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Training on Creative Analysis of ANOVA Statistical Tests with SPSS Applications

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ABSTRACT

Background: ANOVA analysis is crucial for comparing multiple population means and is highly beneficial for final-year students. However, many face challenges in mastering it due to the lengthy SPSS installation process and the complexity of ANOVA material. Despite its importance, ANOVA training is rarely conducted. This research aims to fill that gap.
Contribution: This community service aims to provide creative training for participants regarding ANOVA analysis using SPSS applications technology.
Method: Final-year students (semester 6 and above) participated in basic training using SPSS 22. Pre- and post-training evaluations measured effectiveness.
Results: The evaluation results showed that 92% of participants from final year students experienced improvement in mastering ANOVA analysis.
Conclusion: This activity successfully increased students' knowledge to master ANOVA analysis using SPSS 22 applications. Thus, it allows the emergence of various research topics that apply the ANOVA application so that research in the academic world becomes better.

1. Introduction

ANOVA analysis is an essential statistical process for processing data by comparing more than two population means. A comparison between the Mean Average statistical analysis

method and one-way ANOVA shows that ANOVA is more reliable because it considers many parameters at once plus considers frequency trends [1]. Analysis of variance (ANOVA) can evaluate the results appropriately [2]. The results of ANOVA analysis can be trusted in identifying the best solutions for complex problems [3]. Analysis of Variance (ANOVA) is also used to determine the average response magnitude of each process parameter that can be controlled [4]. So, Analysis of Variance (ANOVA) can be applied in research implementation and various fields of science.

Several literatures explain the use of ANOVA analysis in solving various fields of science. The research of Hassan et al. (2024) uses Anova statistical analysis to identify water quality [1]. The research of O'Driscoll et al. (2024) uses analysis of variance (ANOVA) to optimize 3D printer settings [2]. The research of analyzed the characteristics of spatiotemporal variations in regions and weather in spring through the variance analysis projection pursuit model (ANOVA PPM). ANOVA analysis is also applied to obtain optimal results in identifying building ventilation performance [3]. The ANOVA analysis results support the Taguchi method for evaluating the optimum carbonization conditions for a mixture of domestic polymer waste, biomass, and lignite [4]. In addition, one-way ANOVA analysis can also be used to compare two population groups in machine learning [6]. This shows that ANOVA analysis is essential and needs to be used in research from various fields of science.

Understanding and practicing ANOVA analysis is very useful for final-year students conducting their research. ANOVA analysis is an essential inferential statistical science because it includes hypothesis testing for testing the statements and conclusions [7]. Large-scale ANOVA modeling plays a critical role in selecting basis functions for component function penalty cases in primal-dual algorithms [8]. This identifies that ANOVA (Analysis of Variance) is a fundamental statistical tool that is widely used to compare means across groups, making it invaluable to researchers in various fields. Mastering this technique is essential for students, especially those nearing graduation, to effectively solve complex research problems. Academics must have a more comprehensive and in-depth understanding of ANOVA variance analysis [9], especially final-year students, to become professional graduates. Experimental data from literature and research data analyzed using statistical methods through Analysis of Variance (ANOVA) testing are relevant for identification and conclusion [10-14]. Therefore, these ANOVA analysis skills can be a provision for final-year students when they graduate because students can apply these ANOVA analysis skills after graduating to draw statistical conclusions in their work world.

Despite the importance of ANOVA, many final-year students struggle with understanding and applying this technique, especially when using statistical software such as SPSS. Observations from a private university in Probolinggo indicate that students face challenges in completing assignments due to a lack of familiarity with the practical use of ANOVA analysis. ANOVA analysis is essential and helpful in completing their final assignment. The interview results showed that they still needed to become accustomed to using ANOVA statistical analysis

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to solve their research problems. They need to become more familiar with SPSS practices. This resulted in the author conducting community service to help students understand and practice one-way ANOVA analysis.

Another obstacle to understanding and practicing one-way ANOVA analysis is the inability of human resources to master one-way ANOVA analysis material. On the other hand, financial limitations are also an obstacle because they are generally licensed and paid if you want to use statistical data analysis software or applications. Even though almost all students currently use laptops, the use of laptops with SPSS installed to practice ANOVA analysis is limited, and some students only buy them in crack form. Realizing this, the team also provides installation and download facilities for the SPSS application to practice one-way ANOVA analysis. ANOVA analysis helps obtain optimal results for various research cases [3].

