Jurnal Teknologi Maritim Volume 8 No 2 Tahun 2025
1 Juni 2025 / 2 Oktober 2025 / 3 Oktober 2025

Jurnal Teknologi Maritim

http://jtm.ppns.ac.id

The Use of the Wilcoxon Signed Rank Test in Analyzing the Difference in Test Scores Before and After Digital Marketing Training.

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Abstract. The digital marketing training for twenty-five housewives who are members of the Pos Pendidikan Anak Usia Dini (PAUD) Terpadu (PPT) Tunas Mulia Keputih Surabaya community needs to be evaluated to assess the participants' level of understanding after the training. The purpose of this study is to examine the change in participants' understanding of the training material after the training and to determine the difference in mean scores between the pre-test and post-test. Participants were administered a pre-test and post-test to assess the training's effectiveness. The pre-test and post-test scores were analyzed using the Wilcoxon signed-rank test to examine the difference in mean scores after conducting a normality test. Based on the Shapiro-Wilk normality test, the p-value was less than 0.05, indicating that the pre-test and post-test scores did not follow a normal distribution. The average post-test score increased by 5.11% compared to the average pre-test score, indicating an improvement in participants' understanding after the training. However, the Wilcoxon signed-rank test results showed a p-value greater than 0.05, indicating no significant difference in participants' mean scores before and after the training.

Keywords: *Digital Marketing, Post-Test, Pre-Test, Shapiro-Wilk, Wilcoxon Signed Rank Test*.

1. Introduction

The Integrated PAUD Pos Community (PPT) Tunas Mulia Keputih Surabaya is a community consisting of parents of Tunas Mulia PAUD students. The majority of the community members are female parents who work as housewives. Housewives can also play a role in the household economy because economics also has an influence on children's education (Shihab et al., 2023). Empowerment of housewives in strengthening the economy has been widely carried out because housewives, with their abilities, can be responsible for strengthening the economy of their households (Forijati et al., 2022). Based on the initial survey with the community management, digital marketing training is provided to strengthen family

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doi: 10.35991/jtm.v8i2.73

finances as one of the efforts to improve sales skills. This training is also expected to motivate community members to utilize their abilities to increase household income, thereby strengthening family finances. The number of training participants, which is also the research sample, is the entire membership of the PPT Tunas Mulia community, totaling 25 people. This research uses saturated sampling, which is a sampling technique that uses all members of the population as samples due to the relatively small population size (Sugiyono, 2020; Sari et al., 2021). The advantage of saturated sampling is that it can describe the entire population and minimize errors due to more accurate sampling (Sugiyono, 2020; Fachreza et al., 2024).

The training method provided is through presentations to the training participants. Each participant is given a training module. The trainer also conducts practice using smartphones on how to promote and sell products through social media and marketplaces. The social media and marketplaces used for training are Instagram, Tokopedia, and Olx. The training participants come from productive ages ranging from 26 to 60 years old. Participants also come from various educational backgrounds, ranging from elementary school to bachelor's degree, with the majority having a high school education and working as housewives. Some participants also work as entrepreneurs who are familiar with digital marketing.

Due to the demographic diversity of the training participants, research needs to be conducted to measure the level of understanding of the participants by giving tests before and after the training. Tahira et al. (2024) conducted a measurement of the success rate of digital entrepreneurship socialization programs at SMK Muhammadiyah 1 Wates by giving a pre-test and a post-test. Banuwa et al. (2021) conducted an evaluation of pre-test and post-test scores of participants in the New Siga technical training at the BKKBN Representative of Lampung Province. Both studies used the Wilcoxon method to see the difference in the mean values of pre-test and post-test. There are differences in the demographics of the training participants, including the participants in both trainings having male and female participants, while in this training, the participants are only female. Additionally, based on the interview results, some participants are already familiar with digital marketing. Therefore, this research is conducted on the members of the PPT Tunas Mulia community related to digital marketing training.

