

Human Resource Competency Development and Work Productivity: The Mediating Role of Knowledge Management at The Palm Oil Research Center, Medan

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Abstract

This study examines the effect of human resource competency development on work productivity and tests the mediating role of knowledge management at the Palm Oil Research Center (PPKS) Medan. A quantitative, cross-sectional survey was conducted using 60 purposively selected employees and researchers who were involved in competency-development, research, and knowledge-sharing activities. Data were collected through a five-point Likert questionnaire and analyzed in IBM SPSS using item validity tests, Cronbach's alpha, classical-assumption tests, regression-based path analysis, and the Sobel test. Human resource competency development had a strong positive effect on knowledge management ($B = 0.568$, $\beta = 0.709$, $p < 0.001$) and a positive direct effect on work productivity ($B = 0.545$, $\beta = 0.461$, $p = 0.001$). Knowledge management also positively affected work productivity ($B = 0.465$, $\beta = 0.315$, $p = 0.019$). The first model explained 50.3% of the variance in knowledge management, whereas the second model explained 51.7% of the variance in work productivity. Recalculation of the indirect effect using the mediator-to-outcome coefficient produced a Sobel statistic of 2.299 ($p = 0.022$), indicating partial mediation. The findings demonstrate that competency development produces stronger productivity gains when employee knowledge is systematically created, documented, shared, and applied. PPKS Medan should therefore integrate competency mapping, continuous learning, mentoring, communities of practice, and a searchable institutional knowledge repository within a unified human-resource and knowledge-management strategy.

Keywords: human resource competency development; knowledge management; work productivity; mediation; research organization

Abstrak

Penelitian ini menganalisis pengaruh pengembangan kompetensi sumber daya manusia terhadap produktivitas kerja serta menguji peran mediasi manajemen pengetahuan pada Pusat Penelitian Kelapa Sawit (PPKS) Medan. Penelitian menggunakan survei kuantitatif potong lintang terhadap 60 pegawai dan peneliti yang dipilih secara purposif berdasarkan keterlibatan mereka dalam pengembangan kompetensi, kegiatan penelitian, dan berbagi pengetahuan. Data dikumpulkan melalui kuesioner skala Likert lima poin dan dianalisis dengan IBM SPSS melalui uji validitas butir, reliabilitas Cronbach's alpha, uji asumsi klasik, analisis jalur berbasis regresi, dan uji Sobel. Pengembangan kompetensi SDM berpengaruh positif kuat terhadap manajemen pengetahuan ($B = 0,568$; $\beta = 0,709$; $p < 0,001$) dan berpengaruh langsung terhadap produktivitas kerja ($B = 0,545$; $\beta = 0,461$; $p = 0,001$). Manajemen pengetahuan juga berpengaruh positif terhadap produktivitas kerja ($B = 0,465$; $\beta = 0,315$; $p = 0,019$). Model pertama menjelaskan 50,3% variasi manajemen pengetahuan, sedangkan model kedua menjelaskan 51,7% variasi produktivitas kerja. Perhitungan ulang efek tidak langsung dengan menggunakan koefisien jalur mediator ke variabel hasil menghasilkan statistik Sobel sebesar 2,299 ($p = 0,022$), sehingga menunjukkan mediasi parsial. Temuan ini menegaskan bahwa manfaat pengembangan kompetensi terhadap produktivitas menjadi lebih kuat apabila pengetahuan pegawai diciptakan, didokumentasikan, dibagikan, dan diterapkan secara sistematis. Oleh karena itu, PPKS Medan perlu mengintegrasikan pemetaan kompetensi, pembelajaran berkelanjutan, mentoring, komunitas praktik, dan repositori pengetahuan institusional dalam satu strategi pengelolaan SDM dan pengetahuan.

Kata kunci: pengembangan kompetensi SDM; manajemen pengetahuan; produktivitas kerja; mediasi; organisasi penelitian

INTRODUCTION

Knowledge-intensive organizations increasingly depend on human resources not merely as labor inputs but as repositories and creators of specialized knowledge. Human capital theory explains that education, experience, skills, and work-related capabilities are investments that can generate future productivity, while multilevel human-capital scholarship emphasizes that individual knowledge becomes strategically valuable when it is combined and mobilized at the organizational level. This logic is especially relevant to research institutions, where scientific quality, innovation speed, and the usability of research outputs are inseparable from the competence of researchers and supporting employees.¹

From a strategic-management perspective, competencies become a source of sustained advantage when they are valuable, difficult to imitate, and embedded in organizational routines. Empirical evidence also shows that human-capital investments are more strongly related to operational performance when the knowledge involved is organization-specific and when human-resource systems enable employees to deploy their capabilities effectively. Accordingly, competency development should be treated as a strategic architecture rather than as a collection of isolated training events.² Competent individuals, however, do not automatically create a knowledgeable organization. Knowledge must be generated, articulated, retained, transferred, and applied through processes that connect individual expertise with collective routines. Knowledge-management research therefore distinguishes between the possession of knowledge and the organizational capacity to convert tacit experience into explicit, accessible, and reusable knowledge. Without this conversion, valuable insights may remain personal, disappear when employees move, or be repeatedly rediscovered by different units.³

The knowledge-based view of the firm further proposes that coordination and integration of specialized knowledge are central organizational tasks. Infrastructure, culture,

¹ T W Schultz, "Investment in Human Capital," *American Economic Review* 51, no. 1 (1961): 1–17; G S Becker, *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*, 3rd ed. (University of Chicago Press, 1993); R E Ployhart and T P Moliterno, "Emergence of the Human Capital Resource: A Multilevel Model," *Academy of Management Review* 36, no. 1 (2011): 127–50, <https://doi.org/10.5465/amr.2009.0318>.

² J B Barney, "Firm Resources and Sustained Competitive Advantage," *Journal of Management* 17, no. 1 (1991): 99–120, <https://doi.org/10.1177/014920639101700108>; P M Wright, G C McMahan, and A McWilliams, "Human Resources and Sustained Competitive Advantage: A Resource-Based Perspective," *The International Journal of Human Resource Management* 5, no. 2 (1994): 301–26, <https://doi.org/10.1080/095851994000000020>; D P Lepak and S A Snell, "The Human Resource Architecture: Toward a Theory of Human Capital Allocation and Development," *Academy of Management Review* 24, no. 1 (1999): 31–48, <https://doi.org/10.5465/amr.1999.1580439>.

