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The Influence of Training and Education on Human Resource Development with the Support of Facilities and Infrastructure as a Moderating Variable at PT Energi Persada Inti Kontruksi Jakarta

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ABSTRACT

Human resource development (HR) is essential to ensure the long-term progress of the organization and maintain competitiveness, especially in the construction sector where continuous upskilling and adaptability are essential. This study seeks to empirically examine how training and education affect human resources, with infrastructure facilities acting as a moderation factor. This study was conducted at PT Energi Persada Inti Kontruksi Jakarta using a quantitative method through a structured survey involving 126 employees. Data were processed using Partial Least Squares–Structural Equation Modeling (PLS-SEM) to evaluate the immediate effects and moderation. The results of the study show that training and education each have a positive and significant influence on human resources. In addition, infrastructure facilities substantially strengthen the effects of training and education on human resource outcomes. These findings emphasize the strategic value of integrating strong training and education initiatives with adequate infrastructure support to improve employee capabilities and overall organizational effectiveness. This study enriches the human resource literature by describing the role of infrastructure moderation in the industrial environment and provides practical insights for managers in improving learning environments and capacity building efforts.

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Introduction

Human resources (HR) play an important role in the sustainability and growth of the organization, because human resources are the main implementers of various functions and operational processes. Quality human resources are characterized by good abilities, expertise, knowledge, and work attitudes. To create professional, loyal, and disciplined human resources, agencies and companies need to ensure continuous competency improvement efforts. Human resource development is important so that employees are able to provide optimal performance and support organizational activities effectively.

In management, development is one of the functions that focuses on improving the technical, theoretical, conceptual, and moral skills of employees through education and training. Both are complementary, where education provides a solid foundation of knowledge and mindset, while training is oriented towards practical experiences that are relevant to the current task. The right combination of education and training allows companies to create human resources who are capable of facing changes in the work environment and are able to drive productivity and competitiveness of the organization.

In the construction industry, human resources are the main asset that determines the success of the company. Productivity, adaptability to technology, and technical expertise of employees greatly affect the competitiveness of construction companies. Therefore, human resource development needs to be the main focus so that companies are able to face dynamic industry challenges (Fauzi et al., 2021). One of the important factors in human resource development is training. Training that is designed in a sustainable manner has been proven to improve technical and non-technical skills, as well as encourage employee productivity (Rosmiati et al., 2023). Thus, employees are better prepared to face the complex, risky, and fast-changing demands of a job.

In addition to training, the level of education also has an influence on human resource development. Higher education is generally directly proportional to analytical skills, understanding of instruction, and absorption of new material. A study by Attirmidzi & Darmawan (2022) shows that education, although not always partially dominant, still plays a positive role in improving human resource development when it goes hand in hand with training. This emphasizes that education and training are two aspects that support each other in shaping employee competencies.

However, the effectiveness of training and education is often influenced by the facilities and infrastructure available. Inadequate infrastructure makes it difficult to apply training results in daily work. According to Adriansyah & Josiah (2022), good work facilities and equipment play a role as a strengthening factor in the human resource development process because it supports the successful implementation of training materials. The phenomenon that occurred in construction companies, including PT Energi Persada Inti Konstruksi, shows that there is still a competency gap among employees even though training programs have been implemented. This gap is often caused by variations in

education levels and limited infrastructure, such as training facilities and modern work equipment, so that training results have not been effectively implemented (Rosmiati et al., 2023; Attirmidzi & Darmawan, 2022).

Kasmir (2018) emphasized that education plays an important role in shaping the basic abilities of employees in terms of knowledge, skills, and mindset. Training, on the other hand, improves technical and non-technical competencies according to organizational needs so that employees are able to be more productive, innovative, and adaptive to changes in the work environment. Education and training are also important instruments in developing leadership skills. Programs such as leadership education and training levels III and IV aim to form structural officials who have the ability to manage change, influence stakeholders, and determine the strategic direction of the organization (Adam et al., 2020). Hanafie, Razak, and Hamzah (2021) also emphasized that education and training help employees achieve organizational goals more creatively and effectively. A good training program strengthens the willingness and ability of employees to carry out tasks, so that the organization can carry out programs and work plans optimally. This is in line with the opinion of Prof. Rahayu (2019) who states that training is a short-term educational process to improve technical skills, while development is a long-term process to improve conceptual and moral abilities. These two processes increase organizational productivity through increased knowledge, skills, positive attitudes, empathy, analysis, and decision-making skills.