The provision of pre-test and post-test aims to evaluate the training. Evaluation is the process of assessing by comparing the expected goals with the actual progress or achievement (Magdalena et al., 2021). The pre-test and post-test scores will be calculated to see if there are any changes after the training. The pre-test and post-test scores will be analyzed using statistical tests to see the difference in the mean values. Normality tests are conducted before statistical tests to see the difference in the mean values. The normality test using the Shapiro-Wilk test aims to see if the data is normally distributed or not. Based on the normality test, the pre-test and post-test scores are not normally distributed, so the Wilcoxon Signed Rank Test is used to see the difference in the mean values, also because the population size is limited and the testing is conducted on two related samples (Anam, 2020). The Wilcoxon Signed Rank Test aims to see if there is a difference in the mean values between the pre-test and post-test scores.

This research aims to determine if there is a difference in the mean values between the pre-test and post-test scores. The results of this research are expected to be used as a reference to evaluate the training that has been conducted, so that it can be determined what training methods are suitable for future training activities. The PPT Tunas Mulia Keputih community has not received similar training and research before. Similar training sessions have been conducted in other locations (Hidayati et al., 2021; Forijati et al., 2022), so it is expected that

the training activities and research results will provide benefits for both community members and the research team.

2. Literature Review

2.1 Digital Marketing

Digital marketing is the targeted, measurable, and interactive marketing of goods and services using digital technology to promote a brand, shaping preferences, and increasing sales traffic through various digital marketing techniques (Wati et al., 2020). The types of digital marketing based on marketing media are as follows (Erwin et al., 2024):

1 Website, which functions as a digital store and promotional medium.
2 Pay Per Click, where advertisers pay promotional costs according to the number of clicks made by visitors.
3 Search Engine Marketing (SEM), which utilizes search engines to focus on direct advertising.
4 Search Engine Optimization (SEO), which is a marketing effort to get a website page to rank high (on the first page) in search results.
5 Social Media Marketing (SMM), which utilizes media for marketing.
6 Email Marketing, which utilizes electronic mail (email) for promotion or product information.

The types of digital marketing based on marketing strategy are as follows (Erwin et al., 2024):

1 Push Marketing, which is a marketing strategy that involves directly offering products to customers to achieve quick sales. Examples include endorsements by influencers or celebrities, promotional emails, or broadcasts via WhatsApp.
2 Pull Marketing, which is a marketing strategy that aims to increase awareness and customer loyalty. Examples include SEO content ads, social media marketing, or discounts on marketplaces.

2.2 Shapiro-Wilk Test

A common statistical test used to test normality for small to medium sample sizes is the Shapiro-Wilk test. The Shapiro-Wilk test provides a p-value that is used to determine whether the data is normally distributed or not. If the p-value is greater than the significance level, the data is considered to be normally distributed, and vice versa. If the p-value is less than the significance level, the data is considered not to be normally distributed. In this study, a significance level of 0.05 is used (Isnaini et al., 2025).

The normality test is used to determine whether the data obtained is normally distributed or not, typically for measuring data on an ordinal, interval, or ratio scale. If the data is normally distributed, analysis using parametric methods is employed. Conversely, if the data is not normally distributed or the sample size is small and the data type is nominal or ordinal, then non-parametric statistical methods are used (Nuryadi et al., 2017).

2.3 *Wilcoxon Signed Ranks Test*

The Wilcoxon Signed Ranks Test is a non-parametric statistical test tool that serves the same purpose as the t-test, which is to test the difference in means between two data sets or two samples that have different treatments (Lukita and Widyadana, 2020). The two samples being compared are dependent or come from the same group of respondents (Mashuri et al., 2022).

