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Strengthening Student Research Competence through Structural Equation Modeling-Partial Least Squares (SEM-PLS) Training

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Abstract: *Management students' research competence requires strengthening because statistical software use is not always supported by methodological understanding and interpretation skills. This community engagement program aimed to provide conceptual knowledge and experience in applying partial least squares structural equation modeling (PLS-SEM) with SmartPLS. The training involved 25 students from the Department of Management, Faculty of Economics and Business, Universitas Pattimura, and combined lectures, demonstrations, guided practice, discussions, and data-analysis simulations. Program implementation was evaluated through attendance, engagement observations, discussion notes, and practical exercises. All participants arrived on time, all activities were completed as scheduled, and students actively participated in model specification and analysis simulations. The training fostered preliminary methodological understanding and SmartPLS experience. However, individual competency gains could not be quantified because no pretest or posttest was administered. These findings provide a foundation for tiered training and a methodology clinic to foster independent research and a data-driven academic culture.*
Keywords*: management students; PLS-SEM; research competence; SmartPLS; training*

1. INTRODUCTION

Research competence is a core academic capability that management students need to develop because research quality depends not only on accurately formulating research problems and developing hypotheses but also on selecting appropriate methods, analyzing data, evaluating models, and communicating findings scientifically. These demands become more pronounced when management research involves constructs that cannot be directly observed, mediation and moderation relationships, and simultaneous associations among multiple variables. Under such conditions, statistical proficiency should not be regarded merely as an additional skill but as an integral component of scientific reasoning. Marliana, (2021) explains that statistical proficiency enables researchers to minimize errors while improving the quality of research outputs. Without this competence, students may develop conceptually compelling research designs yet struggle to translate their ideas into empirically testable and academically defensible models.

One method that has become increasingly relevant to management research is partial least squares structural equation modeling (PLS-SEM). This method enables researchers to examine complex relationships between observed variables and latent constructs within an integrated model and can accommodate both explanatory and predictive research objectives. Sarstedt et al., (2022) state that PLS-SEM has developed into a standard method for analyzing complex relationships between observed variables and latent constructs. Its development has been further supported by SmartPLS, which provides a graphical interface that allows users to construct path models and perform estimations without programming expertise. Teeluckdharry et al., (2024) explain that its user-friendly interface and capacity to estimate complex models have encouraged the adoption of PLS-SEM across various business and social science disciplines. Consequently, proficiency in PLS-SEM has become increasingly important for management students whose research relies on primary data and latent constructs.

Despite the accessibility of the software, the ability to operate SmartPLS does not automatically indicate research competence. Students may be able to run the application and generate statistical output without being able to justify the selection of PLS-SEM, distinguish between measurement and structural models, determine appropriate evaluation criteria, or translate statistical results into substantive discussions. Sarstedt et al., (2014) caution that the growing

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adoption of PLS-SEM has also been accompanied by various forms of methodological misapplication, while Sarstedt, et al., (2022) demonstrate that inappropriate procedural decisions may lead to misleading conclusions. Several previous community engagement programs have attempted to address these concerns through SmartPLS training and have reported improvements in participants' understanding (Astuti & Bakri, 2021; Marliana, 2021; Wibisono et al., 2021). Nevertheless, the success of many previous programs has primarily been assessed through attendance, enthusiasm, satisfaction, and participants' general perceptions. Training that integrates methodological reasoning, analytical execution, and result interpretation as interrelated components of research competence is therefore still needed.

A comparable need was identified among students in the Department of Management, Faculty of Economics and Business, Universitas Pattimura. A preliminary needs assessment conducted through research supervision, academic discussions, and observations of data-analysis practices revealed three principal problems. First, some students lacked an adequate conceptual foundation for determining whether PLS-SEM was appropriate for their research objectives and data characteristics. Second, students continued to encounter technical difficulties in preparing data, specifying models, and evaluating validity, reliability, and structural relationships using SmartPLS. Third, students tended to interpret the results solely on the basis of the numerical values displayed by the software without being able to explain their statistical meaning or managerial implications. Similar difficulties were reported by Budiarsi, (2020) and Santoso and Indrajaya, (2023), particularly in data preparation, model specification, and result interpretation. Naz'aina et al., (2023) further indicate that these limitations may delay thesis completion and encourage students to rely on external data-analysis services without adequately understanding the methods applied.

