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Data Processing Training Using Partial Least Squares (PLS) for Management Students in Quantitative Research

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Abstrak

Penelitian kuantitatif merupakan salah satu pilar utama dalam pengembangan ilmu pengetahuan dan teknologi. Di era globalisasi ini, kemampuan untuk melakukan penelitian berkualitas menjadi hal yang penting bagi mahasiswa, khususnya mahasiswa manajemen. Salah satu metode statistik yang populer dan efektif untuk penelitian kuantitatif adalah Partial Least Squares (PLS). Kegiatan pengabdian masyarakat ini bertujuan untuk meningkatkan pengetahuan dan keterampilan mahasiswa manajemen dalam mengolah data kuantitatif menggunakan metode PLS untuk penelitian mereka. Pelatihan ini dilaksanakan selama dua hari dengan melibatkan 30 mahasiswa semester akhir yang sedang menyusun skripsi. Materi pelatihan mencakup konsep dasar PLS, model pengukuran, model struktural, pengoperasian perangkat lunak SmartPLS, serta interpretasi hasil analisis. Metode yang digunakan dalam pelatihan ini meliputi ceramah, demonstrasi, dan praktik langsung. Hasil pelatihan menunjukkan peningkatan pemahaman terhadap konsep PLS, kemampuan mengoperasikan perangkat lunak PLS, dan kemampuan menginterpretasikan hasil analisis dengan benar oleh mahasiswa. Pelatihan ini diharapkan dapat meningkatkan kualitas penelitian mahasiswa dan mempersiapkan mereka untuk dunia kerja di bidang manajemen.

Kata Kunci: Penelitian Kuantitatif; Partial Least Squares (PLS); Mahasiswa Manajemen.

Abstract

Quantitative research is one of the key pillars in the development of science and technology. In this era of globalization, the ability to conduct quality research has become essential for students, particularly management students. One of the popular and effective statistical methods for quantitative research is Partial Least Squares (PLS). This community engagement activity aims to enhance the knowledge and skills of management students in processing quantitative data using PLS methods for their research. The training was conducted over two days with a total of 30 final-semester students participating in the drafting of their theses. The training materials included basic PLS concepts, measurement models, structural models, the operation of SmartPLS software, as well as the interpretation of analysis results. The methods used in this training comprised lectures, demonstrations, and hands-on practice. The results of this training showed an improved understanding of the PLS concept, the ability to operate PLS software, and the ability to correctly interpret analysis results by students. This training is expected to enhance the quality of students' research and better prepare them for the field of management.

Keyword: Quantitative Research; Partial Least Squares (PLS); Management Students.

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1. Introduction

Community engagement is essential for universities in Indonesia (Afandi *et al.*, 2022). This form of service is possible with several mechanisms. One of them is a form of service through students, who are one of the groups of people who are the spearheads of the progress of education and knowledge in Indonesia(Cahyono, 2019). Scientific research is an essential part of the development of science and technology. In the current era of globalization, the ability to conduct quality research is becoming increasingly important for students, especially management students. In management research, statistical analysis is an important part of processing and interpreting data accurately. Statistical analysis is an important part of management research to process and interpret data correctly. One of the popular and effective quantitative research methods is Partial Least Squares (PLS). PLS is a multivariate statistical technique that can be used to analyze the relationship between dependent variables and independent variables (Krishnan *et al.*, 2011).

Statistical techniques are the main instruments used to quantitatively analyze relationships. In general, these techniques are divided into two: (a) parametric and (b) non-parametric. Parametric techniques assume a completely normal distribution. Statistical techniques, whether parametric or non-parametric, can be used to find relationships between several variables in a linear manner. This technique of finding a linear relationship has its roots in the development of mathematical calculations and developed rapidly through the correlation coefficient in regression used or discovered by Pearson (Caldwell, 2012 ;Teguh Iman Santoso & Indrajaya, 2023).

This method is often applied in management research, marketing, human resources, and other fields. PLS is also a statistical method used to build prediction models and relationships between variables in research (Sahban, 2024). PLS has several strengths over other statistical methods, such as the ability to handle complex data, which means that PLS can be used to analyze data with more variables than the number of samples. Then the ability to handle non-normal data, which means PLS does not require normally distributed data, so it can be used to analyze various types of data. And the ability to build nonlinear models, which means PLS can be used to build complex and nonlinear prediction models.

However, based on observations made by researchers on the final thesis results of management students, they do not have sufficient understanding and ability to process data using PLS which can produce outputs as a basis for making conclusions from a study. A researcher should ideally process data into information with the assistance of available programs. This will speed up time, save costs and energy, and produce reports that are relevant to research needs(Anisa Muthia *et al.*, 2021). This difficulty is because they do not have the necessary knowledge or training to run the software (Juliandi, 2018). This can hinder the process of data analysis and accurate interpretation of research results. In reality, the ability to utilize data analysis methods such as PLS is one of the important skills to be possessed by management graduates (Irwan & Adam, 2015).