The Wilcoxon Signed Ranks Test is used on ordinal data (Wulansari, 2023). One of the advantages of this method is that it analyzes the median to distinguish one sample from another

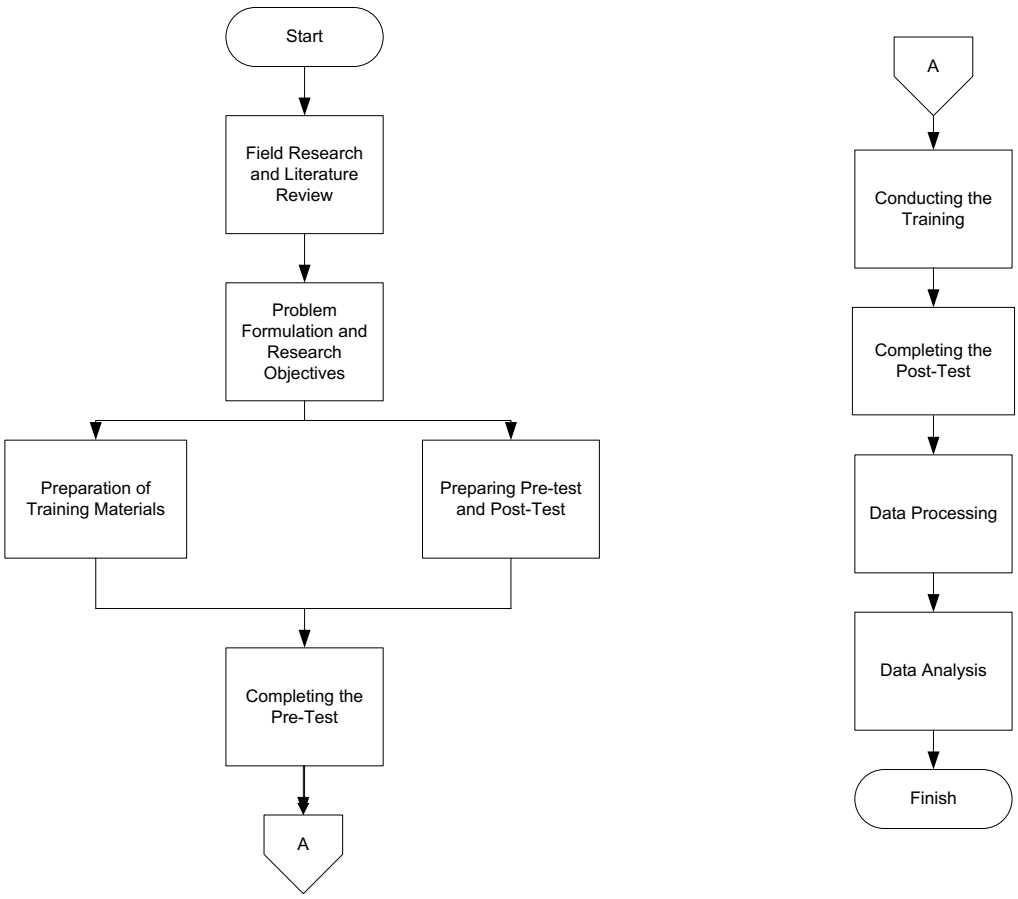
(Fauziah, 2020). Another advantage of this method is that it can be used for statistical testing when the sample size is small. The basis for decision-making in the Wilcoxon Signed Ranks Test is that when the p-value is less than the significance level, there is a difference in means. Conversely, when the p-value is greater than or equal to the significance level, there is no difference in means.

Significance level refers to the level of accuracy of a study or the standard tolerance for error in a study. A significance level of 95% is equivalent to a tolerance for error of 0.05. Typically, research in the fields of education, health, or social sciences uses a significance level of 0.05 or 0.01. For medical and pharmaceutical research that involves risks related to human life, a significance level of 0.005 or 0.001, or even 0.0001, may be used. In this study, a significance level of 0.05 is used because it is a social science study (Setyawan, 2021).

3. Method

3.1. Research Flowchart

The stages of research implementation are depicted in a flowchart. Figure 1 represents the research flowchart.



