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PARTIAL LEAST SQUARES - MULTIGROUP ANALYSIS ON THE EFFECT OF LEADERSHIP ON WORK CULTURE AND LECTURER PERFORMANCE

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ABSTRACT

Higher education institutions depend on leadership to build their organizational culture and achieve better employee performance. However, there remains limited understanding of how the impact of leadership may vary across institutional contexts. This research employs Partial Least Squares - Multigroup Analysis (PLS-MGA) to explore the effects of leadership on work culture and lecturer performance in two Indonesian universities: UIN Maulana Malik Ibrahim and IAIN Ponorogo. A multistage random sampling of 272 lecturers was conducted. The methodological approach allowed for a robust comparative analysis between the institutions. The results reveal that leadership exhibits powerful positive relationships with work culture and lecturer performance in both institutions. Leadership explains 38.7% of work culture variability at IAIN Ponorogo, but only 18.6% at UIN Maulana Malik Ibrahim. These findings underscore the need for context-sensitive leadership development strategies and provide a foundational contribution for future research in higher education leadership and performance.

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1. INTRODUCTION

Leadership plays an important role in shaping organizational culture and employee performance. In the context of Indonesian higher education, there is growing concern about disparities in lecturer performance and the lack of effective leadership development programs. Field observations and national education reviews indicate that inconsistent leadership practices contribute to uneven work cultures and suboptimal academic performance across institutions. These challenges highlight the need for empirical studies that can capture how leadership dynamics shape institutional effectiveness. When a Higher Education Institution is seeking to improve effectiveness, understanding the relationship between leadership, organizational culture, and performance becomes essential [1].

Structural Equation Modeling - Partial Least Squares (SEM-PLS) is a method often used to model complex relationships, especially those related to latent variables [2]. In addition to this, Multigroup Analysis (MGA), which is an advanced analysis of SEM-PLS, allows a researcher to further explore whether there are differences in relationships between groups [3], [4]. The application of Partial Least Squares - Multigroup Analysis (PLS-MGA) to examine the influence of leadership on organizational culture and lecturer performance in higher education institutions is an interesting field of study to research, considering that each higher education institution may have its own uniqueness or characteristics in describing the relationship between the variables to be observed [5].

Mathematically, the PLS algorithm tries to optimize the variance that can be explained by the dependent variable by iteratively estimating the latent variable scores [6]. The process is divided into two parts: outer model estimation and inner model estimation. The outer model explains the relationship between latent variables and their indicators, while the inner model explains the relationship between latent variables. On the other hand, MGA extends the analysis by comparing structural model results between groups. The comparison focuses on the comparison of path coefficients between groups [7].

The main objective of this study is to examine the effect of leadership on organizational culture and lecturer performance using PLS-MGA [6], [7]. In addition, this study also aims to determine whether the relationship between groups differs (in this case between higher education institutions). Using statistical modelling, this research is intended to address critical gaps in literature while offering actionable insights to improve lecturer performance in higher education institutions.

Although research on leadership [8], [9], [10], [11], [12] and its influence on organizational culture [13], [14], [15], [16], [17] as well as lecturer performance [18], [19], [20], [21], [22] has been widely conducted, there are still gaps in understanding how these relationships differ from one environment to another. For example, many studies assume homogeneity in leadership influence [23], [24], [25], [26], [27], thus ignoring the potential moderating influence of demographic characteristics. Such weaknesses limit the generalizability of the findings and reduce the effectiveness of their application elsewhere. In addition, while SEM-PLS has been used extensively to model a wide range of complex structural models, its integration with MGA to examine between-group differences has been less explored. For this reason, this research is very interesting.

The novelty of this research lies not in the introduction of a new method, but in its application of PLS-MGA within the specific comparative context of public Islamic higher education institutions in Indonesia. While PLS-MGA has been previously used in organizational research, its integration to explore how leadership impacts organizational culture and lecturer performance across institutions with similar structural mandates, but different contextual dynamics is still limited. This makes the study empirically significant and methodologically valuable in enriching comparative leadership studies in the field of higher education.

To conclude the introduction, this study contributes to theoretical and methodological developments in leadership studies using PLS-MGA advanced analysis. The focus on inter-college comparisons provides practical relevance [28], [29], [30], [31]. The results of this study are expected to inform managerial policies and strategies and enable universities to design a leadership development program tailored to the specific needs and dynamics of each university.