³ I Nonaka, "A Dynamic Theory of Organizational Knowledge Creation," *Organization Science* 5, no. 1 (1994): 14–37, <https://doi.org/10.1287/orsc.5.1.14>; M Alavi and D E Leidner, "Review: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues," *MIS Quarterly* 25, no. 1 (2001): 107–36, <https://doi.org/10.2307/3250961>; T H Davenport and L Prusak, *Working Knowledge: How Organizations Manage What They Know* (Harvard Business School Press, 1998); L Argote and P Ingram, "Knowledge Transfer: A Basis for Competitive Advantage in Firms," *Organizational Behavior and Human Decision Processes* 82, no. 1 (2000): 150–69, <https://doi.org/10.1006/obhd.2000.2893>.

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information systems, and leadership can either facilitate or inhibit knowledge creation and transfer. Organizations that establish supportive knowledge processes are more likely to turn expertise into improved decisions, innovation, and performance, whereas fragmented documentation and weak sharing norms reduce the value that can be extracted from employee competence.⁴ Work productivity should also be understood as a multidimensional outcome. At the employee level, productivity involves the quantity and quality of output, efficient use of time and resources, consistency, initiative, and contribution to organizational goals. This broader conception is important in research organizations because productivity cannot be reduced to the number of completed tasks; it must also reflect accuracy, scientific rigor, timeliness, usefulness, and continuity of performance.⁵

The Palm Oil Research Center (PPKS) Medan operates in a context in which research quality and responsiveness depend on the continuous renewal of technical and scientific expertise. Employees must absorb developments in agronomy, biotechnology, processing, data analysis, and industry regulation, while simultaneously transferring experience across projects and generations of personnel. In such a setting, competency development can enhance absorptive capacity, but the organizational benefits will remain limited unless acquired knowledge is integrated into routines, repositories, collaborative practices, and research decision making.⁶ Prior studies have established separate links between training or competence and performance, and between knowledge-management practices and organizational outcomes. Nevertheless, the empirical literature still shows variation in how knowledge processes translate human-capital investments into individual productivity,

⁴ B Kogut and U Zander, "Knowledge of the Firm, Combinative Capabilities, and the Replication of Technology," *Organization Science* 3, no. 3 (1992): 383–97, <https://doi.org/10.1287/orsc.3.3.383>; R M Grant, "Toward a Knowledge-Based Theory of the Firm," *Strategic Management Journal* 17, no. S2 (1996): 109–22, <https://doi.org/10.1002/smj.4250171110>; A H Gold, A Malhotra, and A H Segars, "Knowledge Management: An Organizational Capabilities Perspective," *Journal of Management Information Systems* 18, no. 1 (2001): 185–214, <https://doi.org/10.1080/07421222.2001.11045669>; H Lee and B Choi, "Knowledge Management Enablers, Processes, and Organizational Performance: An Integrative View and Empirical Examination," *Journal of Management Information Systems* 20, no. 1 (2003): 179–228, <https://doi.org/10.1080/07421222.2003.11045756>.

⁵ S Tangen, "Demystifying Productivity and Performance," *International Journal of Productivity and Performance Management* 54, no. 1 (2005): 34–46, <https://doi.org/10.1108/17410400510571437>; C Syverson, "What Determines Productivity," *Journal of Economic Literature* 49, no. 2 (2011): 326–65, <https://doi.org/10.1257/jel.49.2.326>; L Koopmans et al., "Conceptual Frameworks of Individual Work Performance: A Systematic Review," *Journal of Occupational and Environmental Medicine* 53, no. 8 (2011): 856–66, <https://doi.org/10.1097/JOM.0b013e318226a763>; J P Campbell and B M Wiernik, "The Modeling and Assessment of Work Performance," *Annual Review of Organizational Psychology and Organizational Behavior* 2 (2015): 47–74, <https://doi.org/10.1146/annurev-orgpsych-032414-111427>.

⁶ W M Cohen and D A Levinthal, "Absorptive Capacity: A New Perspective on Learning and Innovation," *Administrative Science Quarterly* 35, no. 1 (1990): 128–52, <https://doi.org/10.2307/2393553>; S A Zahra and G George, "Absorptive Capacity: A Review, Reconceptualization, and Extension," *Academy of Management Review* 27, no. 2 (2002): 185–203, <https://doi.org/10.5465/amr.2002.6587995>; D J Teece, "Explicating Dynamic Capabilities: The Nature and Microfoundations of Sustainable Enterprise Performance," *Strategic Management Journal* 28, no. 13 (2007): 1319–50, <https://doi.org/10.1002/smj.640>; M Subramaniam and M A Youndt, "The Influence of Intellectual Capital on the Types of Innovative Capabilities," *Academy of Management Journal* 48, no. 3 (2005): 450–63, <https://doi.org/10.5465/amj.2005.17407911>.

particularly in public or research-oriented organizations. Reviews of the field call for more context-sensitive models that connect human-resource practices, knowledge processes, and operational outcomes rather than treating them as independent domains.⁷

This study addresses that gap by examining knowledge management as a mechanism through which human resource competency development influences work productivity at PPKS Medan. The study has four objectives: to assess the direct effect of competency development on knowledge management, to examine the direct effects of competency development and knowledge management on work productivity, to test the indirect or mediating effect of knowledge management, and to formulate managerial implications for an integrated competency and knowledge strategy. The proposed model contributes by positioning knowledge management not simply as an additional predictor, but as an organizational conversion process that helps transform employee competence into productive output.