Gambar 1 Research Flowchart

Based on Figure 1, it is explained that the research begins with conducting field studies and literature reviews. Based on interviews with the chairman of the PPT Tunas Mulia community, digital marketing training is needed for the community members. After determining the problem formulation and research objectives, the training materials were prepared along with pre-test and post-test questions.

The pre-test was administered before the training to measure the participants' basic knowledge level regarding the training material. After the training, a post-test was given to see the participants' knowledge level. The pre-test and post-test questions were the same, only the implementation was given before and after the training.

The scores from the pre-test and post-test will be tested for normality to determine the data distribution. After knowing whether the data is normally distributed or not, the significance test between the two paired data groups will be continued. This test is used to compare the means of two paired data sets, where each observation in one group has a related pair in the other group. The final stage of this research is data analysis.

3.2. Study Participants

Peserta pelatihan dalam penelitian ini adalah keseluruhan anggota paguyuban PPT Tunas Mulia sebanyak 25 orang. Dua puluh lima orang yang akan dijadikan subjek penelitian ini berjenis kelamin perempuan dengan umur dalam rentang 26 tahun hingga 60 tahun. Tingkat pendidikan para peserta pelatihan ini mulai dari SD, SLTA, Diploma hingga Sarjana. Jenis pekerjaan dari para peserta pelatihan ini mayoritas adalah ibu rumah tangga, disusul pegawai swasta dan wirausaha.

3.3. Pre-Test dan Post-Test Design

The pre-test and post-test comprise 8 multiple-choice questions derived from the training material. Each participant receives a training module. The framework of the pre-test and post-test is outlined as follows:

1 Definition of digital marketing
2 Benefits of digital marketing for MSMEs
3 Types of digital marketing media
4 Social media for digital marketing purposes
5 Key players in online marketplaces
6 Examples of online marketplaces
7 The relationship between online marketplaces and digital marketing
8 Steps to promote and sell products through online marketplaces and social media.

3.4. Normality Test

The normality test used in this study is the Shapiro-Wilk test. The Shapiro-Wilk test is generally limited to samples of less than 50 to produce accurate results (Sintia et al., 2022). The hypotheses for the Shapiro-Wilk normality test are as follows:

H_0: The data is normally distributed.

H_1: The data is not normally distributed.

If the p-value generated from the Shapiro-Wilk test is greater than the predetermined significance level (0.05), the decision is to accept the null hypothesis, meaning the data is normally distributed. Conversely, if the p-value is less than the significance level, the null hypothesis is rejected, and it can be interpreted that the data is not normally distributed.

3.5. Wilcoxon Signed Rank Test

The Wilcoxon Signed Rank Test is used as a statistical method to analyze significant differences between two paired data groups that are not normally distributed (Fadilatunnisyah et al., 2024). The hypotheses for the Wilcoxon Signed Rank Test are as follows:

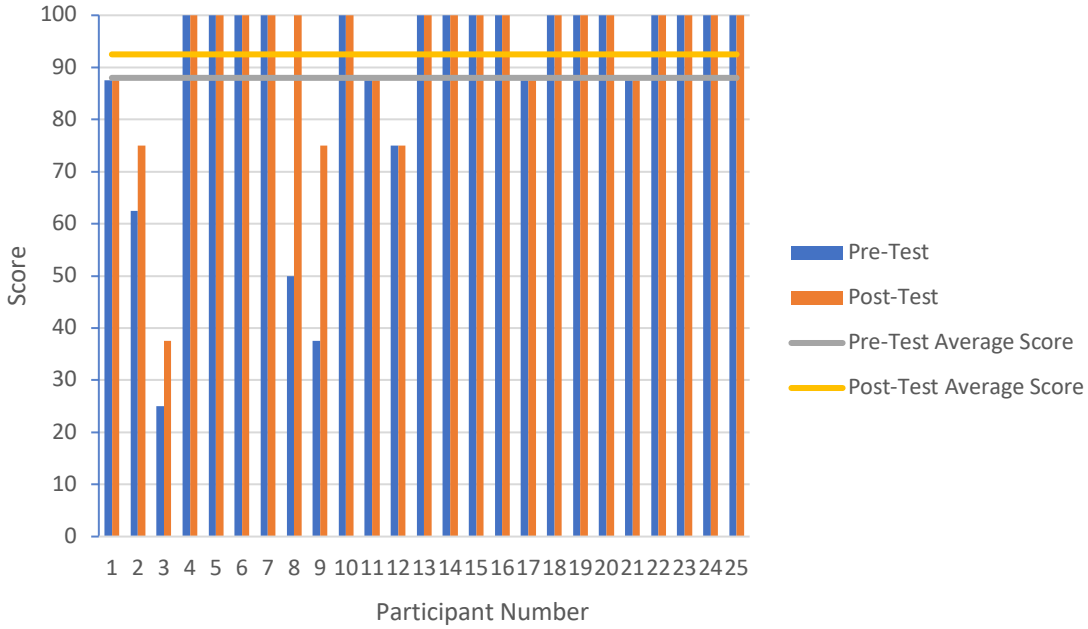
H_0: There is a significant difference
H_1: There is no significant difference

The assessment criteria for the Wilcoxon Signed Rank Test are that if the p-value is less than 0.05, the null hypothesis (H0) is rejected, meaning there is a significant difference. If the p-value is greater than or equal to 0.05, the null hypothesis (H0) is accepted, meaning there is no significant difference.

4. Results and Discussion

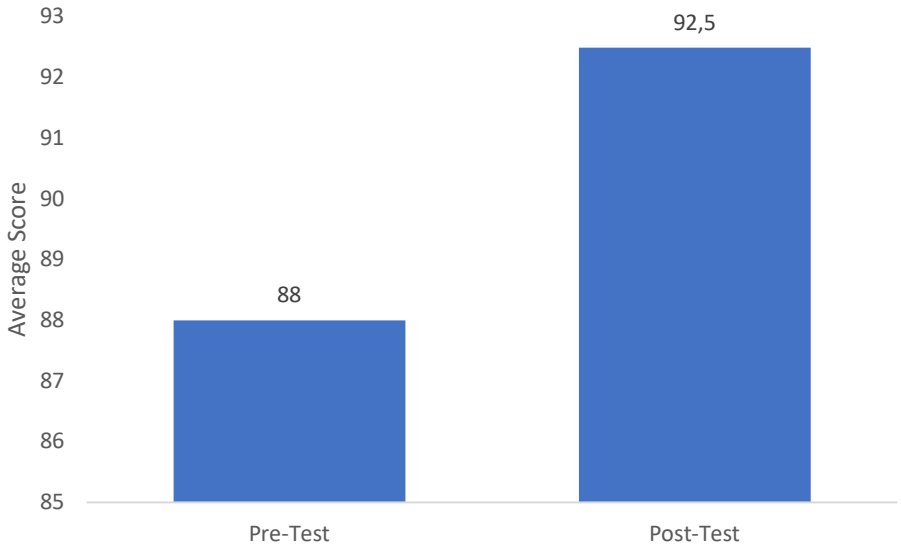
4.1 Pre-Test dan Post-Test Scores

The pre-test and post-test results for each participant are presented in Figure 2.



Gambar 2 Pre-Test dan Post-Test Scores for Each Participant

Based on Figure 2, it can be seen that 21 training participants have the same post-test scores as their pre-test scores. Participants who have the same scores between pre-test and post-test generally have relatively high scores. Based on the questionnaire results and interviews, this is because they are already familiar with digital marketing, so their pre-test and post-test scores are already very good. Four participants have higher post-test scores than their pre-test scores. As for the pre-test, 16 participants have scores above the average, and the rest have scores below the average. For the post-test, 17 participants have scores above the average, and the rest have scores below the average. The average scores of the training participants can be seen in Figure 3.



