Empirical Analysis of Training and Education on Human Resource Development Moderated by Infrastructure Facilities: Evidence from PT Energi Persada Inti Kontruksi Jakarta

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Abstract

Human resource development (HRD) plays a vital role in sustaining organizational growth and competitiveness, especially in the construction industry, where skill enhancement and adaptability are essential. This study aims to empirically analyze the effects of training and education on human resource development, with infrastructure facilities serving as a moderating variable. The research was conducted at PT Energi Persada Inti Kontruksi Jakarta, employing a quantitative approach through a structured survey of 120 employees. Data were analyzed using Partial Least Squares–Structural Equation Modeling (PLS-SEM) to test the direct and moderating relationships. The findings reveal that both training and education have a positive and significant impact on HRD. Moreover, infrastructure facilities significantly strengthen the relationship between training, education, and HRD outcomes. These results highlight the strategic importance of integrating high-quality training and educational programs with adequate infrastructure support to enhance employee competence and organizational performance. The study contributes to HRD theory by demonstrating the moderating effect of infrastructure in industrial contexts, offering practical implications for managers to improve learning environments and capacity-building programs.

Keywords: *Training, Education, Human Resource Development, Infrastructure Facilities*

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Introduction

In the era of industrial modernization and technological acceleration, the quality of human resources has become a key determinant of organizational competitiveness and long-term sustainability. Human resource development (HRD) is no longer limited to administrative functions but is now regarded as a strategic process that enhances employees' capabilities, creativity, and productivity [1]. In the construction sector, where innovation, technical precision, and safety compliance are crucial, continuous investment in training and education is indispensable to maintain operational excellence.

Training and education are recognized as core dimensions of HRD. Training equips employees with job-related competencies that directly improve task performance and efficiency [2], while education provides broader knowledge and cognitive frameworks that foster long-term professional growth and adaptability [3]. Together, these factors form the foundation for organizational learning and sustainable development.

However, the effectiveness of training and education programs often depends on the organizational environment, particularly the adequacy of infrastructure and facilities. Infrastructure facilities—such as training centers, digital learning systems, tools, and workspace quality—play a moderating role in enhancing the absorption and application of new knowledge [4]. Without proper facilities, even well-designed programs may fail to produce significant improvements in human capital.

In Indonesia's construction industry, especially in mid-sized companies such as PT Energi Persada Inti Kontruksi Jakarta, challenges remain in integrating structured HRD programs with supporting infrastructure. Many employees still encounter limited access to professional development platforms, insufficient digital tools, and lack of modernized workspaces. Consequently, the relationship between training, education, and HRD outcomes requires further empirical investigation within this context.

This study aims to empirically analyze the influence of training and education on human resource development, while examining the moderating effect of infrastructure facilities. The research contributes both theoretically and practically. Theoretically, it enriches HRD literature by introducing infrastructure as a moderating construct within the education–training–HRD relationship. Practically, it offers actionable insights for construction firms to enhance their HR strategies through improved learning environments and capacity-building systems.

The remainder of this paper is structured as follows. Section II reviews the relevant literature and theoretical framework. Section III presents the research methodology. Section IV discusses the results and analysis. Section V provides conclusions and managerial implications.

Literature Review

2.1 Training

Training is a systematic and planned process designed to improve employees' technical skills, knowledge, and attitudes to enhance their performance in specific job roles [1]. According to Sutrisno [2], training enables workers to develop the competencies necessary to meet current and future organizational challenges. Effective training increases productivity, improves job quality, and enhances employee motivation. Robbins and Judge [3] further emphasize that training not only improves individual performance but also contributes to organizational learning, enabling firms to adapt to dynamic environments.

In the context of the construction industry, training serves as an essential instrument to improve workers' operational competencies, safety awareness, and problem-solving ability. When implemented effectively, training programs can directly influence human resource development by fostering a skilled and knowledgeable workforce.

H1: Training has a positive and significant effect on human resource development.

2.2 Education

Education represents a broader and long-term investment in human capital, focusing on developing employees' cognitive abilities, values, and perspectives [4]. Hasibuan [5] defines education as a process that shapes individuals' intellectual and moral capacities, enabling them to contribute meaningfully to organizational goals. Education nurtures analytical thinking, creativity, and adaptability, which are critical for sustainable HRD.