2. RESEARCH METHODS

This research uses a quantitative method, where this method prioritizes the collection of numerical data and is analyzed using statistical analysis to test the hypothesis being built. Through this approach, the research variables are measured objectively using predetermined indicators and packaged in the form of a questionnaire. Meanwhile, the statistical analysis used is PLS-MGA. PLS is chosen over covariance-based SEM due to its suitability for predictive and exploratory modeling, especially when working with complex models and relatively small to medium sample sizes. PLS does not require multivariate normality and is robust to violations of distributional assumptions, which makes it appropriate for social science research with real-world data conditions. Additionally, PLS is more appropriate when the research focuses on maximizing explained variance (R^2) of endogenous variables rather than model fit indices. The PLS-MGA extension is used to compare path coefficients across groups, allowing the detection of significant differences in structural relationships. The assumptions underlying PLS-MGA include:

1. Indicator reliability and construct validity must be established beforehand (e.g., via AVE, CR, HTMT);
2. Measurement invariance across groups should ideally be tested; and
3. Adequate sample sizes should be maintained in each group to ensure the stability of bootstrapped estimates.

2.1 Sampling

The sampling method used is Multistage Random Sampling, which involves two stages. The first stage is grouping based on universities, where each university is considered as a stratum or group. While the second stage is random sampling of lecturers in each college. In essence, the sampling process begins by dividing the population into subpopulations (in this case, universities) to ensure representation of each group. This is followed by a random sampling of respondents within the groups.

The Kock and Hadaya method was used to measure the sample size. The sample calculation in the Kock and Hadaya method uses Eq. (1)[32]. This method is more accurate than rules-of-thumb (e.g., 10-times rule) and offers a power-based approach to estimate the minimum required sample size for detecting structural path effects with specified power and significance level. It is particularly relevant when the model includes multiple paths and is designed for use with non-normal data, as often encountered in PLS.

The minimum sample size formula used is as follows:

$$n > \left(\frac{z_{(1-\alpha)} + z_{Power}}{|\beta|_{min}}\right)^2 \tag{1}$$

$$n > \left(\frac{z_{(1-0.05)} + z_{0.95}}{0.2}\right)^2$$

$$n > \left(\frac{1.64 + 1.64}{0.2}\right)^2$$

$$n > 271 \approx 272.$$

In Eq. (1), $z_{(1-\alpha)}$ is the critical value for the standard normal distribution at the significance level α, typically set at 0.05, giving $z_{(1-\alpha)} \approx 1.96$. z_{Power} is the Z-score corresponding to the desired statistical power, usually 0.80, resulting in $z_{Power} \approx 0.84$. $|\beta|_{min}$ is the minimum absolute path coefficient expected in the model, based on prior studies or theoretical assumptions. In this study, we assume a minimum path coefficient of 0.2. This approach strengthens the statistical justification of sample size in PLS-SEM by focusing on statistical power and expected effect size, which is more rigorous than heuristic-based methods. Based on these values, the minimum sample size for each group is calculated using the formula above, ensuring sufficient power for detecting significant effects in PLS-SEM analysis. The results are divided into two because there are two universities, namely UIN Maulana Malik Ibrahim and IAIN Ponorogo. Each of these universities was taken as many as 136 samples.

2.2 Variables and Indicators

The variables and indicators used in this study can be seen in Table 1, where there are 3 indicators that measure leadership, 3 indicators that measure performance culture, and 4 indicators that measure lecturer performance.

Table 1. Variables and Indicators

Variables	Indicators	Code	Source
Leadership	Quality of leader's communication	L1	[33]
	Decision-making ability	L2	[34]
	Ability to motivate the team	L3	[35]
Work Culture	Values upheld in the organization	WC1	[36]
	Norms that exist in the organization	WC2	[37]
	Collective attitude and behavior	WC3	[38]
Lecturer Performance	Work productivity	LP1	[39]
	Quality of work output	LP2	[40]
	Innovation	LP3	[41]
	Contribution to organizational goals	LP4	[42]

In this study, the three variables are arranged in the form of a structural model (can be seen in Fig. 1) with the research hypothesis to be proven as follows:

H_1 : Leadership has a significant positive effect on Work Culture;
H_2 : Leadership has a significant positive effect on Lecture Performance;
H_3 : Work Culture has a significant positive effect on Lecture Performance.