For education and training to run effectively, the support of facilities and infrastructure is a crucial factor. Facilities such as training rooms, technology, learning media, competent instructors, and evaluation systems function as the main tools in the knowledge and skill transfer process. Without adequate facility support, training is difficult to achieve optimal outcomes.

Based on this description, this study aims to analyze the influence of training and education on human resource development, assess the influence of facilities and infrastructure on human resource development, and test the role of facilities and infrastructure as moderation variables that strengthen the relationship between training, education, and human resource development in employees of PT Energi Persada Inti Konstruksi.

Method

1. Research Design

This study uses a quantitative research design with an explanatory approach, which aims to test hypotheses related to causal relationships between variables, namely training, education, facilities and infrastructure, and human resource (HR) development. The quantitative method was chosen because it is appropriate to assess the extent to which training and education affect human resource development, as well as how infrastructure facilities play a role as a moderation variable in the relationship.

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Data collection was carried out through a structured survey using a five-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree. The data obtained was then analyzed using the Partial Least Squares – Structural Equation Modeling (PLS-SEM) method using SmartPLS 4.0 software, which allows simultaneous testing of direct and moderation influences in the research model.

2. Population and Sample

The population in this study includes all employees of PT Energi Persada Inti Kontruksi Jakarta who are engaged in construction and engineering services. The total number of employees is about 126 people. The use of the entire population without having to draw research samples as an observation unit is referred to as a census technique. Census research is a study that takes a group of populations as a sample as a whole and uses structured questionnaires as the main data collection tool to obtain specific information (Usman & Akbar, 2008). The sample from this study is 126 people who work as employees. There are two reasons for conducting a census, namely that census research will be feasible if the population is relatively small and census research is only necessary if the population element units are highly heterogeneous

3. Data Collection Techniques

Primary data was collected through questionnaire surveys that were distributed online and in person. The questionnaire contains closed-ended questions designed to gauge employees' perceptions of training, education, infrastructure facilities, and HR development outcomes. Before full deployment, the instrument was tested for validity and reliability on 30 test respondents to ensure clarity and consistency of statements. Secondary data is obtained from the company's HR division, annual reports, and other relevant documents to complement the primary data and to provide additional context to the research.

4. Operational Research Variables

This research involves two independent variables (training and education), one moderation variable (infrastructure facilities), and one dependent variable (human resource development). The operational definition and indicators of each variable are summarized in Table 1.

	Research Variables	Operational Definition	Indicator
	Dependent Variables: Human Resources Development (Y)	A systematic and continuous process to improve the competencies, knowledge, skills, and work attitudes of employees in order to be able to work effectively and contribute optimally to the organization.	1. Increased Knowledge 2. Upskilling 3. Changes in Attitudes and Behaviors 4. Adaptability to Change 5. Increased Work Productivity Happy (2019)
	Moderation Variables: Facilities and Infrastructure	All forms of physical and non-physical facilities that support the smooth education, training, and human resource development in the company	1. Completeness 2. Conditions 3. Ease of use Hartono in Hall & Nugraha (2020)
	Independent Variables: Training	A learning process that allows employees to gain skills, knowledge, and work motivation in accordance with their field of work so that their performance improves.	1. Training goals and objectives are clear 2. Trainer qualifications 3. Training materials as needed 4. Training methods according to ability level 5. Participant's suitability with the requirements Mangkunegara in Pangestika et al. (2019)
Independent Variables: Education		The process of improving employee knowledge, understanding, and competence to be more professional and in accordance with the needs of the job.	1. Education level 2. Suitability of the major 3. Competencies (knowledge, skills, basic values) Tirtarahardja (2005) in Lubis (2018)