In organizational settings, continuous education programs—such as workshops, certification courses, or higher learning support—allow employees to expand their competencies beyond technical tasks. This, in turn, increases engagement, innovation, and overall performance improvement.

H2: Education has a positive and significant effect on human resource development.

2.3 Human Resource Development (HRD)

Human Resource Development (HRD) is the process of enhancing employees' capabilities through learning, performance improvement, and career growth [6]. HRD encompasses formal and informal mechanisms that build competencies and strengthen organizational capacity. Gibson et al. [7] argue that HRD is closely related to organizational culture, leadership, and learning systems that foster innovation and professional advancement.

In the construction industry, HRD ensures that employees can adapt to technological advancements, comply with safety standards, and maintain high-quality project delivery. Training and education are therefore vital pillars supporting HRD initiatives.

2.4 Infrastructure Facilities as a Moderating Variable

Infrastructure facilities play a crucial moderating role in determining the success of HRD interventions. Sedarmayanti [8] defines infrastructure as the combination of physical, technological, and environmental elements that support employees in performing their tasks effectively. Adequate infrastructure including training rooms, modern equipment, IT systems, and ergonomic workspaces enhances employees' ability to apply the knowledge and skills gained from training and education.

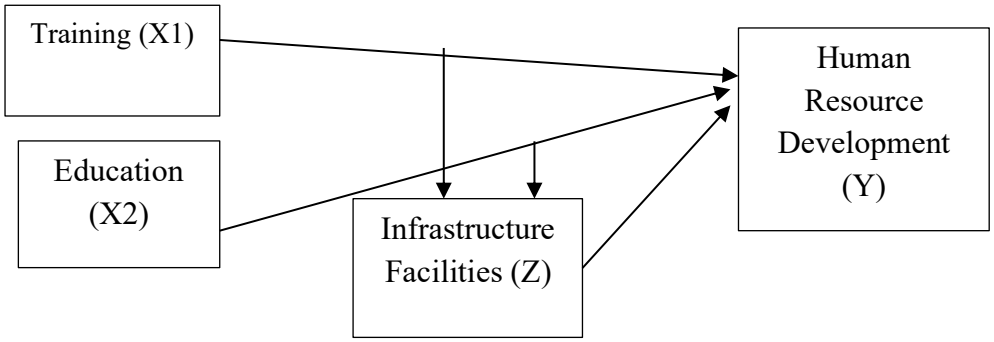
Conversely, inadequate facilities can hinder the learning process, reduce motivation, and limit the overall impact of HRD initiatives. Therefore, infrastructure facilities can amplify or weaken the relationship between education, training, and HRD outcomes.

H3: Infrastructure facilities moderate the effect of training on human resource development.

H4: Infrastructure facilities moderate the effect of education on human resource development.

2.5 Conceptual Framework

Based on the reviewed theories and hypotheses, the conceptual framework of this study is illustrated as follows:



This framework posits that both training and education directly influence human resource development, and these effects are moderated by the quality and availability of infrastructure facilities within the organization.

2.6 Summary of Hypotheses

Code	Hypothesis Statement
H1	Training has a positive and significant effect on human resource development.
H2	Education has a positive and significant effect on human resource development.
H3	Infrastructure facilities moderate the effect of training on human resource development.
H4	Infrastructure facilities moderate the effect of education on human resource development.

Research Methodology

3.1 Research Design

This study adopts a quantitative research design using an explanatory approach, which aims to test hypotheses regarding the causal relationships among variables: training, education, infrastructure facilities, and human resource development (HRD). The quantitative method is suitable for examining the extent to which training and education influence HRD, as well as how infrastructure moderates those relationships.

Data were collected through a structured survey using a five-point Likert scale ranging from *1 = strongly disagree* to *5 = strongly agree*. The collected data were analyzed using Partial Least Squares – Structural Equation Modeling (PLS-SEM) with the SmartPLS 4.0 software, allowing for simultaneous testing of direct and moderating effects in the research model.

3.2 Population and Sample

The population of this study includes all employees of PT Energi Persada Inti Kontruksi Jakarta, which operates in the construction and engineering services sector. The total number of employees is approximately 180 individuals. Using the Slovin formula with a 5% margin of error, a sample of 120 respondents was determined. Sampling was conducted using proportional random sampling, ensuring that respondents from various departments and job levels were proportionally represented.