To strengthen the baseline evidence while avoiding unsupported retrospective estimates, the preliminary needs assessment was structured into three observable domains: (1) methodological reasoning in selecting PLS-SEM, (2) technical ability to prepare data and perform SmartPLS procedures, and (3) ability to interpret statistical output. The available supervision records, academic discussions, and observations of data-analysis practices consistently identified difficulties in all three domains, giving a domain-level baseline coverage of 3 of 3 identified problem areas. This result indicates that assistance was required across the full set of competencies targeted by the program. Because the original needs assessment did not preserve participant-level frequency counts or pretraining scores, the baseline is reported at the domain level and is not converted into percentages of students. Table 1 presents the observable baseline evidence used to define the training priorities.

Table 1. Structured baseline evidence from the preliminary needs assessment

Assessment domain	Observable baseline difficulty	Evidence source	Baseline status
Methodological reasoning	Difficulty determining whether PLS-SEM was appropriate for the research objective and data characteristics.	Research supervision, academic discussions, and observations of data-analysis practices.	Difficulty identified; assistance required.
Technical SmartPLS skills	Difficulty in data preparation, model specification, and evaluation of validity, reliability, and structural relationships.	Research supervision, academic discussions, and observations of data-analysis practices.	Difficulty identified; assistance required.
Interpretive competence	Tendency to rely on numerical software output without adequately explaining its statistical meaning or managerial implications.	Research supervision, academic discussions, and observations of data-analysis practices.	Difficulty identified; assistance required.
Technical SmartPLS skills	Difficulty in data preparation, model specification, and evaluation of validity, reliability, and structural relationships.	Research supervision, academic discussions, and observations of data-analysis practices.	Difficulty identified; assistance required.
Interpretive competence	Tendency to rely on numerical software output without adequately explaining its statistical meaning or	Research supervision, academic discussions, and observations of data-analysis practices.	Difficulty identified; assistance required.

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managerial implications.

The gap between the methodological knowledge acquired through coursework and the practical skills required to conduct research provided the rationale for implementing this community engagement program for 25 students from the Department of Management, Faculty of Economics and Business, Universitas Pattimura. The training was designed around three complementary dimensions of competence: methodological reasoning, technical data-analysis skills, and interpretive competence. The first dimension concerns the ability to justify the use of PLS-SEM and construct a logically grounded research model. The second encompasses the ability to prepare data, specify a model, perform estimation, and evaluate both measurement and structural models. The third concerns the ability to explain statistical results, draw valid conclusions, and relate the findings to the research problem. These dimensions were developed through conceptual instruction, demonstrations, hands-on practice, discussions, and case-based simulations. This approach was adopted because practice-oriented assistance helps participants understand the connections among theoretical concepts, analytical procedures, and result interpretation more systematically (Astuti & Bakri, 2021; Marliana, 2021).

The principal contribution of the program, entitled “Strengthening Student Research Competence through Partial Least Squares Structural Equation Modeling (PLS-SEM) Training,” lies in shifting the focus from software familiarization toward the integrated development of research competence. Unlike training programs that concentrate primarily on operating SmartPLS, this initiative positions methodological decision-making as the foundation for using data-analysis technology. At the individual level, the training was intended to strengthen students’ independence in selecting appropriate methods, performing analyses, and defending their research findings. At the academic level, the program contributes to improving analytical accuracy, interpretive quality, and transparency in research reporting. At the institutional level, it addresses gaps in methodology education while providing a foundation for developing a methodology clinic or sustained research assistance at the Faculty of Economics and Business, Universitas Pattimura. Thus, the training not only introduced SmartPLS but also promoted the methodological reasoning required for students to produce more critical, independent, rigorous, and academically defensible management research.