5. Data Analysis Techniques

Data analysis is carried out through several stages using PLS-SEM, as explained below:

Outer Model Evaluation – This stage assesses the reliability and validity of the measurement model through:

a) Convergent validity: > loading factor value 0.70

b) Composite Reliability (CR): > 0.70

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c) Average Extracted Variance (AVE): > 0.50

d) Discriminant validity: using the Fornell–Larcker criterion

Inner Model Evaluation – This stage tests the relationships between constructs through:

a) R^2 (Coefficient of Determination) to see the magnitude of the variance described by the exogenous variable

b) f^2 (Effect Size) to assess the magnitude of the influence between variables

c) Q^2 (Predictive Relevance) to measure the accuracy and predictive ability of the model

d) Path coefficients and t-statistic obtained through bootstrapping as many as 5,000 subsamples to test the hypothesis at a significance level of 5%

Moderation Analysis – Testing of the moderation variables of infrastructure facilities is carried out using the interaction term (X × Z) approach. A significant interaction coefficient shows that infrastructure facilities are able to moderate the relationship between independent and dependent variables.

6. Validity and Reliability

The internal consistency of the construct is analyzed through Cronbach's Alpha and Composite Reliability (CR) values. The validity of the instrument is maintained through expert judgment, instrument trials, and evaluation of the loading factor of each indicator. Statements with loading values below 0.70 are eliminated to improve model suitability.

7. Ethical Considerations

All respondents were given an explanation of the purpose of the research, and the confidentiality of the answers was strictly maintained. Participation is voluntary, and the data collection process follows the organization's ethical standards for internal research.

H. Research Framework

The empirical framework of this research is shown in Figure 1, which illustrates the relationship between training, education, facilities and infrastructure, and human resource development.

Results and Discussion

1. Respondent Characteristics

A total of 126 employees of PT Energi Persada Inti Kontruksi Jakarta participated in this study. The respondents came from a variety of divisions, including engineering, project management, procurement, finance, and administration. Based on demographic data, 77% of respondents were male and 23% were female. The majority of respondents (66%) are in the age range of 26–35 years, and 46% of them have more than five years of work experience. In addition, 66% of respondents have pursued at least a bachelor's education, which shows that the company's workforce has a relatively high level of education.

The demographic composition shows that employees have adequate educational backgrounds and work experience, so they are suitable as a source of information in examining the influence of training and education on human resource development.

2. Measurement model (outdoor model)

The measurement model (outer model) is tested to ensure the validity and reliability of the construct. The test results showed that all indicator loading values were above the minimum limit of 0.70, indicating a strong convergent validity. The Average Variance Extracted (AVE) value for the entire construct also exceeded 0.50, while the Composite Reliability (CR) value was above 0.80, indicating good internal consistency. A summary of the results of the evaluation of the measurement model is presented in Table 2.

Table 2 Validity Testing by Loading Factor

Indicator	Training	Education	Development	Facilities & Infrastructure	X1. M	X2. M
M.1	0.589	0.644	0.723	0.910	-0.500	-0.542
M.2	0.606	0.675	0.772	0.942	-0.579	-0.625
M.3	0.571	0.656	0.686	0.864	-0.603	-0.649
Training * Facilities & Infrastructure	-0.473	-0.643	-0.632	-0.618	1.000	0.949
Education * Facilities & Infrastructure	-0.580	-0.680	-0.696	-0.667	0.949	1.000
X1.1	0.845	0.713	0.771	0.687	-0.541	-0.637
X1.2	0.789	0.517	0.598	0.508	-0.339	-0.416
X1.3	0.871	0.577	0.673	0.571	-0.427	-0.517
X1.4	0.886	0.489	0.592	0.508	-0.350	-0.446
X1.5	0.792	0.399	0.503	0.384	-0.262	-0.347
X2.1	0.630	0.897	0.778	0.714	-0.568	-0.644
X2.2	0.575	0.900	0.681	0.619	-0.583	-0.617
X2.3	0.554	0.878	0.650	0.600	-0.572	-0.557
Y.1	0.710	0.716	0.898	0.757	-0.615	-0.657
Y.2	0.729	0.708	0.904	0.687	-0.550	-0.623
Y.3	0.691	0.737	0.897	0.795	-0.561	-0.626
Y.4	0.624	0.646	0.865	0.599	-0.549	-0.646
Y.5	0.611	0.693	0.859	0.698	-0.517	-0.566