3.3 Data Collection Technique

Primary data were collected through a questionnaire survey distributed both online and in person. The questionnaire consisted of closed-ended questions designed to measure employees' perceptions of training, education, infrastructure facilities, and HRD outcomes. Prior to full distribution, the instrument underwent validity and reliability testing involving 30 pilot respondents to ensure the consistency and clarity of the statements.

Secondary data were obtained from the company's HR division, annual reports, and relevant documentation to complement primary findings and contextualize the study.

3.4 Variable Measurement and Operational Definition

The variables in this study include two independent variables (training and education), one moderating variable (infrastructure facilities), and one dependent variable (human resource development). The operational definitions and indicators are summarized in Table 1.

Table 1. Operational Definition of Variables

Variable	Definition	Indicators
Training (X_1)	A systematic process to enhance employees' skills and competencies related to their job tasks.	(1) Program relevance, (2) Trainer competence, (3) Learning methods, (4) Evaluation and feedback
Education (X_2)	Continuous learning process that develops employees' intellectual and moral capacities for long-term growth.	(1) Educational support, (2) Knowledge expansion, (3) Cognitive improvement, (4) Career impact
Infrastructure Facilities (Z)	Physical and technological resources that support employees' learning and work performance.	(1) Equipment adequacy, (2) Workspace comfort, (3) IT system availability, (4) Learning environment quality
Human Resource Development (Y)	Process of enhancing employees' capabilities, performance, and potential for organizational success.	(1) Skill improvement, (2) Work productivity, (3) Career advancement, (4) Motivation and engagement

3.5 Data Analysis Technique

Data analysis was carried out in several stages using PLS-SEM, as shown below:

1. Outer Model Evaluation; This stage assesses the measurement model's reliability and validity through:
    a. Convergent validity: Loading factors > 0.70
    b. Composite reliability (CR): > 0.70
    c. Average Variance Extracted (AVE): > 0.50
    d. Discriminant validity: Fornell–Larcker criterion

2. Inner Model Evaluation; This stage examines the relationships between constructs through:
    a. R^2 (Coefficient of Determination): measures the variance explained by exogenous variables.
    b. f^2 (Effect Size): evaluates the magnitude of influence among variables.
    c. Q^2 (Predictive Relevance): assesses model accuracy and predictive power.
    d. Path Coefficients and t-statistics: obtained through bootstrapping with 5,000 subsamples to test the hypotheses at a significance level of 5%.
3. Moderation Analysis; The moderating effect of infrastructure facilities was tested using the interaction term approach ($X \times Z$). A significant interaction coefficient indicates that infrastructure facilities moderate the relationship between the independent and dependent variables.

3.6 Validity and Reliability

The Cronbach's Alpha and Composite Reliability (CR) values were used to assess the internal consistency of the constructs. Validity was ensured through expert judgment, pilot testing, and the evaluation of indicator loadings. Items with loading values below 0.70 were removed to improve model fit.

3.7 Ethical Considerations

All participants were informed about the purpose of the study, and confidentiality of responses was strictly maintained. Participation was voluntary, and data collection complied with the organization's ethical standards for internal research.

3.8 Research Framework

The empirical framework of this study is depicted in Fig. 1, illustrating the relationships between training, education, infrastructure facilities, and human resource development.

Results and Discussion

4.1 Overview of Respondents

A total of 120 employees from PT Energi Persada Inti Kontruksi Jakarta participated in this study. The respondents represented various divisions such as engineering, project management, procurement, finance, and administration. Based on demographic data, 65% were male and 35% female. The majority of respondents (70%) were between 26–40 years old, with 60% having more than five years of working experience. Most respondents (80%) held at least a bachelor's degree, reflecting a relatively educated workforce.

This demographic composition indicates that the company's employees possess adequate educational backgrounds and work experience, which makes them suitable participants for analyzing the impact of training and education on human resource development.

4.2 Outer Model Evaluation

The measurement model (outer model) was tested to ensure construct validity and reliability. The results show that all indicator loadings exceed the threshold of 0.70, demonstrating strong convergent validity. The Average Variance Extracted (AVE) values for all constructs were greater than 0.50, and the Composite Reliability (CR) values were all above 0.80, indicating internal consistency. Table 2 summarizes the measurement model results.