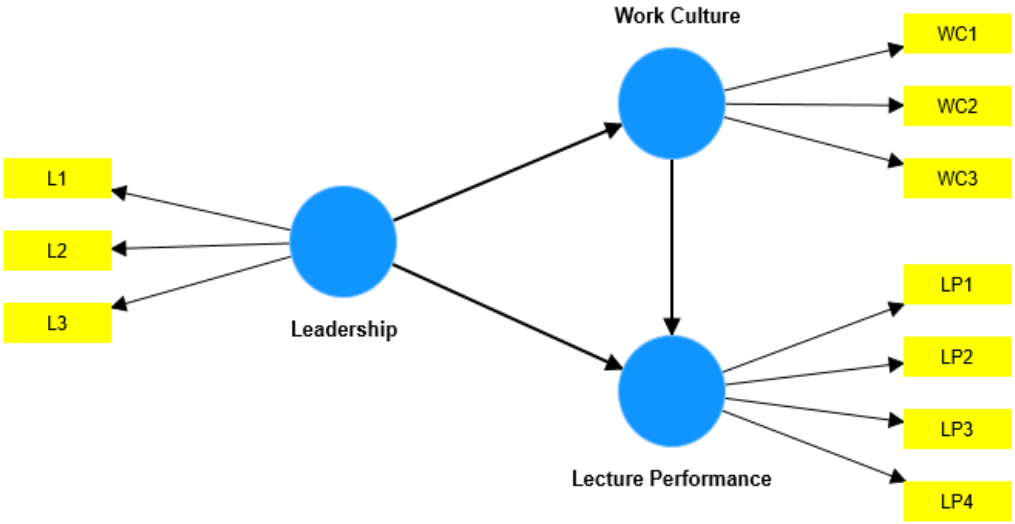


Figure 1. Structural model

The selection of variables in this study is grounded in the theoretical and empirical literature surrounding organizational behavior and higher education management. Leadership is widely recognized as a primary driver of organizational effectiveness, especially in shaping workplace norms and values [7], [13]. In higher education settings, Work Culture mediates the manner in which leadership influences day-to-day academic and administrative practices, creating an environment that supports or inhibits performance [14], [15], [16], [17]. Lecturer Performance is considered the ultimate outcome of interest, reflecting both individual contributions and institutional success [18], [19], [20], [21], [22]. The proposed model assumes that effective leadership will directly impact both work culture and lecturer performance, while work culture itself is hypothesized to further mediate and strengthen the relationship between leadership and performance. This structure is supported by transformational leadership theory and empirical studies indicating that internal culture often channels leadership influence into tangible outcomes.

2.3 Data Analysis

This research uses PLS-MGA. The first stage of PLS-MGA is a PLS analysis using PLS Algorithm on each group, detail for PLS Algorithm can be seen in [43]. For the second stage, the significant path coefficient is tested using the bootstrap method for each group. The Bootstrap algorithm is as follows:

1. Initial preparation
   The initial preparation is to prepare the observation dataset per each group that has been used in the previous stage. In addition, determine the number of bootstrap iterations to be used (some use 500, some use 5000).
2. Bootstrap Sampling
   For every c^{th} bootstrap iteration do the following:
   a. Take n bootstrap samples from the dataset with returns.
   b. Perform PLS Algorithm calculations but with bootstrap resampling data.
3. Calculating the Average Bootstrap Path Coefficient
   In each c^{th} bootstrap iteration, the path coefficient value is obtained. The Bootstrap Average Path Coefficient is calculated using Eq. (2).

$$\bar{b}_{ji} = \frac{1}{C}\sum_{c=1}^{C} b_{jic}, \tag{2}$$

   where C is the number of bootstrap samples used, while b_{jic} is the path coefficient of the influence of the i^{th} latent variable on the j^{th} latent variable at the c^{th} bootstrap iteration.
4. Calculating Standard Error (SE) of Bootstrap Path Coefficient
   To obtain the standard error (SE) value of the path coefficient, the general formula used to calculate the standard deviation of the bootstrap estimate in Eq. (3) can be used.

$$SE(b_{ji}) = \sqrt{\frac{1}{C-1}\sum_{c=1}^{C}(b_{jic} - \bar{b}_{ji})^2}. \tag{3}$$