2. METHODS

Implementation Approach

This community engagement program employed PLS-SEM training using a learning-by-doing approach. This approach was selected to ensure that students not only received conceptual explanations of PLS-SEM but also gained direct experience using SmartPLS to analyze research data. The training comprised five interconnected activities: conceptual instruction, software demonstrations, guided practice, discussions and question-and-answer sessions, and data-analysis simulations. Given the two-hour duration, the training focused on developing fundamental competencies. The team prepared a sample model and practice dataset in advance, allowing participants to concentrate on the analytical procedures. The training materials covered path-model specification, data entry, model estimation, validity and reliability assessment, structural model evaluation, and result interpretation. A similar combination of conceptual instruction, practical exercises, and guided assistance has been adopted in previous PLS-SEM training programs conducted by (Amusa & Hossana, 2024; Dwiyanawati et al., 2025; Hair et al., 2023; Rauf et al., 2025)

Assessment Instruments and Achievement Indicators

Program achievement was assessed using attendance records, an activity implementation checklist, discussion notes, simulation outputs, and a SmartPLS practice observation sheet. Attendance records were used to determine the student participation rate, while the implementation checklist documented the alignment between planned and completed activities. The practice observation sheet was developed according to the training objectives and covered five core

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competencies: specifying a path model based on a research framework, importing data, performing model estimation, evaluating measurement and structural models, and interpreting the results. Discussion notes served as supporting qualitative evidence for assessing students' ability to justify the use of PLS-SEM, identify analytical errors, and relate statistical findings to their research problems. Evaluating participants' practical outputs provides more direct evidence of their abilities than assessments based solely on satisfaction with program implementation (Amaro, 2015; Henseler et al., 2024; Ringle & Sarstedt, 2021).

To operationalize the five targeted competencies, the team prepared a four-point performance rubric summarized in Table 2. The rubric defined progressively higher levels of performance from inability to complete a task (score 1) to independent completion and explanation of results (score 4). The planned weighting was 20% for model specification, 10% for data entry, 15% for model estimation, 30% for measurement and structural model evaluation, and 25% for result interpretation. The intended competency categories were below 60 (not yet competent), 60-79 (competent with assistance), and at least 80 (independently competent). However, participant-level rubric sheets and individual analytical products were not archived systematically. Consequently, these criteria are retained as the program assessment framework, but individual competency scores and the proportion reaching the minimum score are not reported as empirical outcomes.

Table 2. Four-point competency assessment criteria

Score	Performance criterion	Operational interpretation
1	Unable to perform the task	The participant is unable to complete the required analytical task.
2	Completes the task only with full guidance	The participant can complete the task when step-by-step guidance is provided.
3	Completes the task with limited guidance	The participant can complete the task with occasional clarification or correction.

Table 2 converts the four-point scale into observable criteria, making the distinction between full guidance, limited guidance, and independent performance easier to apply and understand. Because participant-level score sheets were not retained, the table should be interpreted as the operational assessment framework used to guide observation rather than as evidence of quantified individual improvement.

Evaluation Data Collection and Analysis

During the practical session, the instructor and a facilitating team member used the same competency indicators and scoring guidance to observe participants' performance. Their observations were discussed when differences in judgment arose, allowing the team to reach a common interpretation of participants' difficulties and assistance needs. Although percentage agreement had been planned as an inter-rater consistency check, the participant-level score sheets required to calculate and report a reproducible agreement coefficient were not archived systematically. Accordingly, the present article reports only aggregate implementation evidence and qualitative observations that can be verified from the program documentation. Quantitative summaries are limited to indicators for which complete records were available, such as attendance and program completion; qualitative evidence from discussions, observations, and difficulties encountered during practice was categorized into conceptual understanding, technical skills, interpretive competence, and the need for further assistance (Wibisono et al., 2021). All findings were reported in aggregate form without disclosing participants' identities.

Measurement of Changes in the Target Group

In addition to SmartPLS skills, the evaluation examined changes in participants' attitudes and socio-academic interactions during the training. Attitudinal indicators included discipline, punctuality, seriousness in completing practical activities, active participation in discussions, persistence in completing analytical procedures, and confidence in explaining the results. Socio-academic changes

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were assessed through participants' involvement in discussions, willingness to assist their peers, ability to provide and respond to feedback, and confidence in communicating methodological difficulties. Evidence relating to these dimensions was obtained from the team's observation notes during conceptual instruction, guided practice, discussions, and simulations. These indicators were included because PLS-SEM training was intended not only to develop individual technical skills but also to foster collaborative and responsible learning practices in addressing research-related problems.