However, not all students know and understand the practice of ANOVA analysis, so it is necessary to carry out community service activities in the form of training on creative analysis of the ANOVA test for final-year students. This ANOVA training activity is rarely carried out due to the long SPSS software installation process and the difficulty of applying ANOVA analysis, which is quite tricky. This activity is expected to improve final-level student participants' understanding, skills, and proficiency in ANOVA analysis through the SPSS application. So, final-year students who take part in this training will be able to master ANOVA analysis creatively. In addition, the contribution to the academic world is that students as young researchers can carry out various variations of research topics by applying the ANOVA application so that research in the academic world becomes better.

2. Method

This community service method is creative training from ANOVA analysis using the SPSS-22 application. Participants in this creative training are final-year students in their sixth semester and above. Training is carried out online and offline at a private university in Probolinggo. Implementation. Creative training related to ANOVA analysis for students includes three stages, namely (1) problem identification, (2) creative training for three days to improve final year students' skills related to ANOVA analysis, (3) evaluation of training, and (4) concluding. The detailed stages are shown in Figure 1.

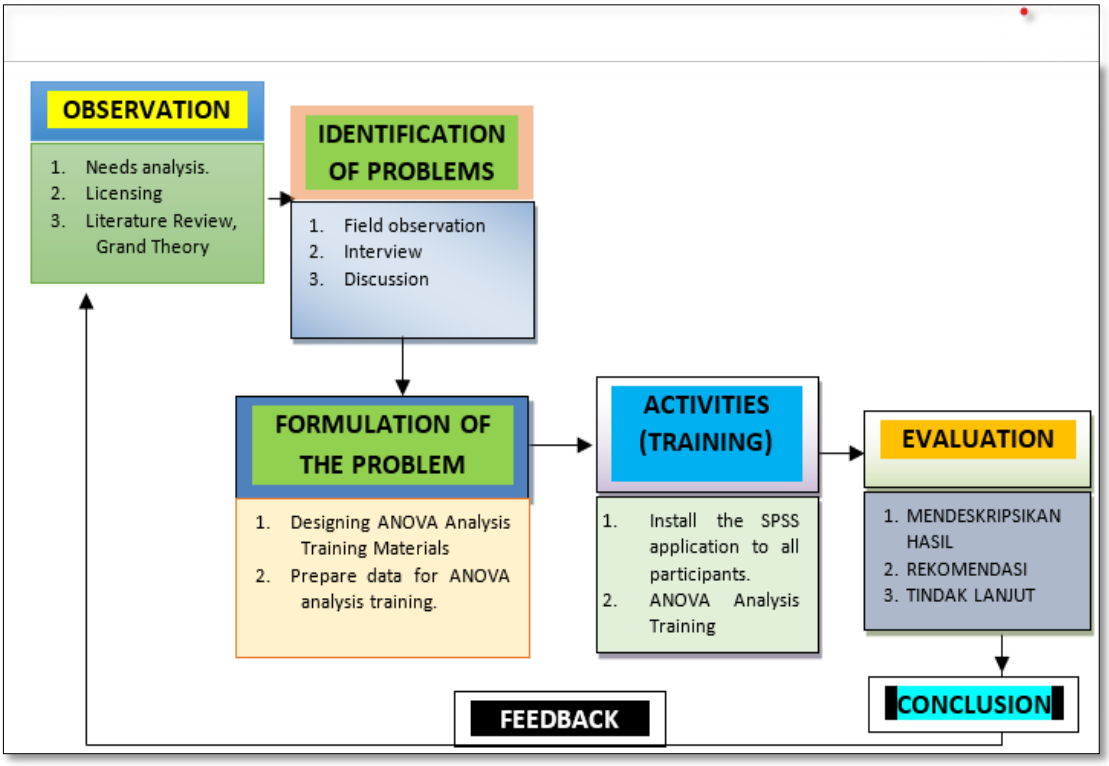

Figure 1. Stages of Creative Training for ANOVA Analysis

At the problem identification stage, the community service team made observations of final-year students at a private university in Probolinggo. Next, the team determined the problem, namely that sixth-semester students and beyond still needed help in quantitative data analysis, especially ANOVA analysis. The second stage is ANOVA analysis training. This training is carried out on students using SPSS. In this training activity, documentation becomes evidence of the evaluation of community service. The third stage is the evaluation stage. The evaluation instrument is a questionnaire of participant satisfaction and mastery. Three validators validate the instrument. Participants will fill out the questionnaire at the beginning and after the training. The innovative method used is the cooperative learning method, where participants work in groups to solve cases by applying ANOVA analysis.