Source: Processed Smart PLS

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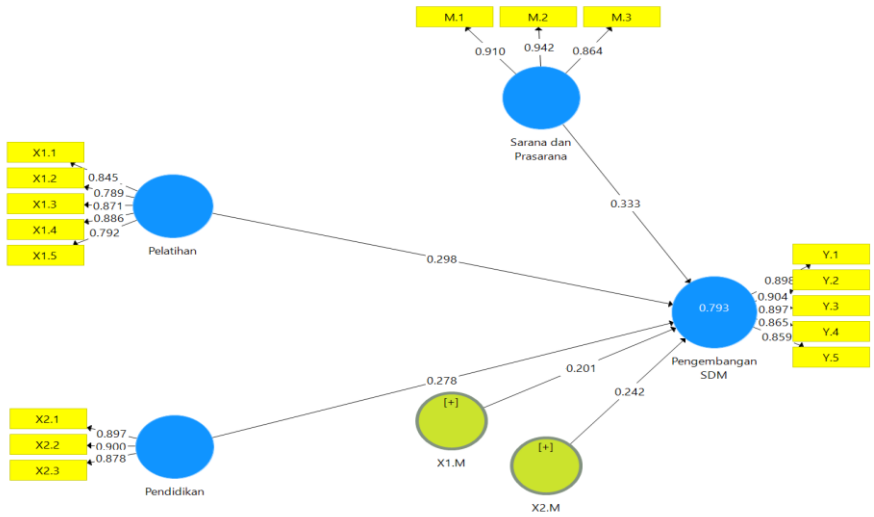

Figure 1 Validity Testing by Loading Factor

Based on the loading factor validity test in Table 2 and Figure 1, it is known that all loading values > 0.7, which means that they have met the validity requirements based on the loading value. Furthermore, validity testing was carried out based on the average variance extracted (AVE) value.

Construction	AVE	CR	Alpha Cronbach
Training	0.702	0.922	0.894
Education	0.795	0.921	0.872
Human resource development	0.783	0.947	0.931
Facilities and infrastructure	0.821	0.932	0.890
X1. M (Training*Facilities)	1.000	1.000	1.000
X2. M (Education*Facilities)	1.000	1.000	1.000

The recommended AVE value is above 0.5 (Mahfud and Ratmono, 2013:67). It is known that all AVE values > 0.5, which means that they have met the validity requirements based on AVE. Furthermore, reliability testing was carried out based on the composite reliability (CR) value.

The recommended CR value is above 0.7 (Mahfud and Ratmono, 2013:67). It is known that all CR values are > 0.7, which means that they have met the reliability requirements based on CR. Next, reliability testing was carried out based on Cronbach's alpha (CA) value.

The recommended CA value is above 0.7 (Mahfud and Ratmono, 2013:67). It is known that all CA values > 0.7, which means that they have met the reliability requirements

based on Cronbach's alpha. Next, a discriminatory validity test was carried out using the Fornell-Larcker approach. Table 4.6 presents the results of the discriminant validity test.

3. Hypothesis Testing

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

	Original Sample (O)	Average sample (M)	Standard Deviation (STDEV)	T Statistics (| O/STDEV |)	P value
Training -> Human Resources Development (Y)	0.298	0.297	0.067	4.461	0.000
Education -> Human Resources Development (Y)	0.278	0.281	0.076	3.676	0.000
Infrastructure Facilities - > Human Resources Development (Y)	0.333	0.331	0.090	3.704	0.000
Moderation Effect X1 -> Human Resources Development (Y)	0.201	0.207	0.065	2.020	0.000
Moderation Effect X2 -> Human Resources Development (Y)	0.242	0.251	0.060	2.695	0.000

All hypothesized relationships were shown to be significant at a $p<0.05$ level, so it can be concluded that training and education have a direct positive influence on human resource development, and infrastructure facilities significantly moderate the relationship.