THEORETICAL FOUNDATIONS

Human Capital Theory and the Strategic Value of Competency

Human Capital Theory views knowledge, skills, abilities, and health-related capacities as productive assets in which individuals and organizations can invest. Education and development are expected to raise future performance because they improve employees' capacity to solve problems, adapt to technological change, and perform complex tasks. In organizational research, this perspective supports the proposition that planned competency development can create productivity benefits that exceed the immediate cost of training.⁸ Strategic human-capital research extends this argument by distinguishing between generic skills and context-specific capabilities. Competencies become more valuable when they are aligned with organizational requirements and embedded in complementary employment systems, team interactions, and work routines. A human-resource architecture therefore needs differentiated development, deployment, and retention practices so that individual competence can emerge as a collective resource.⁹

⁷ H Inkinen, "Review of Empirical Research on Knowledge Management Practices and Firm Performance," *Journal of Knowledge Management* 20, no. 2 (2016): 230–57, <https://doi.org/10.1108/JKM-09-2015-0336>; T Andreeva and A Kianto, "Does Knowledge Management Really Matter," *Linking Knowledge Management Practices, Competitiveness and Economic Performance. Journal of Knowledge Management* 16, no. 4 (2012): 617–36, <https://doi.org/10.1108/13673271211246185>; J Darroch, "Knowledge Management, Innovation and Firm Performance," *Journal of Knowledge Management* 9, no. 3 (2005): 101–15, <https://doi.org/10.1108/13673270510602809>; M Zack, J McKeen, and S Singh, "Knowledge Management and Organizational Performance: An Exploratory Analysis," *Journal of Knowledge Management* 13, no. 6 (2009): 392–409, <https://doi.org/10.1108/13673270910997088>.

⁸ Schultz, "Investment in Human Capital"; Becker, *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*.

⁹ Lepak and Snell, "The Human Resource Architecture: Toward a Theory of Human Capital Allocation and Development"; D P Lepak and S A Snell, "Examining the Human Resource Architecture: The Relationships among Human Capital, Employment, and Human Resource Configurations," *Journal of Management* 28, no. 4 (2002): 517–43, <https://doi.org/10.1177/014920630202800403>; Ployhart and Moliterno, "Emergence of the Human Capital Resource: A Multilevel Model."

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Meta-analytic and systems-based studies indicate that human capital and coherent bundles of human-resource practices are positively associated with operational and organizational performance. The relationship is not purely automatic: employee ability must be supported by motivation and opportunities to contribute, while organizational processes must enable the acquired knowledge to be used. This conditional view provides the theoretical basis for introducing knowledge management as a mediating mechanism.¹⁰

Human Resource Competency Development

Human resource competency development refers to systematic activities that strengthen employees' job-relevant knowledge, technical and interpersonal skills, professional attitudes, and participation in continuous learning. Effective development begins with a diagnosis of role requirements and competency gaps, followed by appropriate learning design, opportunities for practice, feedback, transfer support, and evaluation. Research consistently shows that well-designed training and workplace learning improve individual capability and can contribute to team and organizational outcomes.¹¹ The value of development depends not only on training attendance but also on learning motivation, perceived relevance, opportunities to apply new skills, and the social environment surrounding knowledge exchange. Employees who understand the purpose of learning and receive support for application are more likely to transfer acquired competence into daily behavior. Development practices should therefore connect formal training with coaching, peer learning, challenging assignments, and knowledge-sharing opportunities.¹²

In this study, the construct is operationalized through four dimensions: mastery of job-related knowledge, practical work skills, professional work attitudes, and participation in training and development. These dimensions represent both the stock of competence available to employees and the organizational processes through which that competence is

¹⁰ T R Crook et al., "Does Human Capital Matter," *A Meta-Analysis of the Relationship between Human Capital and Firm Performance. Journal of Applied Psychology* 96, no. 3 (2011): 443–56, <https://doi.org/10.1037/a0022147>; M Subramony, "A Meta-Analytic Investigation of the Relationship between HRM Bundles and Firm Performance," *Human Resource Management* 48, no. 5 (2009): 745–68, <https://doi.org/10.1002/hrm.20315>; K Jiang et al., "How Does Human Resource Management Influence Organizational Outcomes," *A Meta-Analytic Investigation of Mediating Mechanisms. Academy of Management Journal* 55, no. 6 (2012): 1264–94, <https://doi.org/10.5465/amj.2011.0088>.

¹¹ H Aguinis and K Kraiger, "Benefits of Training and Development for Individuals and Teams, Organizations, and Society," *Annual Review of Psychology* 60 (2009): 451–74, <https://doi.org/10.1146/annurev.psych.60.110707.163505>; B S Bell et al., "100 Years of Training and Development Research: What We Know and Where We Should Go," *Journal of Applied Psychology* 102, no. 3 (2017): 305–23, <https://doi.org/10.1037/apl0000142>; E Salas et al., "The Science of Training and Development in Organizations: What Matters in Practice," *Psychological Science in the Public Interest* 13, no. 2 (2012): 74–101, <https://doi.org/10.1177/1529100612436661>; R A Noe, A D M Clarke, and H J Klein, "Learning in the Twenty-First-Century Workplace," *Annual Review of Organizational Psychology and Organizational Behavior* 1 (2014): 245–75, <https://doi.org/10.1146/annurev-orgpsych-031413-091321>.

¹² J A Colquitt, J A LePine, and R A Noe, "Toward an Integrative Theory of Training Motivation: A Meta-Analytic Path Analysis of 20 Years of Research," *Journal of Applied Psychology* 85, no. 5 (2000): 678–707, <https://doi.org/10.1037/0021-9010.85.5.678>; A Cabrera, W C Collins, and J F Salgado, "Determinants of Individual Engagement in Knowledge Sharing," *The International Journal of Human Resource Management* 17, no. 2 (2006): 245–64, <https://doi.org/10.1080/095851905000404614>.

renewed. The operationalization is appropriate for a research institution because scientific work requires current conceptual knowledge, methodological skill, disciplined professional behavior, and recurrent exposure to new techniques and evidence.¹³

Knowledge Management

Knowledge management is the coordinated process through which organizations create or acquire knowledge, retain it in individual and organizational memory, share it among members, and apply it to decisions and work processes. The distinction between tacit and explicit knowledge is central: tacit knowledge is rooted in experience and is often difficult to articulate, whereas explicit knowledge can be documented, codified, and transferred more readily. Effective knowledge management connects both forms through interaction, reflection, documentation, and reuse.¹⁴ Knowledge-management capability depends on both infrastructure and process. Structural arrangements, information technology, organizational culture, and leadership provide the enabling conditions, while acquisition, conversion, sharing, and application constitute the operational processes. Studies show that organizations with stronger knowledge infrastructure and processes tend to report better innovation, responsiveness, and performance, although the magnitude of the relationship varies by context and implementation quality.¹⁵

Knowledge sharing is particularly important because it determines whether individual expertise becomes accessible to colleagues. Sharing is affected by trust, reciprocity, perceived costs, professional identity, technology, and opportunities for interaction. When employees actively exchange experience and apply one another's insights, knowledge management can reduce duplicated effort, accelerate problem solving, and support individual work performance.¹⁶ The present study measures knowledge management through knowledge creation, knowledge sharing, and knowledge utilization. Creation captures the generation and acquisition of new insights; sharing captures the dissemination of experience and information

¹³ Noe, Clarke, and Klein, "Learning in the Twenty-First-Century Workplace"; Aguinis and Kraiger, "Benefits of Training and Development for Individuals and Teams, Organizations, and Society."