Economic outcomes were not treated as a direct indicator of program success because the training primarily focused on strengthening students' research competence. Nevertheless, the ability to analyze and interpret data independently may generate indirect economic benefits by reducing students' reliance on paid data-analysis services. Such benefits were not reported as actual economic impacts because no data were collected on changes in participants' research-related expenditures. Furthermore, because the program did not employ formal pretests and posttests, the evaluation findings were interpreted as evidence of the attainment of fundamental competencies following the training and indications of attitudinal change during the learning process. The findings were not used to estimate the magnitude of improvement or establish a causal relationship between the training and students' research competence. Instead, the evaluation was conducted to determine the extent to which the program objectives were achieved, identify areas that participants continued to find challenging, and formulate the need for sustained PLS-SEM assistance.

3. RESULTS AND DISCUSSION

The community engagement program on partial least squares structural equation modeling (PLS-SEM) was conducted on Friday, March 13, 2026, from 10:00 a.m. to 12:00 p.m. Eastern Indonesia Time at the Marketing Laboratory, Building C, Faculty of Economics and Business, Universitas Pattimura. The program involved 25 students from the Department of Management as its target participants. The training was designed to strengthen students' methodological understanding and provide introductory experience in using SmartPLS for research, particularly undergraduate thesis preparation. The program comprised registration, an opening session, instructional delivery, discussion and question-and-answer sessions, data-analysis simulations, and a closing session. All registered students arrived on time and participated in the activities as scheduled. The consistency between the number of registered attendees and actual participants indicated that the training addressed students' academic needs.

For clarity, the results are organized into three complementary forms of evidence: documentation of the learning process (Figures 1-4), program implementation and preliminary learning indicators summarized in Table 3, and closing documentation of the program (Figure 5). Each figure is referred to explicitly in the narrative and interpreted according to the stage of training it documents. The visual evidence is used to explain the learning process, whereas claims concerning program achievement are based on the documented indicators presented in Table 3.

The instructional session began with an explanation of the role of PLS-SEM in quantitative management research. Participants were introduced to the purposes of PLS-SEM, the characteristics of suitable data and research models, and its differences from simpler statistical techniques. The presentation also discussed circumstances in which PLS-SEM may be considered, including prediction-oriented studies, models involving latent constructs measured by multiple indicators, relatively complex research models, and datasets that do not fully satisfy normality assumptions. This conceptual foundation was necessary to prevent students from selecting SmartPLS solely because of its operational convenience. Memona et al., (2021) explain that PLS-SEM software offers a relatively user-friendly modeling interface and does not require programming expertise. Nevertheless, users must understand their research design and its methodological foundations to apply the software appropriately.

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As shown in Figure 1, the initial instructional stage focused on introducing the role of PLS-SEM in undergraduate thesis research. The figure documents the delivery of foundational material before participants moved to model-specification and software practice.



Figure 1. Initial presentation of PLS-SEM training materials for undergraduate thesis research
Source: Community Engagement Team documentation, 2026.

Following the general introduction, the instructor directed the discussion toward the relationships among research problems, constructs, indicators, and structural paths. This stage helped participants understand that a PLS-SEM model must be grounded in theoretical reasoning rather than merely created by drawing relationships among constructs within the software. Participants were also introduced to the logic underlying measurement and structural model specification, along with the general procedures for evaluating validity, reliability, and relationships among constructs. Emphasizing these components was essential because model misspecification can affect the entire estimation process and lead to inappropriate conclusions. Marliana, (2021) found that participants' difficulties in learning PLS-SEM generally emerged when they attempted to understand its algorithms, specify research models, and evaluate measurement and structural models. Therefore, management-related research examples were used to bridge conceptual explanations and practical applications.

Figure 2 illustrates the subsequent explanation of the research conditions and methodological requirements for applying PLS-SEM. This stage emphasized that method selection should be based on research objectives, construct characteristics, and model complexity rather than on software convenience alone.



Figure 2. Explanation of research conditions and requirements appropriate for PLS-SEM
Source: Community Engagement Team documentation, 2026.

The subsequent stage involved a simulation and hands-on practice using SmartPLS in the computer laboratory. Participants were guided through the software interface, data preparation and entry, construct and indicator specification, structural path development, and basic analytical procedures. Throughout the session, the instructor and facilitating team provided step-by-step guidance, enabling participants to follow the data-analysis process on their respective computers. Hands-on practice was adopted because statistical software proficiency cannot be developed through lectures alone. Students need to understand how conceptual models, data structures, estimation procedures, and software-generated outputs are interconnected. Astuti & Bakri, (2021)

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similarly combined presentations, demonstrations, practical exercises, discussions, and assistance in PLS-SEM training, enabling participants to learn data-analysis procedures while discussing difficulties encountered during practice.