5. Calculate t
   The t value is obtained from the path coefficient divided by the standard error (SE) of the bootstrap path coefficient as in Eq. (4).

$$t = \frac{b_{ji}}{SE(b_{ji})}. \tag{4}$$

6. Calculate p-value
   If we calculate the p-value based on the t-distribution assumption, Eq. (5) is used as follows:

$$p = 2 \times (1 - F_t(|t|, df)), \tag{5}$$

   where F_t is the cumulative distribution function (CDF) of the distribution of t. This approach is a parametric approach. However, there is also a way to get the p-value with a non-parametric approach using Eq. (6).

$$p = 2 \times \min\left(\frac{Count(b_{jic} \le 0)}{C}, \frac{Count(b_{jic} > 0)}{C}\right). \tag{6}$$

Before entering the third stage, it is necessary to test multicollinearity in the inner model using VIF. In addition, it is also necessary to check the value of R^2 and Q^2 [44]. For the third stage of MGA, one method that can be used is bootstrap MGA:

1. Calculating the Average Bootstrap Path Coefficient Difference
   We no longer need to repeat the bootstrap process from the beginning, because the bootstrapping process has been carried out in the second stage of part b. What needs to be done from these results is to calculate the difference in the bootstrap path coefficient between groups as in Eq. (7).

$$d_{jic} = b_{jic1} - b_{jic2}. \tag{7}$$

   After that, calculate the average difference of the bootstrap path coefficient as in Eq. (8).

$$\bar{d}_{ji} = \frac{1}{C}\sum_{c=1}^{C} d_{jic}. \tag{8}$$

2. Calculating Standard Error (SE) of Bootstrap Path Coefficient Difference

Same as the second stage of part d, but for the bootstrap path coefficient difference as can be seen in Eq. (9).

$$SE(d_{ji}) = \sqrt{\frac{1}{C-1}\sum_{c=1}^{C}(d_{jic} - \bar{d}_{ji})^2}. \quad (9)$$

3. Calculate t
The t value is obtained from the difference in path coefficient divided by the standard error (SE) of the bootstrap path coefficient as in Eq. (10).

$$t = \frac{d_{ji}}{SE(d_{ji})}. \quad (10)$$

4. Calculate p-value
If we calculate the p-value based on the t-distribution assumption, Eq. (11) is used as follows:

$$p = 2 \times (1 - F_t(|t|, df)), \quad (11)$$

where F_t is the cumulative distribution function (CDF) of the distribution of t. This approach is a parametric approach. However, there is also a way to get the p-value with a non-parametric approach using Eq. (12).

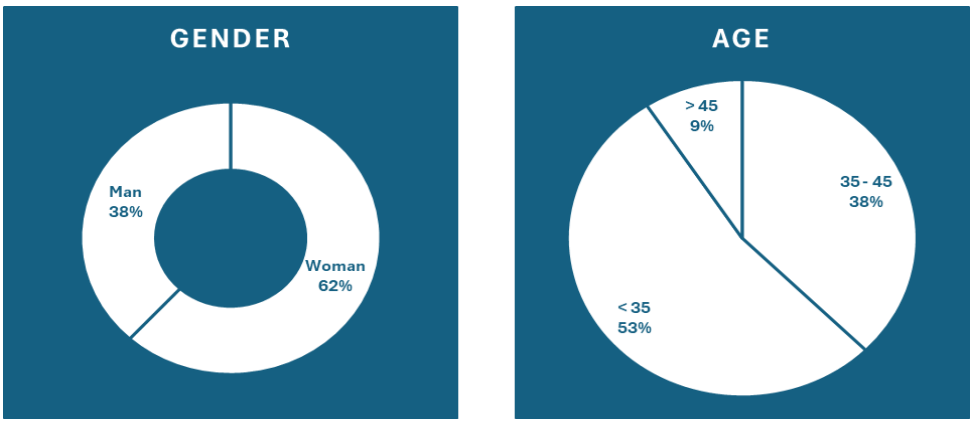
$$p = 2 \times \min\left(\frac{Count(d_{jic} \leq 0)}{C}, \frac{Count(d_{jic} > 0)}{C}\right). \quad (12)$$

3. RESULTS AND DISCUSSION

3.1 Respondent

Based on Fig. 2, the demographic profile of respondents reveals a gender distribution skewed toward women, with 62% of participants being female (168 individuals) and 38% being male (104 individuals). This composition suggests that female lecturers constitute a larger proportion of the academic workforce within the surveyed institutions. The gender imbalance may also reflect broader national trends in higher education, particularly in fields or institutions where female participation is actively encouraged or more prevalent.