¹⁴ Nonaka, "A Dynamic Theory of Organizational Knowledge Creation"; Alavi and Leidner, "Review: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues"; D Hislop, R Bosua, and R Helms, *Knowledge Management in Organizations: A Critical Introduction*, 4th ed. (Oxford University Press, 2018); L Argote, *Organizational Learning: Creating, Retaining and Transferring Knowledge*, 2nd ed. (Springer, 2013).

¹⁵ Gold, Malhotra, and Segars, "Knowledge Management: An Organizational Capabilities Perspective"; Lee and Choi, "Knowledge Management Enablers, Processes, and Organizational Performance: An Integrative View and Empirical Examination"; Darroch, "Knowledge Management, Innovation and Firm Performance"; Zack, McKeen, and Singh, "Knowledge Management and Organizational Performance: An Exploratory Analysis."

¹⁶ S Wang and R A Noe, "Knowledge Sharing: A Review and Directions for Future Research," *Human Resource Management Review* 20, no. 2 (2010): 115–31, <https://doi.org/10.1016/j.hrmr.2009.10.001>; K Henttonen, A Kianto, and P Ritala, "Knowledge Sharing and Individual Work Performance: An Empirical Study of a Public Sector Organisation," *Journal of Knowledge Management* 20, no. 4 (2016): 749–68, <https://doi.org/10.1108/JKM-10-2015-0414>; L Razmerita, K Kirchner, and P Nielsen, "What Factors Influence Knowledge Sharing in Organizations," *A Social Dilemma Perspective of Social Media Communication. Journal of Knowledge Management* 20, no. 6 (2016): 1225–46, <https://doi.org/10.1108/JKM-03-2016-0112>.

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among employees; and utilization captures the integration of knowledge into work execution and decisions. These dimensions reflect the conversion of competence into an organizationally usable resource.¹⁷

Work Productivity

Productivity is commonly defined as the relationship between outputs and the resources used to produce them, but this ratio must be interpreted in relation to quality, effectiveness, and organizational objectives. A narrow emphasis on output volume may encourage speed at the expense of accuracy or value. For knowledge work, productivity therefore includes the ability to deliver relevant and high-quality outcomes while using time, information, and organizational resources responsibly.¹⁸ At the individual level, work performance encompasses task proficiency, adaptive behavior, initiative, and contextual contribution. Systematic reviews recommend multidimensional measurement because no single indicator adequately captures employee productivity across different occupations. In the present study, productivity is represented by quantity, quality, efficiency, consistency, initiative, and contribution to organizational targets.¹⁹

Relationships among Competency Development, Knowledge Management, and Productivity

Competency development and knowledge management

Employees with stronger knowledge and skills are better able to recognize valuable information, assimilate new evidence, combine it with prior experience, and communicate it to others. Competency development can therefore strengthen organizational absorptive capacity and the quality of knowledge creation and sharing. When development activities are linked to collaborative work and documentation, individual learning is more likely to become organizational learning.²⁰

H1: Human resource competency development has a positive effect on knowledge management.

Competency development and work productivity

Competency development should improve productivity because knowledgeable and skilled employees can execute tasks more accurately, solve problems more quickly, and adapt their behavior to changing work requirements. Training research and human-capital meta-

¹⁷ Alavi and Leidner, "Review: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues"; Andreeva and Kianto, "Does Knowledge Management Really Matter."

¹⁸ Syverson, "What Determines Productivity"; Tangen, "Demystifying Productivity and Performance."

¹⁹ Koopmans et al., "Conceptual Frameworks of Individual Work Performance: A Systematic Review"; Campbell and Wiernik, "The Modeling and Assessment of Work Performance."

²⁰ Cohen and Levinthal, "Absorptive Capacity: A New Perspective on Learning and Innovation"; Zahra and George, "Absorptive Capacity: A Review, Reconceptualization, and Extension"; M M Crossan, H W Lane, and R E White, "An Organizational Learning Framework: From Intuition to Institution," *Academy of Management Review* 24, no. 3 (1999): 522–37, <https://doi.org/10.5465/amr.1999.2202135>.

analysis indicate positive effects on job-related behavior and operational performance, particularly when learning is relevant and supported in the workplace.²¹

H2: Human resource competency development has a positive effect on work productivity.

Knowledge management and work productivity

Knowledge management can increase productivity by reducing information-search costs, avoiding repeated mistakes, accelerating access to expertise, and enabling employees to apply proven solutions. Evidence from public-sector and business settings shows that knowledge sharing and knowledge-management processes are associated with individual performance and broader organizational outcomes.²²

H3: Knowledge management has a positive effect on work productivity.

The mediating role of knowledge management

Competency represents the potential to perform, whereas knowledge management represents the organizational process through which that potential is connected, retained, and applied. Learning that remains isolated at the individual level may improve personal capability but generate limited spillover. By contrast, knowledge transfer, organizational memory, and knowledge-oriented leadership can amplify the productivity impact of competency development across tasks and units.²³

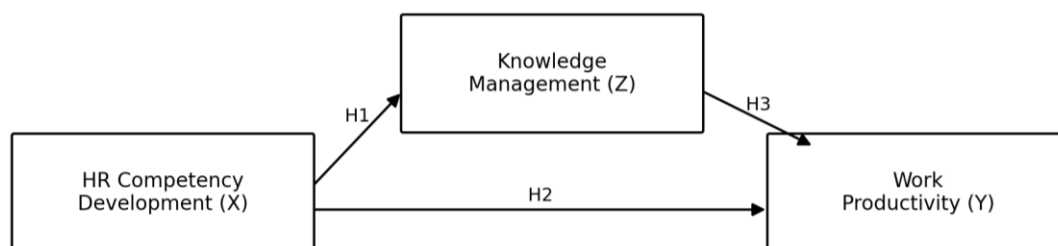
H4: Knowledge management mediates the effect of human resource competency development on work productivity.