3. Results and Discussion

Creative training for final-year students related to ANOVA analysis is conducted online and offline. Online community service activities are carried out via the Zoom Meeting platform. Offline training is carried out in the private University Hall in Probolinggo, Indonesia. This training requires participants to have at least installed the SPSS-22 applications. The speaker provides raw data and invites participants to follow along and practice creatively with ANOVA analysis. The training was carried out by 30 students from semester 6, semester 7, and semester 8.

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The training begins with offline training for two days and continues with online training. All participants can follow creative training related to ANOVA analysis. The speaker first provides theoretical ANOVA material. Theoretical understanding is also needed for students to understand the practice of ANOVA analysis via SPSS and the interpretation of ANOVA output results. The delivery of material offline is shown in Figure 2.

Figure 2. Delivery of Material During Offline Training

The delivery of material related to ANOVA analysis carried out online is shown in Figure 3

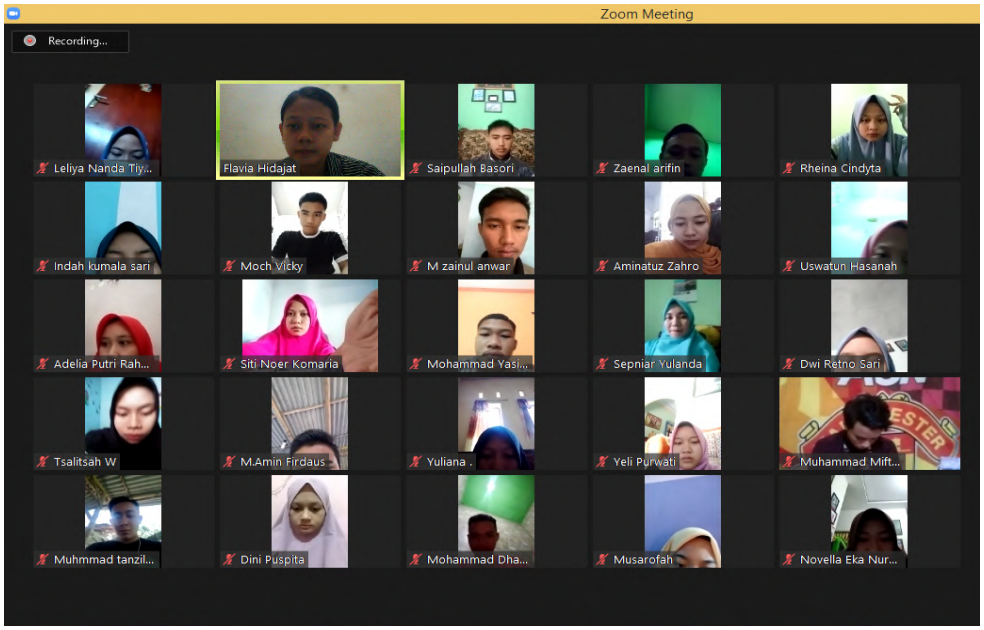

Figure 3. Online Training

Creative practices related to ANOVA analysis using the SPSS application conducted offline

are shown in Figure 4. ANOVA statistical analysis is very sophisticated in analyzing comparisons of more than two population groups. This training explains in detail the process of ANOVA statistical analysis with SPSS software, shown in Figure 4.

Figure 4. ANOVA analysis practice using SPSS-22 Application

Participants were distributed and asked to fill out a questionnaire at the beginning of the creative training from ANOVA analysis. The questionnaire instrument is a g.form link that the Team has prepared. The results of the questionnaire before and after the training will be compared as evaluation material to measure the success of this training.