Therefore, training on the use of PLS analysis tools for management students is very important. With this training, students are expected to understand the basic concepts of PLS, operate PLS software properly, and interpret the analysis results appropriately. This will improve the quality of student research and prepare them for the world of work or further studies in management (Patradhiani *et al.*, 2022).

1.1. Activity Objectives

This activity aims to enhance the understanding and skills of management students in processing quantitative data using the Partial Least Squares (PLS) method. Through this training, students are expected to comprehend the basic concepts of PLS, operate SmartPLS software proficiently, and accurately interpret analysis results. Additionally, the training seeks to prepare students to complete their academic research, such as thesis writing, with higher quality outcomes. Moreover, this activity is designed to equip students with practical skills relevant to the demands of the professional world, particularly in the fields of management and data analysis.

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1.2. Benefits of Activities

This activity benefits management students by enhancing their understanding of the Partial Least Squares (PLS) method and their ability to process quantitative data effectively. Students will gain the skills to operate SmartPLS software and interpret analysis results more accurately, enabling them to complete their theses or other academic research with improved quality. Additionally, this training equips students with practical skills that are highly relevant to the demands of the professional world, particularly in management, marketing, and data analysis. Thus, this activity supports the development of students' abilities to make significant contributions to their chosen professions.

2. Method

The SEM model is a second-generation multivariate analysis method that allows authors to examine complex relationships between variables in order to obtain a complete picture of the complete model (Ghozali, 2017; Ferianda *et al.*, 2022). The method of implementing activities carried out to overcome student problems. The lack of understanding of data analysis tools using SEM PLS in empowering 6th Semester undergraduate students of the Faculty of Economics Management, Study Program of Muhammadiyah Sorong is as follows:

1) Identification stage: an empirical study was conducted on how important it is for students to have knowledge and understanding of research data analysis tools in the context of preparing a thesis (Rosadi *et al.*, 2022). Students of the Management Study Program are targeted in this training because of the problem-solving the study conducted on the thesis results of management students who have graduated. From the results of the study, it was found that there were still many students who did not understand the use of data analysis tools. In this training, the analytical tool used is SEM-PLS which has several advantages over the analytical tools that have been used by students.
2) Partner Selection Stage, at this stage, partner selection is carried out, namely undergraduate students of the Management study program, Faculty of Economics, Muhammadiyah Sorong University, class of 2021 or semester 6th who will complete the thesis. This partner has the potential to use the SEM -PLS analysis tool in completing his thesis so that it will speed up the thesis completion process.
3) Training Phase, the training will be held for 1 day with a workshop method where the team implementing the service activities presents theories and concepts as well as practices in using SEM-PLS. The content in this training includes (1) the importance of introducing data analysis tools used in research, one of which is SEM-PLS with the aim that partners know the types of data analysis tools and one of which is SEM-PLS, (2) training in inputting data into SEM-PLS and the stages in running SEM PLS, (3) training in interpreting the output of SEM-PLS so as to provide conclusions in research.
4) At the evaluation stage, partners (students) were asked to complete an oral test given by the team to evaluate the development of partner knowledge before and after the training.
5) The mentoring phase and the training provided in a short time have not been able to provide maximum results. Therefore, the service implementation team provides assistance to students who use SEM PLS4 in processing their research data.

3. Results and Discussion

3.1 Results of Community Service Implementation

This community engagement activity was attended by 30 students of the Management Study Program of the Faculty of Economics, Muhammadiyah Sorong. This community engagement activity was carried out on April 1, 2024. Students were very enthusiastic about participating in this

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training because this training was not obtained in the previous course. The first lecture was on parametric and non-parametric statistics and gave an overview of what tools should be used to complete the research. The next lesson was a comparison between PLS-SEM, CB-SEM, and GSCA. After that, the explanation of reflective and formative structural equation models. The comparison of regression vs SEM was also explained on this occasion. Then successively continued with running SmartPLS 3.3.3 software for simple models, running complex models, consistent PLS (CB-SEM), CTA and IPMA, and explaining the new rule of thumbs.

Figure 1. Training Activity Banner

Training activities are conducted interactively to ensure that students can understand the theory properly (Samaria et al., 2020). The training process also provides opportunities for questions and discussion. During the training, almost all students wanted to ask questions. Especially when simulating the use of SEM-PLS. because this application is new to them, so it requires adjustment and guidance.