²¹ Aguinis and Kraiger, "Benefits of Training and Development for Individuals and Teams, Organizations, and Society"; Salas et al., "The Science of Training and Development in Organizations: What Matters in Practice"; Crook et al., "Does Human Capital Matter."

²² Henttonen, Kianto, and Ritala, "Knowledge Sharing and Individual Work Performance: An Empirical Study of a Public Sector Organisation"; Andreeva and Kianto, "Does Knowledge Management Really Matter"; A Kianto, J Sáenz, and N Aramburu, "Knowledge-Based Human Resource Management Practices, Intellectual Capital and Innovation," *Journal of Business Research* 81 (2017): 11–20, <https://doi.org/10.1016/j.jbusres.2017.07.018>.

²³ Argote and Ingram, "Knowledge Transfer: A Basis for Competitive Advantage in Firms"; M J Donate and J D S de Pablo, "The Role of Knowledge-Oriented Leadership in Knowledge Management Practices and Innovation," *Journal of Business Research* 68, no. 2 (2015): 360–70, <https://doi.org/10.1016/j.jbusres.2014.06.022>; Teece, "Explicating Dynamic Capabilities: The Nature and Microfoundations of Sustainable Enterprise Performance."

Figure 1. Conceptual Framework



H4: Knowledge management mediates the relationship between HR competency development and work productivity.

METHOD

The study used an explanatory quantitative design with a cross-sectional survey. This design was selected because the objective was to estimate the direction and magnitude of relationships among human resource competency development, knowledge management, and work productivity at one point in time. Regression-based path analysis was used to decompose direct and indirect relationships in a parsimonious mediation model.²⁴ The research setting was the Palm Oil Research Center (PPKS) Medan. The unit of analysis was the individual employee. The model focused on employees' perceptions of their competency development, the organization's knowledge-management processes, and their own work productivity. Because all constructs were collected through a single questionnaire, interpretation emphasizes statistical association rather than definitive causal proof.²⁵

The population comprised staff members of PPKS Medan. Purposive sampling was used to identify employees and researchers who were actively involved in competency-development activities, research work, or knowledge-sharing processes. A total of 60 usable responses were analyzed. The sample supports estimation of the study's two-predictor regression model, but the nonprobability sampling strategy and single-institution context restrict statistical generalization beyond the organization.²⁶

All variables were measured with a five-point Likert-type response format. Human resource competency development consisted of eight items covering knowledge mastery, work skills, professional attitudes, and participation in training. Knowledge management consisted of six items covering knowledge creation, sharing, and utilization. Work productivity consisted of ten items covering quantity, quality, efficiency, consistency, initiative, and contribution. The conceptual basis of the measures was aligned with established literature on workplace learning, knowledge processes, and individual work performance.²⁷

²⁴ A Field, *Discovering Statistics Using IBM SPSS Statistics*, 5th ed. (Sage, 2018); J F Hair et al., *Multivariate Data Analysis*, 8th ed. (Cengage, 2019).

²⁵ P M Podsakoff et al., "Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies," *Journal of Applied Psychology* 88, no. 5 (2003): 879–903, <https://doi.org/10.1037/0021-9010.88.5.879>.

²⁶ Hair et al., *Multivariate Data Analysis*.

²⁷ Noe, Clarke, and Klein, "Learning in the Twenty-First-Century Workplace"; Alavi and Leidner, "Review: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research

Table 1. Operationalization of Research Variables

Variable	Dimensions	Items	Measurement basis
HR competency development (X)	Knowledge mastery; work skills; professional attitudes; training participation	8	Workplace learning and competency development
Knowledge management (Z)	Knowledge creation; knowledge sharing; knowledge utilization	6	Knowledge-process perspective
Work productivity (Y)	Quantity; quality; efficiency; consistency; initiative; contribution	10	Multidimensional individual performance

Item validity was examined by comparing item-total correlations with the critical Pearson correlation value of 0.254 for 60 observations at the five-percent significance level. Internal consistency was evaluated using Cronbach's alpha, with values around or above 0.70 interpreted as acceptable for research use. Reliability coefficients should be understood as evidence of score consistency rather than proof of construct validity.²⁸ Before hypothesis testing, residual normality and heteroscedasticity were assessed, and variance inflation factors were examined for multicollinearity. Model 1 regressed knowledge management on competency development. Model 2 regressed work productivity on both competency development and knowledge management. The coefficient of determination and F test were used to evaluate explanatory power and overall model significance, while t tests evaluated individual paths.²⁹

Mediation was assessed from the unstandardized coefficients and standard errors of the X-to-Z path and the Z-to-Y path. The indirect effect was calculated as $a \times b$, and its significance was evaluated using the Sobel statistic. Because contemporary mediation analysis generally recommends bootstrap confidence intervals, the Sobel result is treated as supportive evidence and should be replicated with resampling in future research.³⁰

Issues"; Koopmans et al., "Conceptual Frameworks of Individual Work Performance: A Systematic Review."

²⁸ J C Nunnally and I H Bernstein, *Psychometric Theory*, 3rd ed. (McGraw-Hill, 1994); L J Cronbach, "Coefficient Alpha and the Internal Structure of Tests," *Psychometrika* 16 (1951): 297–334, <https://doi.org/10.1007/BF02310555>.

²⁹ Field, *Discovering Statistics Using IBM SPSS Statistics*; A F Hayes, *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*, 3rd ed. (Guilford Press, 2022).

³⁰ D P MacKinnon et al., "A Comparison of Methods to Test Mediation and Other Intervening Variable Effects," *Psychological Methods* 7, no. 1 (2002): 83–104, <https://doi.org/10.1037/1082-989X.7.1.83>; K J Preacher and A F Hayes, "SPSS and SAS Procedures for Estimating Indirect Effects in Simple Mediation Models," *Behavior Research Methods, Instruments, & Computers* 36, no. 4 (2004): 717–31, <https://doi.org/10.3758/BF03206553>; Hayes, *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*.

RESULTS AND DISCUSSION

Descriptive Statistics

The descriptive results show relatively high mean scores for all three variables. Human resource competency development had a mean of 35.60 out of a possible observed maximum of 40, knowledge management had a mean of 26.30 out of 30, and work productivity had a mean of 44.60 out of 50. The standard deviations were modest relative to the means, indicating that respondents' scores were concentrated within a comparatively narrow range.