Figure 3 shows participants applying the explained procedures directly on laboratory computers. The visual evidence supports the implementation of the learning-by-doing approach because participants were not limited to observing the instructor but followed the data-analysis sequence during the simulation.



Figure 3. Students participating in a data-analysis simulation using SmartPLS
Source: Community Engagement Team documentation, 2026.

The practical session facilitated interaction among the participants, instructor, and facilitating team. Rather than merely following on-screen instructions, participants engaged in discussions when they encountered differences in software displays, difficulties in understanding the data structure, or uncertainty regarding the sequence of analytical procedures. Such interaction was important because competence in applying PLS-SEM encompasses two interrelated dimensions: operational skills and interpretive understanding. Operational skills concern the ability to perform analytical procedures using the software, whereas interpretive understanding refers to the ability to explain the meaning of statistical outputs in relation to research hypotheses. Accordingly, the practical session was not intended merely to enable participants to execute software commands but also to develop their awareness that each statistical output must be interpreted according to the relevant theory, research model, and study objectives.

Figure 4 illustrates the mentoring process during practice, including interaction between participants and facilitators when methodological or technical difficulties arose. This assistance was particularly important because several analytical steps required clarification before participants could continue the procedure.



Figure 4. Mentoring and discussion during the data-analysis practice
Source: Community Engagement Team documentation, 2026.

Program achievement was evaluated using attendance data, adherence to the planned agenda, observations of participant engagement, interactive discussions, and participation in SmartPLS practice. These indicators were used to distinguish verified implementation performance

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from preliminary learning evidence. Table 3 summarizes the evaluation results and explicitly identifies where participant-level measurement was unavailable.

Table 3. Program implementation and preliminary learning-outcome indicators

Evaluation dimension	Success indicator	Measurement instrument orevidence	Observed result	Interpretation
Participation	Registered participants attended the program	Attendance records and documentation	All 25 registered participants attended and arrived on time	The participation target was achieved at 100%
Program implementation	All planned stages were completed according to the agenda	Program schedule and team observations	Registration, opening, presentation, discussion, simulation, and closing sessions were completed between 10:00 a.m. and 12:00 p.m.	The implementation target was achieved
Learning engagement	Participants attended the presentation and engaged in discussions	Observation sheet and discussion notes	Participants followed the materials and interacted during the question-and-answer and mentoring sessions	Learning engagement was qualitatively identified
Operational experience	Participants completed the SmartPLS simulation	Practice observations and documentation	Participants used the laboratory computers and followed the data-analysis procedures with assistance	Initial exposure and operational experience were achieved
Methodological understanding	Participants related the research model to the analytical procedures	Oral questions, interactive discussions, and practice observations	Oral questions, interactive discussions, and practice observations	Oral questions, interactive discussions, and practice observations
Independent proficiency	Participants completed and interpreted an analysis without assistance	Individual performance rubric and archived analytical product	Individual performance rubric and archived analytical product	Individual performance rubric and archived analytical product

Source: Processed from the program report and observation results, 2026.

As shown in Table 3, the strongest evidence concerns program implementation: all 25 registered participants attended and arrived on time, all scheduled stages were completed within the 10:00 a.m.-12:00 p.m. period, and participants took part in discussions and SmartPLS simulations. These indicators demonstrate that the program was delivered as planned and that participants received the intended learning opportunities. Evidence for learning outcomes is more limited. Discussion responses, practice observations, and mentoring interactions indicate preliminary methodological understanding and operational exposure, but the absence of archived participant-level rubric scores, individual analytical products, and a pretest-posttest comparison prevents estimation of the magnitude of competency improvement. Therefore, Table 3 deliberately distinguishes between verified implementation achievement and preliminary evidence of learning, avoiding claims that exceed the available documentation.