In terms of age, the majority of respondents (53%) are under the age of 35, indicating a predominantly young lecturer population (145 individuals). This is followed by 38% of respondents aged between 35 and 45 (102 individuals), and only 9% above the age of 45 (25 individuals). The age distribution implies that the institutions involved are characterized by a relatively youthful academic environment, which could influence both work culture and leadership expectations. The presence of a younger workforce may also signal opportunities for leadership development and cultural shaping aligned with generational values.



(a) **(b)**

Figure 2. (a) Gender, and (b) Age of respondents

3.2 Stage 1 Results

The results of the outer weight and outer loading estimation can be seen in Table 2, while the path coefficient estimation can be seen in Table 3. Because this is a multigroup, the results are divided into two groups, namely the first group UIN Maulana Malik Ibrahim and the second group IAIN Ponorogo.

Table 2. Outer Weight and Outer Loading Estimation Results as well as CR and AVE

Variables & Indicators	UIN Maulana Malik Ibrahim		IAIN Ponorogo	
	Outer Weight	**Outer Loading**	**Outer Weight**	**Outer Loading**
Leadership	CR=0.837 & AVE=0.631		CR=0.856 & AVE=0.665	
Quality of leader's communication	0.490	0.799	0.426	0.829
Decision-making ability	0.426	0.811	0.437	0.829
Ability to motivate the team	0.341	0.771	0.362	0.787
Work Culture	CR=0.809 & AVE=0.586		CR=0.842 & AVE=0.642	
Values upheld in the organization	0.508	0.789	0.459	0.835
Norms that exist in the organization	0.356	0.719	0.431	0.846
Collective attitude and behavior	0.436	0.787	0.352	0.716
Lecturer Performance	CR=0.883 & AVE=0.654		CR=0.881 & AVE=0.649	
Work productivity	0.352	0.790	0.279	0.778
Quality of work output	0.300	0.812	0.295	0.791
Innovation	0.316	0.819	0.332	0.829
Contribution to organizational goals	0.269	0.815	0.333	0.822

Based on Table 2 for testing indicator reliability, the outer loading on all indicators in both the UIN Maulana Malik Ibrahim and IAIN Ponorogo groups has a value > 0.7, which means that all indicators are reliable or consistently measure latent variables. Meanwhile, testing internal consistency reliability using CR can be seen that all CR> 0.7, which means that internal consistency reliability has been met. Meanwhile, for convergent validity testing using AVE, it is found that all AVE values> 0.5, which means that the indicators have been precise in measuring latent variables. Meanwhile, for discriminant validity testing using HTMT, the results can be seen in Table 3.

Table 3. Estimation Results of Path Coefficients and HTMT

Path	UIN Maulana Malik Ibrahim		IAIN Ponorogo	
	Path Coefficient	**HTMT**	**Path Coefficient**	**HTMT**
Leadership → Work Culture	0.432	0.604	0.622	0.836
Leadership → Lecturer Performance	0.399	0.698	0.462	0.778
Work Culture → Lecturer Performance	0.342	0.675	0.242	0.679

Based on Table 3 for discriminant validity testing, the value of all HTMT <0.9, which means that the latent variables that have been formed really have a strong bond with the indicators that measure them rather than compared to indicators of other latent variables. From the results of the path coefficient estimation, it is found that all path coefficients have a positive influence relationship. However, to know whether the effect is significantly positive or not, it is necessary to see the results of stage 2.

3.3 Stage 2 Results

The results of the significance test of the influence between variables can be seen from the p-value in Fig. 3. Meanwhile, the R^2 and Q^2 values can be seen in Table 4.