Table 2. Descriptive Statistics

Variable	N	Minimum	Maximum	Mean	SD
HR competency development (X)	60	30	40	35.60	3.206
Knowledge management (Z)	60	21	30	26.30	2.566
Work productivity (Y)	60	37	50	44.60	3.792

Validity and Reliability

All 24 questionnaire items exceeded the item-correlation criterion of 0.254. Item correlations ranged from 0.527 to 0.792 for competency development, from 0.649 to 0.764 for knowledge management, and from 0.623 to 0.746 for work productivity. Cronbach's alpha values were 0.844, 0.780, and 0.871, respectively, indicating acceptable to strong internal consistency.³¹

Table 3. Summary of Instrument Quality

Variable	Number of items	Item-correlation range	Critical r	Cronbach's alpha	Decision
HR competency development	8	0.527–0.792	0.254	0.844	Valid and reliable
Knowledge management	6	0.649–0.764	0.254	0.780	Valid and reliable
Work productivity	10	0.623–0.746	0.254	0.871	Valid and reliable

Classical-Assumption Tests

The residuals of both regression models met the normality criterion based on the Kolmogorov–Smirnov significance values of 0.067 and 0.088. The Glejser tests produced significance values above 0.05, indicating no detected heteroscedasticity. In Model 2, both predictors had tolerance values of 0.497 and VIF values of 2.011, well within commonly used

³¹ Cronbach, "Coefficient Alpha and the Internal Structure of Tests"; Nunnally and Bernstein, *Psychometric Theory*.

thresholds. Model 1 contained only one predictor, so its tolerance and VIF values were both 1.000.³²

Table 4. Summary of Regression-Assumption Tests

Test	Model 1	Model 2	Interpretation
Residual normality (K-S p)	0.067	0.088	Normality criterion met
Glejser p: competency development	0.097	0.204	No detected heteroscedasticity
Glejser p: knowledge management	—	0.079	No detected heteroscedasticity
Tolerance / VIF: competency development	1.000 / 1.000	0.497 / 2.011	No problematic multicollinearity
Tolerance / VIF: knowledge management	—	0.497 / 2.011	No problematic multicollinearity

Direct Effects and Model Fit

Model 1 indicates that human resource competency development positively predicts knowledge management ($B = 0.568$, $SE = 0.074$, $\beta = 0.709$, $t = 7.658$, $p < 0.001$). The positive coefficient means that higher competency-development scores are associated with stronger knowledge-management practices. The model explained 50.3% of the variance in knowledge management and was statistically significant, $F(1, 58) = 58.644$, $p < 0.001$. H1 was therefore supported.

Model 2 indicates that competency development positively predicts work productivity after knowledge management is included ($B = 0.545$, $SE = 0.154$, $\beta = 0.461$, $t = 3.527$, $p = 0.001$). Knowledge management also has a positive effect on productivity ($B = 0.465$, $SE = 0.193$, $\beta = 0.315$, $t = 2.410$, $p = 0.019$). Together, the predictors explained 51.7% of the variance in work productivity, and the model was statistically significant, $F(2, 57) = 30.469$, $p < 0.001$. H2 and H3 were supported.

Table 5. Regression and Path Coefficients

Path	B	SE	β	t	p	Decision
$X \rightarrow Z$	0.568	0.074	0.709	7.658	< 0.001	H1 supported
$X \rightarrow Y$	0.545	0.154	0.461	3.527	0.001	H2 supported
$Z \rightarrow Y$	0.465	0.193	0.315	2.410	0.019	H3 supported

³² Cronbach, "Coefficient Alpha and the Internal Structure of Tests"; Nunnally and Bernstein, *Psychometric Theory*; Field, *Discovering Statistics Using IBM SPSS Statistics*; Hair et al., *Multivariate Data Analysis*.

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Table 6. Model Summary and Simultaneous Tests

Model	Dependent variable	R	R ²	Adjusted R ²	F	df	p
1	Knowledge management	0.709	0.503	0.494	58.644	1, 58	< 0.001
2	Work productivity	0.719	0.517	0.500	30.469	2, 57	< 0.001

Mediation Analysis

The unstandardized indirect effect of competency development on productivity through knowledge management was 0.264, calculated from 0.568×0.465 . Using $SEa = 0.074$ and $SEb = 0.193$, the Sobel standard error was 0.115 and the Sobel statistic was 2.299, producing a two-tailed p value of 0.022. The standardized indirect effect was 0.223 (0.709×0.315), while the direct standardized effect remained significant at 0.461. These results indicate partial rather than full mediation and support H4.³³

Table 7. Direct, Indirect, and Total Effects

Effect	Calculation	Standardized effect	Significance	Interpretation
Direct effect X → Y	β_{XY}	0.461	$p = 0.001$	Significant direct effect
Indirect effect X → Z → Y	0.709×0.315	0.223	Sobel $z = 2.299$; $p = 0.022$	Significant indirect effect
Approximate total effect	$0.461 + 0.223$	0.684	—	Direct and mediated pathways

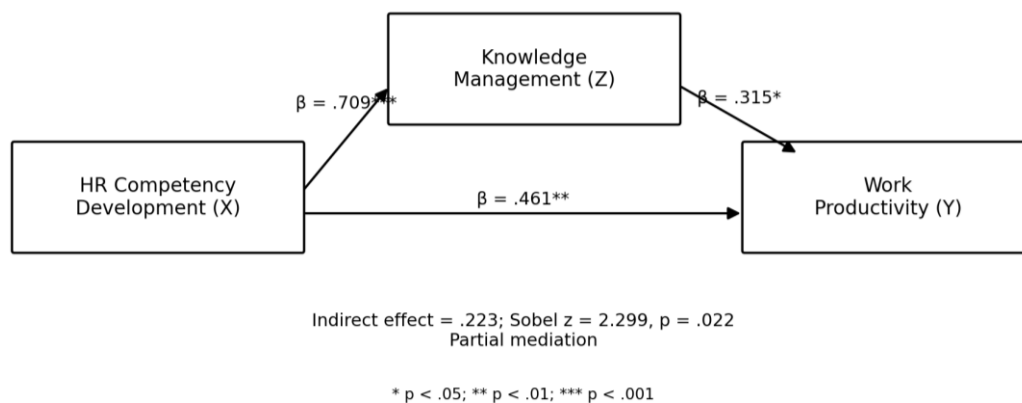


Figure 2. Empirical Path Model

³³ MacKinnon et al., "A Comparison of Methods to Test Mediation and Other Intervening Variable Effects"; Preacher and Hayes, "SPSS and SAS Procedures for Estimating Indirect Effects in Simple Mediation Models."