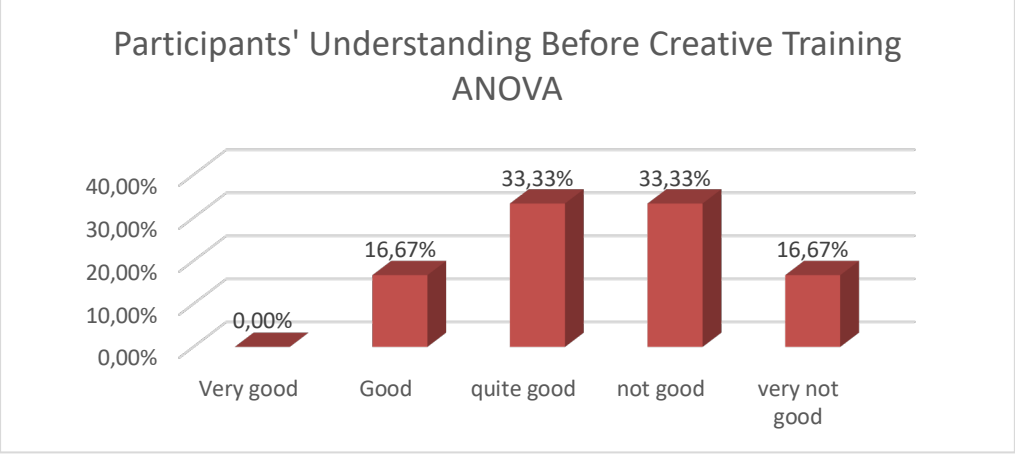

Figure 5. Participants' Understanding Before Creative Training ANOVA

The evaluation results show that 16.67% of students' understanding of the material in mastering ANOVA analysis is in a good category because 5 out of 30 students chose the "good" category.

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Furthermore, 33.33% of students' understanding of the material in mastering ANOVA analysis fell into the "quite good" category because 10 out of 30 students chose the "quite good" category. On the other hand, ten students (33.33%) understood the material in mastering ANOVA analysis in the "not good" category. The understanding of the material from 5 students (16.67%) in mastering ANOVA analysis was in the "very not good " category.

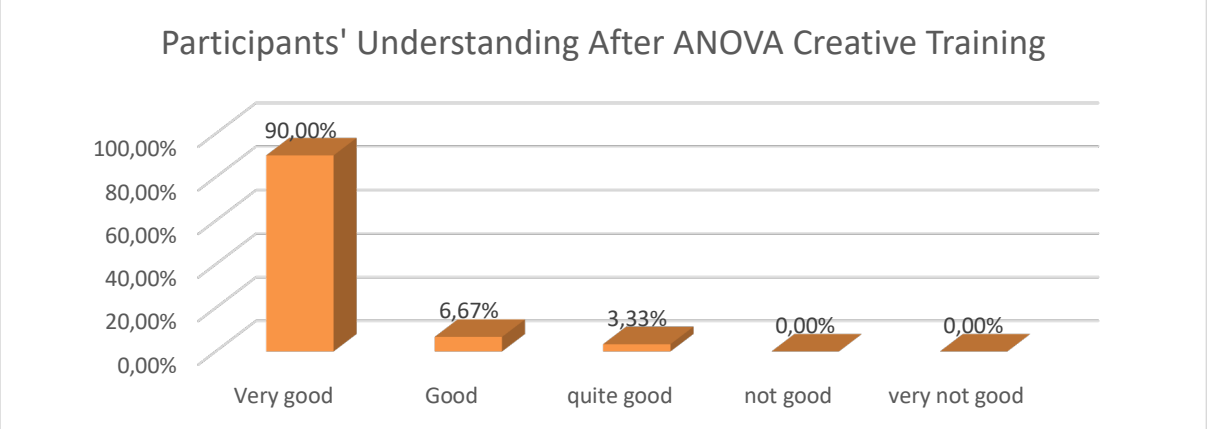

Figure 6. Participants' Understanding After ANOVA Creative Training

At the end of the training, participants were given a questionnaire again after the training via the g.drive link. The evaluation results showed that 90% of students' understanding of the material in mastering ANOVA analysis was very good because 27 out of 30 students chose a very good understanding of the material after taking part in ANOVA training. 66.67% of students' understanding of the material in mastering ANOVA analysis was good, with 2 out of 30 students choosing it as good for their understanding of the material after taking part in ANOVA training. Furthermore, 3.33% of students' understanding of the material in mastering ANOVA analysis was quite good with only one student.