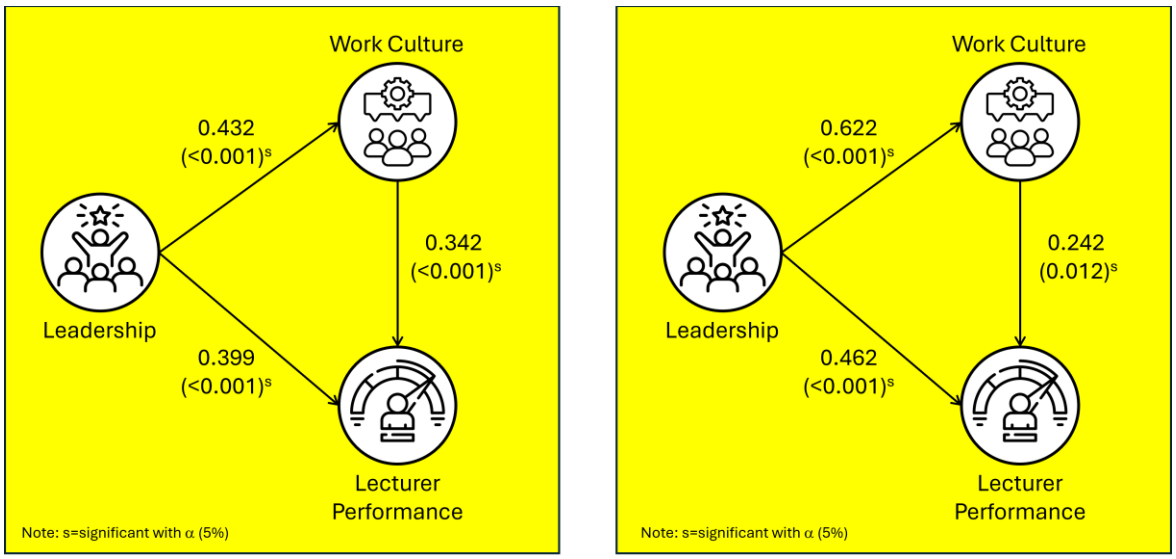


Figure 3. Influence between latent variables

Based on Fig. 3, it can be seen that both at UIN Maulana Malik Ibrahim and IAIN Ponorogo, both provide positive significant results on the influence of Leadership on Work Culture, Leadership on Lecture Performance and also Work Culture on Lecture Performance. This is indicated by the p-value (the value inside the brackets in Fig. 3) which is <0.05 for all relationships at both UIN Maulana Malik Ibrahim and IAIN Ponorogo.

Table 4. Indirect Effects

Indirect Effect	Path Coefficient	P values	Location
Leadership→Work Culture→Lecture Performance	0.151	0.020	IAIN Ponorogo
Leadership→Work Culture→Lecture Performance	0.148	< 0.001	UIN Maulana Malik Ibrahim

Based on Table 4, the analysis of indirect effects reveals that work culture significantly mediates the relationship between leadership and lecturer performance in both institutions. At IAIN Ponorogo, the indirect effect of leadership on lecturer performance through work culture is statistically significant with a path coefficient of 0.151 (p = 0.020), while at UIN Maulana Malik Ibrahim, the mediation effect is also significant with a path coefficient of 0.148 (p < 0.001). These results suggest that leadership influences lecturer performance not only directly but also indirectly by shaping the organizational culture in which lecturers operate. The consistent significance of the mediation across both institutions highlights the critical role of work culture as a mechanism through which leadership exerts its impact on performance outcomes in the academic environment.

Table 5. R^2 and Q^2

Variable	UIN Maulana Malik Ibrahim		IAIN Ponorogo	
	R^2	Q^2	R^2	Q^2
Work Culture	0.186	0.100	0.387	0.239
Lecturer Performance	0.395	0.246	0.411	0.255

The results in Table 5 show the difference in the strength of the model in explaining and predicting variables in two universities, namely UIN Maulana Malik Ibrahim and IAIN Ponorogo. In the Work Culture variable, the resulting model has a weaker ability at UIN Maulana Malik Ibrahim than at IAIN Ponorogo. This is indicated by R^2 Work Culture at UIN Maulana Malik Ibrahim is only 18.6%, which means that by using leadership alone, UIN Maulana Malik Ibrahim is only able to explain work culture by 18.6%, which also means that at UIN Maulana Malik Ibrahim there are still many other things that need to be added to be able to explain work culture more clearly. Meanwhile, at IAIN Ponorogo, the contribution of leadership alone can explain the diversity of work culture by 38.7%. On the other hand, using leadership and work culture can explain Lecturer Performance at UIN Maulana Malik Ibrahim by 39.5%, while at IAIN Ponorogo the two variables can explain Lecturer Performance by 41.1%.