Analysis/Discussion

Competency Development as an Antecedent of Knowledge Management

The strong X-to-Z coefficient indicates that competency development is closely associated with employees' ability to create, exchange, and use knowledge. This finding is theoretically plausible because more competent employees have broader cognitive schemas, stronger technical vocabularies, and greater confidence in evaluating and communicating work-related information. Competency development may therefore improve not only what employees know, but also their ability to recognize valuable external knowledge and integrate it with existing organizational experience.³⁴

The result also supports the view that knowledge management begins with capable knowledge actors. Technology and repositories cannot substitute for the expertise required to generate useful content, interpret evidence, and contribute meaningful lessons. At PPKS Medan, investments in scientific methods, technical skills, data capabilities, and professional attitudes are likely to improve the quality of material that enters the organization's knowledge system. Nevertheless, this individual competence must be connected to documentation routines and collaborative forums to avoid remaining tacit and person-dependent.³⁵

The magnitude of the relationship suggests that competency policies and knowledge-management policies should not be designed separately. Training plans can require post-training knowledge products, such as technical notes, method protocols, internal seminars, recorded demonstrations, or updated standard operating procedures. These mechanisms help convert learning expenditure into reusable organizational knowledge and are consistent with organizational-learning models that link individual intuition and interpretation to group integration and institutionalization.³⁶

The Direct Effect of Competency Development on Work Productivity

Competency development retained a significant direct effect on productivity even after knowledge management was introduced. The finding indicates that improved knowledge, skill, and professional behavior can immediately influence how employees perform their own tasks. Better competence can reduce errors, shorten completion time, improve methodological decisions, and increase confidence in handling nonroutine assignments. This interpretation is consistent with evidence that well-designed development improves job-related behavior and that human capital is positively associated with operational performance.³⁷

The persistence of the direct path also means that not all competency benefits require organization-wide knowledge diffusion. Some benefits arise through the employee's personal application of acquired expertise. For example, a researcher may use improved analytical

³⁴ Cohen and Levinthal, "Absorptive Capacity: A New Perspective on Learning and Innovation"; Zahra and George, "Absorptive Capacity: A Review, Reconceptualization, and Extension."

³⁵ Nonaka, "A Dynamic Theory of Organizational Knowledge Creation"; Alavi and Leidner, "Review: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues"; Davenport and Prusak, *Working Knowledge: How Organizations Manage What They Know*.

³⁶ Crossan, Lane, and White, "An Organizational Learning Framework: From Intuition to Institution"; Argote, *Organizational Learning: Creating, Retaining and Transferring Knowledge*.

³⁷ Aguinis and Kraiger, "Benefits of Training and Development for Individuals and Teams, Organizations, and Society"; Salas et al., "The Science of Training and Development in Organizations: What Matters in Practice"; Crook et al., "Does Human Capital Matter."

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competence to produce more accurate results, while a laboratory employee may apply a new protocol to reduce processing time. The direct pathway is therefore compatible with individual performance models that emphasize task proficiency, adaptive performance, and initiative.³⁸

From a human-resource systems perspective, the result supports continuous rather than episodic development. Training should be based on competency mapping, linked to actual work demands, and followed by application opportunities and supervisory feedback. Without transfer support, learning may remain detached from performance; with appropriate support, competency development can become part of a coherent ability–motivation–opportunity system that raises productivity.³⁹

The Effect of Knowledge Management on Work Productivity

Knowledge management had a positive effect on work productivity after competency development was controlled. This finding indicates that employees benefit when relevant knowledge is accessible beyond the boundaries of their own experience. Shared methods, documented lessons, expert directories, and collaborative problem solving can reduce redundant effort and enable employees to build on prior organizational learning rather than starting from the beginning.⁴⁰

The coefficient is smaller than the direct competency effect, but it remains substantively important because knowledge management creates leverage. The same insight can support multiple employees and projects when it is properly codified and disseminated. This leverage is particularly valuable in research organizations, where project cycles generate methods, data, failed experiments, contextual judgments, and stakeholder knowledge that may be useful beyond the original assignment.⁴¹

The finding also suggests that knowledge management should not be reduced to an information-technology project. Repositories are necessary but insufficient unless employees trust one another, perceive reciprocal value, and have time and incentives to contribute. Communities of practice, mentoring, cross-unit reviews, and after-action learning can complement digital infrastructure by creating social conditions for exchange and application.

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³⁸ Koopmans et al., “Conceptual Frameworks of Individual Work Performance: A Systematic Review”; Campbell and Wiernik, “The Modeling and Assessment of Work Performance.”

³⁹ Colquitt, LePine, and Noe, “Toward an Integrative Theory of Training Motivation: A Meta-Analytic Path Analysis of 20 Years of Research”; Jiang et al., “How Does Human Resource Management Influence Organizational Outcomes”; Bell et al., “100 Years of Training and Development Research: What We Know and Where We Should Go.”

⁴⁰ Argote and Ingram, “Knowledge Transfer: A Basis for Competitive Advantage in Firms”; Henttonen, Kianto, and Ritala, “Knowledge Sharing and Individual Work Performance: An Empirical Study of a Public Sector Organisation.”

⁴¹ Grant, “Toward a Knowledge-Based Theory of the Firm”; Gold, Malhotra, and Segars, “Knowledge Management: An Organizational Capabilities Perspective”; Lee and Choi, “Knowledge Management Enablers, Processes, and Organizational Performance: An Integrative View and Empirical Examination.”

⁴² Wang and Noe, “Knowledge Sharing: A Review and Directions for Future Research”; Razmerita, Kirchner, and Nielsen, “What Factors Influence Knowledge Sharing in Organizations”; Hislop, Bosua, and Helms, *Knowledge Management in Organizations: A Critical Introduction*.