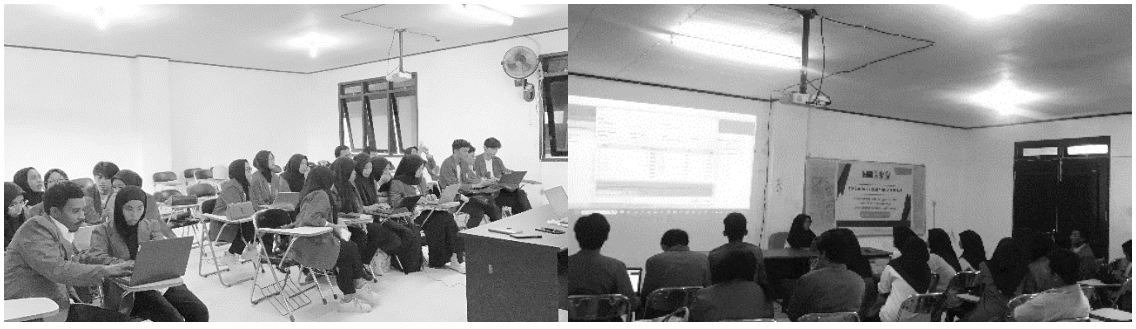

Figure 2. Students Practicing Using SEM-PLS

Students who bring laptops have the convenience to be more flexible in practicing the use of this analyzer. Some students did not bring laptops so that in the practice process made these students feel difficult. Because they cannot use SEM-PLS directly. The simulation data input process carried out by students uses data from the results of field lectures and statistical data sourced from official government websites.

During the oral evaluation stage, all students who were asked about data analysis tools were able to answer the question well. However, when practicing the use of SEM-PLS data analysis tools, some students are still unable to use the application. Students who have these obstacles are some

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students who do not bring laptops during the training. The short training time is also an obstacle for students in understanding this data analysis tool. Because of this, assistance will continue to be provided to students by opening opportunities for students who want to discuss and ask questions about the use of SEM-PLS outside of training.

3.2 Target Community

The target of this community engagement activity is final-year management students who are working on their theses and require skills in processing quantitative data using the Partial Least Squares (PLS) method. These students are expected to gain a deep understanding of data analysis to improve the quality of their academic research. Furthermore, this activity aims to equip students with practical data analysis skills that are relevant to the needs of the professional world, particularly in management, marketing, and human resources. Through this program, students are expected to effectively apply the PLS method in their research and future careers.

3.3 Discussion

The community engagement activity involved 30 students from the Management Study Program, Faculty of Economics, Muhammadiyah Sorong, conducted on April 1, 2024. Students showed high enthusiasm, as the training introduced knowledge and practical skills that had not been covered in prior courses, aligning with the principle of enhancing student involvement in educational development (Afandi *et al*., 2022). The training began with an explanation of parametric and non-parametric statistics, helping students understand the tools appropriate for their research. This was followed by a comparative discussion of PLS-SEM, CB-SEM, and GSCA, as well as reflective and formative structural equation models, which are essential for data analysis in management research (Juliandi, 2018).

Students were also introduced to regression versus SEM comparisons and trained to use SmartPLS 3.3.3 software. The hands-on activities included building simple and complex models, consistent PLS (CB-SEM), CTA, IPMA, and applying new rules of thumb for SEM-PLS. These sessions were crucial for bridging theoretical knowledge and practical application (Krishnan et al., 2011). Interactive methods, such as discussions and Q&A sessions, ensured student engagement, in line with effective pedagogical approaches for skill acquisition (Samaria *et al*., 2020). The use of simulation data from field lectures and official government statistics further enriched the training experience. However, some students faced challenges, particularly those who did not bring laptops, limiting their ability to practice the software directly. This issue is consistent with findings that technology accessibility is a critical factor in training success (Sahban, 2024).

During the evaluation stage, students demonstrated a good theoretical understanding of data analysis tools, with many successfully answering questions on SEM-PLS. However, some students struggled with practical application, especially those lacking prior exposure or immediate access to laptops. This aligns with previous findings that inadequate preparation and limited training time can hinder practical skill development (Cahyono, 2019). To address these challenges, follow-up support was provided through opportunities for consultation and discussions outside the training sessions. This ongoing assistance ensures that students can overcome initial difficulties and effectively utilize SEM-PLS tools in their research (Teguh Iman Santoso & Indrajaya, 2023). The training successfully laid the foundation for equipping students with practical data analysis skills critical for academic and professional success. Future programs should consider extending training durations and ensuring equal access to necessary tools to enhance learning outcomes.

4. Conclusion

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This community engagementprogram is very useful for management students who will take the stage of making a thesis, especially to provide an overview of parametric and non-parametric statistics, provide an overview of what tools should be used to complete their research, and provide practical training on how to use the SEM-PLS statistical tool with the SmartPLS application. Evaluation of the results of participant satisfaction shows that this activity is in accordance with the needs of the partners, the time of implementation of community engagementactivities in the form of training is relatively appropriate and sufficient, the material presented is clear and easy to understand, the committee provides good service during the activity, and participants accept and hope that activities like this will be continued in the future.

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