Based on the results in Table 3, the results were obtained:

1. HR Development → Training

The original sample value was 0.298, T-statistic 4.461, and P-value 0.000 showed that Training had a positive and significant effect on Human Resources Development.

This means that the more intensive and quality the training program provided, the more human resource development in the organization will increase.

2. Education → Human Resources Development

The results showed a genuine sample of 0.278, a T-statistic of 3.676, and a P-value of 0.000.

With a P-value of < 0.05, the Education variable has a positive and significant influence on Human Resources Development.

This means that the level of education and the improvement of formal competencies also encourage the improvement of the quality of human resources.

3. Facilities and Infrastructure → Human Resources Development

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The original sample coefficient of 0.333, the T-statistic of 3.704, and the P-value of 0.000 showed a significant positive influence.
This means that the better the facilities and infrastructure available, the more optimal the process and results of human resource development.
4. Moderation Effect X1. M → Human Resources Development
The original sample value was 0.201, the T-value was 2.020, and the P-value was 0.000 indicating that the moderation effect was X1. M has a significant positive effect.
This indicates that the moderation variable X1. M strengthens the relationship between the main related variables, so that its influence on human resource development becomes stronger.
5. Moderation Effect X2. M → Human Resources Development
With an original sample of 0.242, a T-value of 2.695, and a P-value of 0.000, the moderation is X2. M has also been proven to have a significant positive influence on human resource development.
This means the existence of the moderation variable X2. M is able to strengthen the relationship of independent variables to Human Resources Development.

Table 4 R-Square

	R Square	Customized R Box
Human Resources Development (Y)	0.793	0.784

It is known that the R-Square value of HR Development (Y) is 0.793, which means Training and Education and Facilities and Infrastructure (Z) are able to affect human resource development (Y) by 79.3%. The *Adjusted R Square* value for HR development (Y) is 0.784. Since *the Adjusted R Square* = 0.784 > 0, it is concluded that Training and Education and continuous improvement (Z) have predictive relevance for human resource development (Y).

Table 5 Suitability Model Goodness Testing

	Saturated Model
SRMR	0.079
d_ULS	0.847
d_G	0.904
Chi-Square	534.184
NFI	0.743

It is known that based on the results of *the SRMR goodness of fit* test , the SRMR value = 0.079 < 0.1, so it is concluded that the model has FIT

4. Discussion
The results of this study provide empirical evidence that training and education have a very important role in improving human resource development in the construction sector. The positive and significant relationship between training and HR development (H1) is in line

with the findings of Al-Mzary, Soud, & Mohammad (2015) finding that training has a positive and significant influence on employee development in the public sector. Similarly, Noe & Kodwani (2018) stated that education and training carried out systematically have a long-term impact on improving the competence, motivation, and readiness of human resources in facing change. Therefore, the better the education and training programs provided, the greater the opportunity for human resource development to be realized. In the context of PT Energi Persada Inti Kontruksi Jakarta, a structured technical training program has been proven to be able to improve employee skills and project completion efficiency.

Similarly, the influence of education on human resource development (H2) supports the view of Hasibuan (2019) and Robbins & Judge (2019) who affirm that education plays a role in increasing cognitive capacity, decision-making ability, and innovation. Employees who attend professional education and certification programs show higher levels of adaptability and career development.

The role of moderation of infrastructure facilities (H3 and H4) makes a new contribution to the literature on human resource development. Significant interaction results show that adequate facilities—such as modern training centers, information technology support, and conducive learning environments—can strengthen the impact of training and education on human resource development outcomes. These findings are consistent with Sedarmayanti's view [5], which emphasizes that a supportive work environment and learning resources are important elements in optimizing employee development.

Overall, this study emphasizes the importance of alignment between human capital investment and infrastructure improvement. Organizations that have strong learning facilities can convert training and education programs into more tangible performance outcomes, especially in industries with high levels of technical and operational complexity such as construction.