Knowledge Management as a Partial Mediator

The significant indirect effect confirms that part of the productivity benefit of competency development operates through knowledge management. Employees who develop stronger competencies are better positioned to create and share useful knowledge, and these knowledge processes subsequently support productive work. The mediation is partial because competency development also improves productivity through direct personal application. This combined pattern is more realistic than a full-mediation model for knowledge-intensive work.⁴³

The mediation finding contributes to Human Capital Theory by identifying an organizational conversion mechanism. Human capital provides productive potential, but knowledge management determines whether portions of that potential are retained and scaled beyond the individual. In this sense, knowledge management helps transform individual competence into collective intellectual capital and dynamic capability.⁴⁴

The result is also consistent with the knowledge-based view, which treats knowledge integration as a central source of organizational capability. Competency development without integration may produce isolated experts; knowledge management without competent contributors may produce repositories with limited value. Productivity improves most plausibly when the organization develops high-quality expertise and creates routines that connect, preserve, and apply that expertise.⁴⁵

Theoretical Contributions

First, the study integrates human-capital and knowledge-based perspectives in a single empirical model. Rather than assuming a direct and self-executing relationship between competence and productivity, the model demonstrates that knowledge processes explain a meaningful portion of the relationship. This integration responds to calls for human-resource research that specifies the mechanisms connecting practices and capabilities to performance outcomes. Second, the study extends knowledge-management evidence to an Indonesian research institution in the plantation sector. Much of the literature has examined private firms, technology companies, or broad public-sector settings. The PPKS context shows that knowledge management is also relevant to applied scientific organizations whose outputs depend on accumulated expertise, continuity of methods, and cross-project learning.

Third, the partial-mediation result clarifies that knowledge management complements rather than replaces competency development. The strongest theoretical interpretation is one of synergy: competence improves the quality of knowledge inputs, while knowledge-management capability improves their circulation and application. This is consistent with

⁴³ MacKinnon et al., "A Comparison of Methods to Test Mediation and Other Intervening Variable Effects"; Hayes, *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*.

⁴⁴ Subramaniam and Youndt, "The Influence of Intellectual Capital on the Types of Innovative Capabilities"; Kianto, Sáenz, and Aramburu, "Knowledge-Based Human Resource Management Practices, Intellectual Capital and Innovation"; Teece, "Explicating Dynamic Capabilities: The Nature and Microfoundations of Sustainable Enterprise Performance."

⁴⁵ Kogut and Zander, "Knowledge of the Firm, Combinative Capabilities, and the Replication of Technology"; Grant, "Toward a Knowledge-Based Theory of the Firm"; Zack, McKeen, and Singh, "Knowledge Management and Organizational Performance: An Exploratory Analysis."

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research showing that knowledge-oriented leadership and coherent knowledge practices strengthen innovation and performance.

Managerial Implications for PPKS Medan

PPKS Medan should begin with a competency architecture that maps critical roles, current capability levels, future scientific and technological requirements, and the risks associated with knowledge concentration in a small number of experts. Individual development plans can then combine formal courses, certification, project rotation, mentoring, and supervised application. Development priorities should be linked to research strategy rather than determined solely by general training availability. Each significant learning activity should generate an organizational knowledge output. Examples include concise technical briefs, updated protocols, datasets with metadata, frequently asked questions, recorded demonstrations, lessons-learned documents, and internal seminars. Requiring such outputs will help convert individual learning into institutional memory and reduce the loss of tacit knowledge when projects end or employees change roles. (Nonaka, 1994; Argote, 2013)

A searchable digital repository should be organized around research themes, methods, commodities, laboratories, projects, and expertise. Governance must specify document ownership, review cycles, access rights, version control, and quality standards. The repository should be integrated with everyday workflow so that knowledge contribution and retrieval do not become additional administrative burdens detached from research activity. Communities of practice can complement the repository by enabling discussion of complex and tacit knowledge. Regular method clinics, cross-unit case reviews, research colloquia, and mentoring circles can provide spaces for employees to explain judgments, failures, and adaptations that are difficult to capture in formal documents. Leadership should recognize knowledge contribution in appraisal and career systems to strengthen motivation and reciprocity. Performance monitoring should connect input, process, and outcome indicators. Input indicators may include competency-gap closure and development participation; process indicators may include repository use, knowledge contributions, mentoring activity, and cross-unit collaboration; outcome indicators may include timeliness, error reduction, research quality, innovation adoption, and stakeholder usefulness. A balanced measurement system will reduce the risk of treating either training attendance or document volume as sufficient evidence of impact.

5.7 Limitations and Future Research

The study is limited by its cross-sectional design, single-organization setting, purposive sample, and modest sample size. The results identify associations consistent with the proposed theory but cannot establish temporal causality. Future studies should use longitudinal or time-lagged designs and include multiple research institutions or plantation-sector organizations to assess the stability and generalizability of the model. All variables were measured through self-report, creating the possibility of common-method variance and social-desirability effects. Subsequent research should combine survey measures with supervisor ratings, objective indicators of research output, project timeliness, error rates, or repository-use data. Separating predictor and outcome measurement in time would further strengthen causal interpretation.

The measurement of competency development combines competency outcomes with participation in development activities. Future research should distinguish more clearly

between development practices, acquired competence, learning transfer, and performance. A sequential model could test whether development practices build competence, competence increases knowledge sharing and application, and these processes subsequently improve objective productivity. Finally, the Sobel test assumes an approximately normal indirect-effect distribution and is less robust than bootstrap estimation, particularly in smaller samples. Replication should use bias-corrected bootstrap confidence intervals and could examine moderators such as leadership, trust, digital knowledge infrastructure, organizational climate, or employee motivation.

CONCLUSION

Human resource competency development has a positive and substantial relationship with knowledge management at PPKS Medan. It also directly improves work productivity, while knowledge management independently contributes to productivity. The corrected mediation calculation shows that knowledge management partially mediates the competency–productivity relationship. Thus, competent employees are productive not only because they personally apply stronger knowledge and skills, but also because their competence supports the creation, sharing, and use of knowledge across the organization. The central managerial implication is that competency development and knowledge management should be managed as an integrated system. PPKS Medan can strengthen productivity by aligning competency mapping and continuous learning with mentoring, communities of practice, structured documentation, and a well-governed digital repository. This integrated approach is expected to preserve institutional knowledge, accelerate problem solving, improve research consistency, and increase the long-term value of investment in human resources.

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