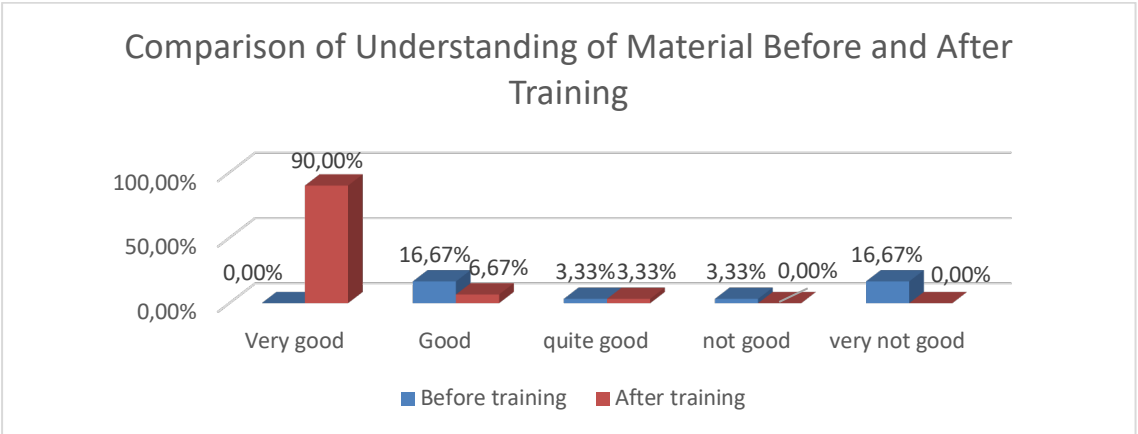

Figure 7. Comparison of Understanding of Material Before and After Training

Figure 7 shows a comparison between before and after training related to each criterion of students' understanding of ANOVA skills mastery in the application of SPSS software. The difference in knowledge and mastery of ANOVA skills for the "very good" criteria is significant, at 90%. This significant increase indicates that ANOVA training can support understanding and improve ANOVA analysis skills in SPSS software to be better. The mastery of ANOVA skills with the "good" criteria by participants before and after the creative ANOVA training is significantly different by 10%. The difference in mastery of ANOVA skills from students for the "not good" criteria is significant, which is dominated by the low ANOVA analysis skills of students before training, which is 13.33%. Meanwhile, the difference in mastery of ANOVA skills from students for the "not very good" criteria is quite significant, which is 16.67%, which is dominated by the low ANOVA analysis skills of students before training.

Participants' understanding of the material after creative training related to ANOVA analysis was better and increased than before ANOVA analysis training. The comparison of the percentage regarding understanding of the material from participants in the "Very good" category before and after the ANOVA analysis training increased by 90%. Graph 6 shows that the curve tends to lean to the left and towards "Very Good" because the percentage of participants' understanding of the material after training is dominated by the "Very Good" category, followed by the "Good" category and the "Quite Good" category with only one student. Meanwhile, before the ANOVA analysis training, Graph 2 shows that the curve tends to lean to the right and towards "good criteria (6.67%)" followed by the "quite Good category (3.33%); the "not good category (0.00%) and very not good category (0.00%).

Table 1. Data of Before and After Training

Indicators	**Before Training**	***After Training***
Very good	0.00%	90.00%
Good	16.67%	6.67%
Quite good	3.33%	3.33%
Not good	3.33%	0.00%
Very not good	16.67%	0.00%

Based on Table 1, there is a significant difference between the ANOVA skills of students before and after training. Only 16.67% of students already understand and have ANOVA analysis skills before training. After ANOVA training, 96.67% (accumulated percentage between the criteria "good" and "very good") of students were helped to understand and implement ANOVA analysis in SPSS application software. This is in accordance with previous research [7]; namely, data analysis using ANOVA is very important for comparative testing of two population groups, so this creative ANOVA training can help the understanding of student participants' ANOVA analysis. This shows that creative training has succeeded in increasing understanding and mastery of ANOVA analysis. Participants' understanding after creative training related to ANOVA analysis was better and increased than before ANOVA analysis training.

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4. Conclusion

This creative training activity on mastering ANOVA analysis, attended by 30 final-year students at Probolinggo University, increased understanding and mastery of ANOVA analysis. The responses of participants in the questionnaire prove this before taking the training; namely, the curve tends to lean to the right and towards the "Quite Good" category, followed by the "Not Good" and "Very Bad" categories. Meanwhile, participant responses after participating in the training showed a curve that tended to lean to the left and towards "Very Good" because the "Very Good" category was dominated, followed by the "Good" category and the "Quite Good" category with only one student. This finding implies that students can apply SPSS for ANOVA analysis so that they can conduct statistical data testing more easily through ANOVA analysis to compare more than one population group. The limitation of the study is that this training is only for student participants, so it requires heterogeneous participants in various professions. Recommendations for future research are that ANOVA training can be for employees or workers in other fields who require ANOVA analysis skills in their work profession.

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