Conclusion

Based on the results of the path analysis carried out, several conclusions were obtained as follows:

1. HR Development → Training

The results showed an original sample value of 0.298, T-statistic 4.461, and a P-value of 0.000, which means that Training has a positive and significant effect on Human Resources Development. The better the quality and frequency of training provided, the more the ability and development of human resources in the organization will increase.

Previous research supports this. Al-Mzary, Soud, & Mohammad (2015) found that training has a positive and significant influence on employee development in the public sector. Similarly, Noe & Kodwani (2018) stated that education and training carried out systematically have a long-term impact on improving the competence, motivation, and readiness of human resources in facing change. Therefore, the better the education and training programs provided, the greater the opportunity for human resource development to be realized

2.Education → Human Resources Development

With an original sample value of 0.278, T-statistic 3.676, and a P-value of 0.000, the Education variable has been proven to have a significant positive influence. This

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confirms that the level of education and the improvement of formal competencies contribute directly to the improvement of human resource development.

The results of previous studies showed the same thing. Zahra & Iram (2020) emphasized that the work environment and the availability of facilities have a positive effect on the development of employee competencies. Meanwhile, Mbugua & Kinyua (2020) found that adequate infrastructure makes training programs more effective in producing competent employees

3.Facilities and Infrastructure → Human Resources Development

The original sample value was 0.333, the T-statistic was 3.704, and the P-value was 0.000 indicating that Facilities and Infrastructure had a significant positive influence on Human Resources Development. Adequate work facilities are able to accelerate and strengthen the process of developing employee competencies.

Khan et al. (2017) in their research emphasized that training carried out with the support of modern technology is able to increase the effectiveness of employee development programs. This shows that facilities and infrastructure have an important role in strengthening the influence of education and training on human resource development

4.Moderation Effect X1. M → Human Resources Development

The original sample value was 0.201, the T-statistic was 2.020, and the P-value was 0.000 indicating that the moderation variable X1. M has a positive and significant effect. This means that moderation strengthens the relationship of the main variables related to improving human resource development.

Research by Ocen, Francis, & Angundaru (2017) proves that organizational support, including the availability of infrastructure and technology, is able to increase the effectiveness of training programs in producing competent employees. This shows that facilities and infrastructure are not only supporting factors, but also elements that strengthen the influence of education and training on human resource development

5.Moderation Effect X2. M → Human Resources Development

With the original sample value of 0.242, the T-statistic of 2.695, and the P-value of 0.000, the moderation effect is X2. M also proved to be a significant positive. This indicates that the moderation of X2. M is able to increase the strength of the relationship between independent variables and Human Resources Development

Suggestion

1. Managerial Implications

The results of this study provide a number of practical implications for the management of PT Energi Persada Inti Kontruksi Jakarta and similar organizations Management needs to integrate human resource development strategies with infrastructure planning through adequate budget allocation for the improvement of training facilities, digital platforms, and learning spaces. In addition, a systematic continuous learning program must be implemented as part of the human resource development policy so that employee competence continues to improve. The use of technology, including the use of digital devices and e-learning systems, also needs to be encouraged to expand access and increase the effectiveness of the learning process. On the other hand, periodic evaluations of infrastructure conditions and human resource development results must be carried out simultaneously to ensure sustainability, efficiency, and alignment between facility support and human resource capacity building needs.

2. Theoretical Contributions

From the theoretical side, this study enriches the literature on human resource development by proving the role of infrastructure facilities as a moderation variable. These findings expand on traditional HR development models that typically focus on training and education, by incorporating environmental and organizational context factors that influence learning outcomes. This multidimensional approach is in line with the strategic HRD perspective that emphasizes the synergy between human capital and organizational resources

3. Limitations and Future Research

Although the research produced significant findings, the scope of the research was limited to only one company so generalizations to the entire construction industry were still limited. Further research can expand this model by including other moderation variables such as leadership style, organizational culture, or digital transformation readiness. In addition, longitudinal research can provide a deeper understanding of the long-term impact of training and education on employee career development.

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