the better the Services provided to participants, the higher the participants' Post-Exam Score. The regression coefficient value of material mastery is 0.393, indicating that the better the Facilities provided to participants, the higher the Post-Exam Score of participants. The equation obtained is as follows for the multiple linear regression equation in the online method.

$$Y = 17,959 + 0,086X_1 + 0,056X_2 + 0,304X_3 + 0,018X_4 + 0,044X_5 + 0,050X_6$$

The constant value is 17.959, which means that if there is no change in the variables of Material Mastery, Delivery of Explanation, Infrastructure, Organization, Services, and Facilities (the value of X1, X2, X3, X4, X5, and X6 is 0), then the Post Test Score of participants in Bimtek SMKK is 17.959 units. The regression coefficient value of material mastery is 0.086, indicating that the more material mastery provided by resource persons to participants, the higher the Post post-test score of participants. The regression coefficient value of material mastery is 0.056, indicating that the better the delivery of the explanation given to the participants, the higher the participants' Post-Exam Score. The regression coefficient value of material mastery is 0.304, indicating that the better the infrastructure provided to participants, the higher the participants' Post-Examination Score. The regression coefficient value of material mastery is 0.018, indicating that the better the Organizational Implementation provided to the

participants, the higher the Post-Examination Score of the participants. The value of material mastery is 0.044, indicating that the better the services provided to participants, the higher the participants' Post-Examination Score. The material mastery value is 0.050, indicating that the more facilities provided, the higher the participants' Post-Examination Score. The equation obtained for the multiple linear regression equation in the hybrid method.

$$Y = 17.107 + 0{,}518X_1 + 0{,}013X_2 + 0{,}134X_3 + 0{,}329X_4 + 0{,}058X_5 + 0{,}576X_6$$

The constant value is 17.107, which means that if there is no change in the variables of Material Mastery, Delivery of Explanation, Infrastructure, Organization, Service, Facilities, and Recommendation (the value of X1, X2, X3, X4, X5, and X6 is 0), then the Post-Exam Score of participants in the Vocational Technical Guide is 17,107 units. The regression coefficient value of material mastery is 0.518, indicating that the better the mastery of the material provided by the resource person to the participant, the higher the participant's Post-Exam score. The regression coefficient value of material mastery is 0.013, indicating that the better the Explanation Delivery given by the resource person to the participants, the higher the Post-Exam Score of the participants. The regression coefficient value of material mastery is 0.134, indicating that the more Infrastructure provided to participants, the higher the Post-Exam Score of participants. The value of mastery of the material is 0.329, indicating that the better the Organizational Implementation provided to the participants, the higher the Post-Examination Score of the participants. The regression coefficient value of material mastery is 0.058, indicating that the better the Services provided to participants, the higher the participants' Post-Examination Score. The regression coefficient value of material mastery is 0.576, indicating that the better the Facilities provided to participants, the higher the Post-Examination Score of participants.

4.5.1. T-Test (Partial)

According to [20], the value of tcount is used to test the partial influence of the independent variable on the dependent variable. This test is carried out by looking at the significant column in each independent variable (free) with a significant level < 0.05. The t-test conducted can be seen in the following table.

Table 4. T-Test of offline, online, and hybrid methods

Method	Sig.					
	X1	X2	X3	X4	X5	X6
Offline	0,581	0,700	0,782	0,428	0,824	0,189
Online	0,839	0,833	0,493	0,966	0,907	0,877
Hybrid	0,300	0,954	0,608	0,255	0,915	0,258

Based on primary data after being processed using SPSS Ver.25 software, the significance value of each variable in the dominant offline method is smaller than the t-table value. For the value of t-table = t (a/2; n-k-1 = t (0.05/2; 200-6-1) = t (0.025; 193) = 1.97240 while the variables of Material Mastery (X1), Delivery of Explanation (X2), Infrastructure (X3), Organization (X4), Service (X5), and Facilities (X6) have a significance value < 1.97240. Therefore, the satisfaction level variable in the offline method less influences the post-test score in the Construction Safety Management System Technical Manual.

The significance value of each variable in the online method is also smaller than the t-table value. For the t-table value = t (a/2; n-k-1 = t (0.05/2; 123-6-1) = t (0.025; 116) = 1.981. while the variables of Material Mastery (X1), Delivery of Explanation (X2), Infrastructure (X3), Organizational Implementation (X4), Services (X5), and Facilities (X6) have a significance value < 1.65734. Therefore, the satisfaction level variable in the online method less influences the post-test score in the Construction Safety Management System Technical Manual.

The significance value of each variable in the hybrid method is smaller than the t-table value. For the t-table value = t (a/2; n-k-1 = t (0.05/2; 153-6-1) = t (0.025; 146) = 1.976, while the variables of Material Mastery (X1), Delivery of Explanation (X2), Infrastructure (X3), Organizational Implementation (X4), Services (X5), and Facilities (X6) have a significance value < 1.976. Therefore, it can be concluded that in the hybrid method, the satisfaction level variable has less influence on the post-test score in the Construction Safety Management System Technical Manual.