In terms of the model's ability to predict, the ability to predict work culture using leadership at UIN Maulana Malik Ibrahim is still relatively low. This is indicated by the Q^2 value which is only 10%. Meanwhile, at IAIN Ponorogo, using leadership can predict work culture by 23.9%. Meanwhile, the ability to predict Lecturer Performance at UIN Maulana Malik Ibrahim and IAIN Ponorogo is not too much different, where both are still classified as moderate.

3.4 Stage 3 Results

Although the results of the effect are both significantly positive, it does not necessarily mean that the magnitude of the effect can be considered the same. For this reason, in stage 3, the MGA test was carried out using the MGA Bootstrap method. The Bootstrap MGA results can be seen in Table 6.

Table 6. Multigroup Analysis Result

Path	d	p-value
Leadership → Lecturer Performance	0.063	0.583
Leadership → Work Culture	0.190	0.038
Work Culture → Lecturer Performance	-0.100	0.397

Based on Table 6, there is no significant difference in the influence of leadership on Lecturer Performance at UIN Maulana Malik Ibrahim and IAIN Ponorogo, this is evidenced by the p-value (0.583) > α (0.05). On the other hand, there is also no significant difference in the influence of work culture on Lecturer Performance at UIN Maulana Malik Ibrahim and IAIN Ponorogo, as evidenced by the p-value (0.397) > α (0.05). However, there is a significant difference in the effect of Leadership on Work Culture at UIN Maulana Malik Ibrahim and IAIN Ponorogo, where the effect at IAIN Ponorogo is greater than that at UIN Maulana Malik Ibrahim.

3.5 Discussion

This research shows leadership produces significant impacts on work culture and lecturer performance at UIN Maulana Malik Ibrahim and IAIN Ponorogo. Organizational members transform based on leadership according to transformational leadership theory which demonstrates leaders shape employee values alongside motivation and productivity. Groups' identical results validate the essential role proficient leadership plays to enhance both teams' working culture and academic results. While leadership had a meaningful effect on work culture the difference in magnitude between the institutions produced statistical variations. Analysis shows that institutional context elements within organizations create environmental factors which may affect relationship strength. Previous research indicates different organizations show divergent responses when leadership is applied [45], [46], [47], [48], [49]. These results support the need to evaluate the influence of contextual factors during analysis between leadership methods and work environment development.

This study applies PLS-MGA, a powerful technique that can detect group-based differences in structural relationships within SEM frameworks. Unlike conventional SEM approaches that assume homogeneity across samples, PLS-MGA enables this research to uncover contextual differences across institutions. The use of two distinct institutions with similar operational structures but different performance patterns strengthen the reliability of cross-group analysis. Furthermore, the use of a detailed bootstrap MGA method adds statistical rigor to the significance testing of intergroup differences.

The novelty of this research lies in both the methodological approach and the empirical focus. Methodologically, this research is among the few in the Indonesian higher education context to implement PLS-MGA for comparing leadership impact across institutions. Empirically, while many studies have explored leadership's role in education [6], [7], this study uniquely contrasts two public Islamic universities with differing organizational climates, offering fresh insight into how leadership effectiveness varies by context.

The study contributes to leadership theory by providing empirical evidence that leadership does not exert a uniform influence on organizational culture across institutions. It confirms that context-sensitive approaches are necessary. Practically, it offers actionable recommendations for institutional leaders to tailor leadership development based on their university's specific dynamics. The findings enrich the discourse on how to bridge the theory-practice gap in leadership implementation within the education sector.

The findings imply that higher education leaders must design leadership programs not only based on general principles but also informed by institution-specific diagnostics. For example, UIN Maulana Malik Ibrahim may benefit from strengthening communication and feedback systems, while IAIN Ponorogo should maintain its participatory leadership culture. National education policy may also consider supporting context-based leadership development grants.