In terms of attitudinal change, punctual attendance and willingness to participate in the entire program indicated participants' acceptance of an analytical method that was relatively unfamiliar to some students. Hands-on practice also provided an opportunity for participants to reduce their uncertainty about operating statistical software. From a social and academic culture perspective, the program encouraged peer learning, discussion of methodological issues, and greater awareness that data analysis must be conducted systematically. However, these changes were preliminary and limited to the training context. Their sustainability should therefore be examined through participants' subsequent use of PLS-SEM in research proposals, undergraduate theses, or other research activities. Economic effects were not measured because the program primarily focused on strengthening academic capacity. Any economic benefits would likely arise indirectly over

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the longer term, such as through more efficient data analysis and thesis completion, and should therefore not be reported as direct outcomes of a two-hour training program.

The findings reinforce the view that data-analysis training should combine conceptual knowledge with practical experience. Naz'aina et al., (2023) demonstrate that PLS-SEM training is relevant to students preparing or completing undergraduate theses because it helps them understand data-processing procedures and output interpretation. This observation is consistent with the needs of students in the Department of Management at Universitas Pattimura, who require not only an alternative analytical tool but also an understanding of the methodological reasons underlying its selection. Thus, the program's principal contribution lies in narrowing the gap between research methodology taught in the classroom and the practical skills required when students begin working with empirical data.

The program's principal strengths were the relevance of the materials to students' academic needs, the availability of laboratory facilities for hands-on practice, and the assistance provided during the simulation. Focusing the training on undergraduate thesis research made the materials directly applicable to participants' academic interests. In addition, SmartPLS provides a visual modeling interface that helps students understand the relationships among constructs, indicators, and structural paths. The program's primary output was not a physical product but an educational service comprising methodological knowledge, experience in operating SmartPLS, and an introduction to systematic result interpretation. Therefore, the quality of the output depends primarily on the depth of learning and participants' ability to apply the acquired skills in their own research.

Despite these strengths, the program had several limitations. The two-hour duration was sufficient for an introduction and basic simulation but inadequate for an in-depth examination of measurement model assessment, structural model evaluation, bootstrapping, mediation and moderation analyses, and model prediction. Differences in students' prior knowledge also created varying levels of need for assistance. Participants unfamiliar with data preparation or conceptual model development required more time than those with previous exposure to multivariate analysis. Budiarsi, (2020) emphasizes that PLS-SEM proficiency generally cannot be developed optimally through only one or two training sessions; continued assistance is therefore required to help participants operate the software and interpret its outputs. Another limitation was the absence of pretests, posttests, performance rubrics, and archived analytical outputs for each participant. Consequently, substantive achievement at the individual level could not be objectively verified.

The primary implementation challenge was communicating methodological concepts and software procedures within a limited period. PLS-SEM requires not only the ability to operate the software accurately but also the competence to specify constructs, assign indicators, assess validity and reliability, and interpret structural relationships. Errors at an early stage, such as using an inappropriate data format or misspecifying the model, may affect subsequent analytical procedures. Astuti and Bakri, (2021); Santoso and Indrajaya, (2023); Sarstedt et al., (2014); and Sarstedt, Radomir, et al., (2022) similarly notes that technical challenges may arise when importing data and specifying research models. Accordingly, the availability of facilitators and computer facilities at the Marketing Laboratory supported program implementation, although developing independent proficiency among participants will require repeated practice.

The two-hour limitation was not merely a scheduling issue but reflected a mismatch between the breadth of competencies targeted and the sequential nature of PLS-SEM learning. Operationally, the 120-minute session had to accommodate five interconnected learning components conceptual instruction, software demonstration, guided practice, discussion and question-and-answer, and data-analysis simulation while also allowing time for participants to resolve technical difficulties. Participants were expected to understand method selection, data preparation, model specification, measurement-model assessment, structural-model evaluation, and result interpretation within this single session. These competencies are interdependent: misunderstanding during data preparation or model specification can delay estimation and subsequently weaken interpretation. The time

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constraint was intensified by differences in prior statistical knowledge and by the need for facilitators to troubleshoot software displays, data formats, and procedural errors during hands-on practice. Consequently, a meaningful part of the available time was devoted to guided correction rather than independent repetition, comparison of alternative outputs, and reflection on interpretation. This explains why the program could reasonably achieve introductory exposure and guided competence, but not independent mastery of advanced procedures such as bootstrapping, mediation, moderation, and predictive assessment. Budiarsi (2020) similarly emphasizes the need for continued assistance, while Astuti and Bakri (2021) show that practical PLS-SEM learning depends on iterative explanation, practice, and discussion.