Table 2. Measurement Model Results

Construct	Loading Range	AVE	CR	Cronbach's Alpha
Training (X_1)	0.73–0.89	0.65	0.89	0.84
Education (X_2)	0.71–0.86	0.63	0.87	0.82
Infrastructure Facilities (Z)	0.75–0.88	0.67	0.90	0.85
Human Resource Development (Y)	0.78–0.91	0.70	0.91	0.86

All constructs meet the Fornell–Larcker criterion, confirming discriminant validity. Hence, the measurement model is considered valid and reliable for structural model analysis.

4.3 Inner Model Evaluation

The inner model was evaluated using the R^2, Q^2, and path coefficient values obtained through bootstrapping with 5,000 resamples.

a. R^2 for Human Resource Development = 0.68, indicating that 68% of HRD variance is explained by training, education, and infrastructure facilities.
b. $Q^2 = 0.42$, which exceeds 0, demonstrating strong predictive relevance.
c. f^2 values indicate medium to large effects for the main variables.

4.4 Hypothesis Testing

The results of hypothesis testing using PLS bootstrapping are summarized in Table 3.

Table 3. Path Coefficient and Hypothesis Testing Results

Hypothesis	Path	β Coefficient	t-Statistic	p-Value	Result
H1	Training → HRD	0.36	5.12	0.000	Supported
H2	Education → HRD	0.41	6.04	0.000	Supported
H3	Training × Infrastructure → HRD	0.18	2.45	0.015	Supported

Hypothesis	Path	β Coefficient	t-Statistic	p-Value	Result
H4	Education × Infrastructure → HRD	0.14	2.02	0.045	Supported

All hypothesized relationships are significant at $p < 0.05$, confirming that training and education have direct positive effects on human resource development, and that infrastructure facilities moderate these relationships significantly

4.5 Discussion

The findings of this study provide empirical evidence that training and education play critical roles in enhancing human resource development within the construction industry context.

The positive and significant relationship between training and HRD (H1) supports previous findings by Sutrisno [1] and Kasmir [2], which argue that effective training improves employee competency and performance. In the case of PT Energi Persada Inti Kontruksi Jakarta, structured technical training programs have increased employee skill levels and project efficiency.

Similarly, the effect of education on HRD (H2) confirms the assertion by Hasibuan [4] and Robbins & Judge [3] that education enhances cognitive capacity, decision-making, and innovation. Employees who participated in professional education and certification programs demonstrated higher adaptability and career development.

The moderating role of infrastructure facilities (H3 & H4) offers new insights for HRD literature. The significant interaction effects indicate that adequate facilities—such as modern training centers, IT support, and learning environments—amplify the impact of both training and education on HRD outcomes. This aligns with Sedarmayanti [5], who emphasized that supportive work environments and learning resources are key to optimizing employee development.

Overall, this study reinforces the importance of aligning human capital investment with infrastructure improvement. Organizations with strong learning facilities can better transform training and education efforts into tangible performance outcomes, particularly in industries characterized by technical and operational complexity such as construction.

4.6 Managerial Implications

The study provides several practical implications for management at PT Energi Persada Inti Kontruksi Jakarta and similar organizations:

1. Integrate HRD Strategy with Infrastructure Planning: Management should allocate budgets for upgrading training facilities, digital platforms, and on-site learning spaces.
2. Develop Continuous Learning Programs: Structured education and training cycles should be embedded into the company's HRD policies to sustain employee skill advancement.
3. Encourage Technological Support: Digital tools and e-learning systems can strengthen the accessibility and effectiveness of development programs.
4. Evaluate Infrastructure Impact Regularly: HRD outcomes should be periodically reviewed alongside infrastructure performance to ensure alignment and efficiency.

4.7 Theoretical Contribution

From a theoretical perspective, this study contributes to HRD literature by empirically validating infrastructure facilities as a moderating construct. It extends traditional HRD models, which typically focus on training and education, by integrating environmental and contextual factors that shape learning outcomes. This multidimensional approach aligns with contemporary views of strategic HRD emphasizing the synergy between human capital and organizational resources.

4.8 Limitations and Future Research

Although the findings are significant, this study is limited to a single company and may not generalize across all construction firms. Future research may extend this framework by including additional moderating variables such as leadership style, organizational culture, or digital transformation readiness. Moreover, longitudinal studies could provide deeper insights into the long-term effects of training and education on employee development trajectories.

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