4.5.2. F-Test (Simultaneous)

According to [20], the F test can be used to test the simultaneous influence of the independent variables on the dependent variable (Y). If the independent variables simultaneously influence the dependent variable (Y), the regression equation model is included in the fit or fit criteria. Conversely, there is no simultaneous influence, so it falls into the category of unsuitable or unfit, with a certain degree of confidence df1 = k - 1 and df2 = n - k. This test is carried out by comparing the significance of the Fcount > Ftabel value, then the model formulated is correct.

Table 5. F-Test of offline, online, and hybrid methods

Method	F_{count}	F_{table}	Sig.
Offline	1.170	1.80	0,322
Online	0,125	1.83	0,993
Hybrid	0,685	1.81	0,662

Table 6. Test result of the coefficient of determination

Method	R Square
Offline	0,41
Online	0,26
Hybrid	0,27

The test results in the table above on the Offline method with the value Ftabel = f (k; n-k), F = (6; 200-6), Ftabel = (6; 194) = 1.80 with an error rate of 5%. In the Fcount value of 1.170 with an Ftable value of 1.80 so that the Fcount value < Ftable or 1.170 < 1.80, and a significance level of 0.322> 0.05, then H0 is accepted and H8 is rejected, it can be concluded that the variables of Material Mastery (X1), Delivery of Explanation (X2), Infrastructure (X3), Organizational Implementation (X4), Services (X5), and Facilities (X6) simultaneously have no significant effect on the Post Test Value of participants in the Technical Guidance of the Construction Safety Management System in the offline method.

Based on the test results of the Online method, the Ftabel value = f (k; n-k), F = (6; 123-6), Ftabel = (6; 116) = 1.83. In the Fcount value of 0.125 with a Ftable value of 1.83, the Fcount value < Ftable or 0.125 < 1.83, and the significance level is 0.993> 0.05, then H0 is accepted, and H8 is rejected.

It can be concluded that the variables of Material Mastery (X1), Delivery of Explanation (X2), Infrastructure (X3), Organizational Implementation (X4), Services (X5), and Facilities (X6) simultaneously have no significant effect on the Post Test Value of participants in the Technical Guidance of the Construction Safety Management System in the online method.

Based on the test results on the Hybrid method, the Ftabel = f (k; n-k) value, F = (6; 153-6), Ftabel = (6; 147) = 1.81 with an Fcount value of 0.685 and an Ftable value of 2.07 so that the Fcount value < Ftabel or 0.625 < 1.81, and a significance level of 0.662 > 0.05, then H0 is accepted and H8 is rejected.

It can be concluded that the variables of Material Mastery (X1), Delivery of Explanation (X2), Infrastructure (X3), Organizational Implementation (X4), Services (X5), and Facilities (X6) simultaneously have no significant effect on the Post Test Value of participants in the Technical Guidance of the Construction Safety Management System in the hybrid method.

4.5.3. Determination Coefficient Test

The Coefficient of Determination (R2) will measure the degree of the model's capacity to clarify the subordinate factors. The coefficient of assurance is zero and one. A moo R2 esteem implies that the ability of the free aspects to explain the variety within the subordinate variable is negligible.

The coefficient of determination in the R Square value of the offline method is 0.41. This means that the ability of the independent variables to explain the dependent variable is 41%; the remaining 59% is explained by other variables not discussed in this study, such as background level of education, work experience, age of participants, and others. The coefficient of determination is found in the R Square value of the online method of 0.26.

This means that the ability of the independent variables to explain the dependent variable is 26%; the remaining 74% is explained by other variables not discussed in this study, such as background level of education, work experience, age of participants, and others. The coefficient of determination is found in the R Square value of the hybrid method of 0.27. This means that the ability of the independent variables to explain the dependent variable is 27%; the remaining 73% is explained by other variables not discussed in this study, such as background level of education, work experience, age of participants, and others.

5. Conclusion

Based on the implementation date of the construction safety management system technical guidance from 2019 to 2022, three implementation methods were applied: offline, online, and hybrid. Of the three methods, the one with the highest pass rate is the offline method, with a pass rate of 95%. It was followed by the hybrid method, with a pass rate of 90%, and the lowest pass rate was applied by the online method, at 85%. Factors affecting the pass rate, consisting of material mastery, delivery, infrastructure, organization, services, and facilities, are insignificant to the post-test score.

Based on the analysis results with multiple linear regression equations using SPSS Version 25 software, the regression analysis between the independent and dependent variables had no significant correlation. In the offline method, the R2 value is 41%. For the online method, the R2 value was 26%, and for the hybrid method, the R2 value was 27%. In other words, the offline method is the most effective and efficient in carrying out construction safety management system technical guidance activities at the Makassar Region VI Construction Service Centre.

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