Future program development should involve a tiered training structure comprising introductory classes, advanced classes, and a research methodology clinic. Introductory classes should focus on method selection, data preparation, and model specification. Advanced classes should cover measurement and structural model evaluation, bootstrapping, mediation, moderation, and predictive assessment. The research clinic should provide individualized assistance in applying PLS-SEM to participants' undergraduate thesis models. In future programs, each student should complete an individual analytical project assessed using a rubric covering model specification accuracy, data processing, model evaluation, result interpretation, and academic reporting. Pretests and posttests should also be administered to quantify changes in knowledge, while observation sheets, portfolios of SmartPLS outputs, and brief interviews could strengthen the qualitative evaluation.

Figure 5 documents the completion of the training with the community engagement team and participants. In the context of program evaluation, the figure serves as supporting documentation that the scheduled activity was completed with the target group, while competency claims continue to rely on the assessment evidence described in Table 3.



Figure 5. Community engagement team and participants following the PLS-SEM training
Source: Community Engagement Team documentation, 2026.

Overall, the PLS-SEM training was implemented according to the planned agenda and provided a learning process that integrated conceptual instruction, simulation, discussion, and mentoring. Its direct contribution was the provision of introductory experience in connecting research models with data-analysis procedures using SmartPLS. However, based on the available evidence, the outcomes should be interpreted as strengthened initial understanding and practical exposure rather than a fully measured improvement in individual competence. Sustaining the program through tiered training, performance-based assessment, and an undergraduate thesis research clinic would increase its potential to foster a more systematic, critical, and data-driven research culture within the Department of Management, Faculty of Economics and Business, Universitas Pattimura.

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4. CONCLUSION

The SmartPLS-assisted PLS-SEM training for 25 Management students at Universitas Pattimura was implemented as planned and achieved its immediate objective of providing conceptual exposure, guided analytical practice, and initial experience in linking research models with PLS-SEM procedures. All registered participants attended the full program, and the training covered method selection, model specification, data analysis, and interpretation. The findings therefore support successful program implementation and preliminary competence development at the guided-practice level. However, improvement in individual competence cannot be quantified because no pretest-posttest comparison and no complete archive of participant-level rubric scores or analytical products were available. The two hour duration also limited opportunities for independent practice and advanced PLS-SEM procedures.

For research oriented follow-up, future programs should use a documented pretest-posttest design, individual performance rubrics, and archived SmartPLS outputs so that changes in methodological and analytical competence can be measured objectively. For practical follow up, the Faculty should establish a structured research methodology clinic consisting of introductory PLS-SEM sessions, advanced analytical modules, and scheduled thesis-oriented consultations. The clinic should allow students to work with their own models and datasets, receive diagnostic feedback, repeat interpretation exercises, and document progress through individual portfolios. This sustained arrangement would address the limitations of a one-time two hour training session while strengthening students' independence and the Faculty's evidence based research culture.

DAFTAR PUSTAKA

Amaro, S. (2015). Comparing CB-SEM and PLS-SEM Results : An empirical example. *International Symposium on Partial Least Squares Path Modeling*, 1–7.

Amusa, L. B., & Hossana, T. (2024). An empirical comparison of some missing data treatments in PLS-SEM. *PLOS ONE*, 1–14. https://doi.org/10.1371/journal.pone.0297037

Astuti, N. P., & Bakri, R. (2021). Pelatihan Pengolahan Data Menggunakan Aplikasi Smart-PLS 3 Secara Online di Masa Pandemik Covid 19. *CARADDE: Jurnal Pengabdian Kepada Masyarakat*, *4*, 613–619. https://doi.org/https://doi.org/10.31960/caradde.v4i1.1134

Budiarsi, S. Y. (2020). PENDAMPINGAN PENGENALAN PROGRAM SEM-PLS PADA FAKULTAS EKONOMI UNIVERSITAS MERDEKA SURABAYA. *Jurnal Abdimas PeKA*, *3*(2), 126–134. https://doi.org/https://doi.org/10.33508/.v3i2.3001 A