Gambar 3 Average Score of Training Participants

As shown in Figure 3, the average post-test score exceeds the pre-test score. Specifically, the average post-test score increased by 5.11% compared to the pre-test score, rising from 88 to 92.5. This suggests that the participants demonstrated an enhanced understanding of the training material.

4.2 Normality Test

The Shapiro-Wilk test is employed to assess normality in this analysis. The results of the Shapiro-Wilk normality test are presented in Table 1 and were previously discussed in the research background. These results inform the selection of the appropriate method for testing the difference in mean scores between the participants' test results.

Table 1 Test of Normality

	Shapiro-Wilk		
	Statistic	df	Sig.
Nilai Pre_Test	0.633	25	0.000
Nilai Post_Test	0.589	25	0.000

a. Lilliefors Significance Correction

Based on Table 1, it can be seen that the pre-test scores have a W value of 0.633 and a p-value of less than 0.05. Meanwhile, the post-test scores have a W value of 0.589 and a p-value of less than 0.05. If the W value approaches 0 and the p-value is less than 0.05, the data is not normally distributed. In this study, the Shapiro-Wilk test was used for normality testing because the population being studied consisted of 25 individuals, or fewer than 50 (Agustin and Permatasari, 2020). One common reason for non-normal data distribution is the presence of extreme values in the data (Pasaribu et al., 2024). According to Figure 2, some values significantly deviate from the mean, such as the score of the third participant.

4.3 *Wilcoxon Signed Rank Test*

The Wilcoxon test results are presented in Tables 2 and 3, where Table 2 provides a descriptive analysis, and Table 3 shows the significance of the difference between the pre-test and post-test scores.

Table 2 Ranks

		N	Mean Rank	Sum of Ranks
Nilai Post Test-Pre Test	Negative Ranks	0[a]	0.00	0.00
	Positive ranks	4[b]	2.50	10.00
	Ties	21[c]		
	Total	25		

a. Nilai Post Test < Nilai Pre Test
b. Nilai Post Test > Nilai Pre Test
c. Nilai Post Test = Nilai Pre Test

According to Table 2, the results of the Wilcoxon signed rank test indicate that none of the participants had post-test scores lower than their pre-test scores, while 4 participants had higher post-test scores, and 21 participants had identical post-test and pre-test scores. These findings are consistent with the analysis depicted in Figure 2.

Table 3 Test of Statistics[a]

	Nilai Post Test - Nilai Pre Test
Z	-1.841[b]
Asymp. Sig. (2-tailed)	0.066

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks

According to Table 3, the negative Z value indicates that the pre-test scores are lower than the post-test scores. Specifically, the Z value is -1.841, and the p-value exceeds 0.05. Given that the Z value is greater than -1.96 and the p-value is greater than 0.05, it can be concluded that there is no significant difference between the pre-test and post-test scores. This suggests that the training did not result in a significant change in the mean scores of the participants. Notably, 21 out of 25 participants had identical post-test and pre-test scores. These findings contrast with those of Banuwa et al. (2021) and Thahira et al. (2024), who reported significant differences between pre-test and post-test scores among vocational school students and BKKBN representatives, likely due to the training's impact on their understanding. The discrepancy may be attributed to the fact that the majority of participants in this study already had high pre-test scores, resulting in no significant improvement post-training.

5. Conclusion

The study's results indicate that there is an increase in post-test scores relative to pre-test scores, suggesting a 5.11% enhancement in participants' comprehension of the training material. Nevertheless, the Wilcoxon signed-rank test reveals that the difference between the mean pre-test and post-test scores is not statistically significant.

Acknoledgement

We would like to extend our gratitude to Politeknik Perkapalan Negeri Surabaya for supporting this project through the 2025 DIPA funding. Our appreciation also goes to

Paguyuban PPT Tunas Mulia Keputih Surabaya for their collaboration and provision of facilities for the training.

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