Dwiyanawati, N., Kartika, C., & Subijanto. (2025). Pengaruh Pelatihan dan Kepemimpinan Terhadap Kinerja Pegawai Melalui Kepuasan Kerja di Inspektorat Kabupaten Bojonegoro. *Jurnal Ilmiah Ekonomi Dan Manajemen*, *3*(10), 12–23. https://doi.org/https://doi.org/10.61722/jiem.v3i10.6489

Hair, J. F., Sharma, P. N., Ringle, C. M., & Liengaard, B. D. (2023). The shortcomings of equal weights estimation and the composite equivalence index in PLS-SEM. *European Journal of Marketing*, *September 2026*. https://doi.org/10.1108/EJM-04-2023-0307

Henseler, J., Lee, N., Roemer, E., Kemény, I., Dirsehan, T., & Cadogan, J. W. (2024). Beware of the Woozle effect and belief perseverance in the PLS‐SEM literature ! *Electronic Commerce Research*, *24*(2), 715–744. https://doi.org/10.1007/s10660-024-09849-y

Marliana, R. R. (2021). Pelatihan pls-sem menggunakan smartpls 3.0 dosen mata kuliah statistika fisip uin sunan gunung djati bandung. *Jurnal Abdimas Sang Buana*, *02*(02), 43–50.

Memona, M. A., Ramayah, T., Cheah, J.-H., Ting, H., Chuah, F., & Cham, T. H. (2021). PLS-SEM STATISTICAL PROGRAMS : A REVIEW. *Journal of Applied Structural Equation Modeling*, *5*(1). https://doi.org/10.47263/JASEM.5(1)06

Naz'aina, Raza, H., & Faliza, N. (2023). Pelatihan Pengolahan Data menggunakan SEM PLS bagi Mahasiswa S1 Akuntansi FEB Universitas Malikussaleh. *Jurnal Malikussaleh Mengabdi*, *2*(1), 161–166. https://doi.org/https://doi.org/10. 29103/jmm.v1n1.xxx

Rauf, A., Dio, A., Awalia, N., Suwahyu, I., Jamaluddinn, A. Bin, & Fakhri, M. M. (2025). Pelatihan

Vol. 6, No. 6 -November 2026, Hal. 3628-3639
DOI: 10.59395/altifani.v6i6.1543

SmartPLS Berbasis Online sebagai Upaya Peningkatan Kompetensi Analisis Data Mahasiswa. *VOKATEK*, *03*(C), 177–184. https://doi.org/https://journal.diginus.id/index.php/VOKATEK/index

Ringle, C. M., & Sarstedt, M. (2021). *Partial Least Squares Structural Equation Modeling (PLS-SEM) Using R*.

Santoso, T. I., & Indrajaya, D. (2023). Penggunaan SEM – PLS dan Aplikasi SmartPLS Untuk Dosen dan Mahasiswa. *Jurnal Pengabdian Masyarakat Akademisi*, *2*(2), 97–103. https://doi.org/https://journal.adpebi.com/index.php/JPMA

Sarstedt, M., Hair, J. F., Pick, M., Liengaard, B. D., Radomir, L., & Ringle, C. M. (2022). Progress in partial least squares structural equation modeling use in marketing research in the last decade. *Psychology and Marketing*, *39*(5), 1035–1064. https://doi.org/10.1002/mar.21640

Sarstedt, M., Radomir, L., Moisescu, O. I., & Ringle, C. M. (2022). Latent class analysis in PLS-SEM: A review and recommendations for future applications. *Journal of Business Research*, *138*(September 2021), 398–407. https://doi.org/10.1016/j.jbusres.2021.08.051

Sarstedt, M., Ringle, C. M., & F.Hair, J. (2014). PLS-SEM : Looking Back and Moving Forward. *Long Range Planning*, *47*, 132–137. https://doi.org/10.1016/j.lrp.2014.02.008

Teeluckdharry, N. B., Teeroovengadum, V., & Seebaluck, A. K. (2024). A roadmap for the application of PLS-SEM and IPMA for effective service quality improvements. *TQM Journal*, *36*(5), 1300–1345. https://doi.org/10.1108/TQM-11-2021-0340

Wibisono, A., Destryana, R. A., & Ghufrony, A. (2021). Pelatihan Partial Least Square (PLS) Bagi Mahasiswa Oleh. *Jurnal Abdiraja*, *4*(September).