Leadership programs in higher education can benefit from these discoveries for their practical development needs. UIN Maulana Malik Ibrahim should establish assessments to determine what causes a decrease in leadership effectiveness on organizational culture because of inadequate leadership training and bureaucratic constraints. The participatory feedback system operated by IAIN Ponorogo should be upheld since it stands as one of their best current practices. The research stresses that leadership training must provide educators with both technical competence and skills for building interrelationships while instilling shared organizational values. The development of inclusive policies which support transparency can create the basis to fortify leadership-work culture connections across different organizational settings. This study has some limitations that need to be acknowledged. First, the sample includes only two universities, so generalization of the findings to a broader context needs to be done with caution. Second, additional variables such as specific organizational culture, work stress levels, or infrastructure support were not included, which may have influenced the results. Third, the PLS-MGA method, while powerful for multi-group analysis, has assumptions about normality and linearity that may not be fully met. Future research could expand the sample coverage and include moderating or mediating variables to explain the mechanisms behind the differences between groups. In addition, the qualitative approach can be complemented with in-depth interviews to explore lecturers' subjective perceptions of leadership and work culture.

The proposed research should conduct additional repetitions of this study across institutions with distinct features between public and private educational institutions or faith-based versus public universities. The analysis would gain better understanding through the incorporation of variables which include entrepreneurial culture along with innovation climate and technology support. The implementation of mixed methods enables researchers to establish complete understanding regarding how leadership impacts performance. The study should investigate modern leadership paradigms including adaptive and digital leadership since these concepts might better suit present-day higher education difficulties. This study creates a base for researchers to develop leadership models that fit within specific contexts.

The main research methodology in this investigation consists of PLS-MGA which stands as an uncommon statistical technique among leadership studies affecting the higher education sector. The PLS-MGA analysis technique reveals weaknesses that standard methodologies overlook when studying group differences. Employing PLS-MGA for non-normal data while dealing with small sample sizes in complex models represents one of its greatest advantages. Measurement validity and model stability assessment need to be performed by researchers before they can compare groups. When PLS and MGA operate together the combination creates an effective methodology for policy research that needs deep understanding of context-based variations.

These research findings create essential policy recommendations for developing leadership development programs that fulfill institutional requirements. UIN Maulana Malik Ibrahim should deliver interpersonal communication and conflict management training to improve the relationship between leadership impact on work environment. The leadership practices at IAIN Ponorogo must be maintained due to their existing success. The institution can establish policies targeting increased HR development funding together with incentives for leadership innovation. High education institutions must develop persistent monitoring procedures to determine how leadership builds an enduring work culture.

The research provides important additions to existing knowledge in higher education leadership and management research. This discovery about divergent leadership impact levels between institutions demonstrates that researchers should avoid applying research findings outside their specific context. Academic researchers benefit from this research because it enhances their comprehension of PLS-MGA utilization during multi cluster assessments. Overall, these research findings establish a foundation for practitioners who need to create intervention strategies with specific targets. However, this study is not without limitations. First, the study is limited to only two institutions, which constrains generalizability. Second, it focuses on only three core construct leadership, work culture, and performance without including possible moderating variables such as organizational trust, tenure, or leadership style. Future studies should extend this analysis to more diverse higher education institutions, including private and vocational institutions, to increase generalizability. The integration of qualitative methods such as interviews or focus

groups could provide deeper insight into the mechanisms of leadership influence. Researchers are also encouraged to examine moderating variables (e.g., gender, job tenure) or mediating variables (e.g., motivation, job satisfaction) to enrich the model. Future improvement of national lecturer and leadership quality requires strategic collaboration between institutions for practice exchange.

4. CONCLUSION

The findings of this study suggest that leadership functions not only as a managerial tool but as a contextual driver of organizational transformation in higher education. The research highlights the importance of adaptive leadership approaches, showing that leadership effectiveness is not universally applicable but shaped by institutional culture. Methodologically, the use of Partial Least Squares - Multigroup Analysis offers a novel lens to identify subtle differences between groups often overlooked by traditional SEM. This methodological and empirical contribution serves as a foundation for future research aimed at developing leadership models that are sensitive to context and organizational dynamics, particularly in diverse educational settings.

Author Contributions

Hairur Rachman: Conceptualization, Funding Acquisition, Investigation, Resources, Supervision. Angga Dwi Mulyanto: Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Project Administration, Resources, Software, Visualization, Writing - Original Draft, Writing - Review and Editing. Sri Harini: Conceptualization, Formal Analysis, Investigation, Resources. Fachrur Rozi: Conceptualization, Formal Analysis, Investigation, Resources, Visualization. Bambang Widjanarko Otok: Formal Analysis, Validation. Jerry Dwi Trijoyo Purnomo: Formal Analysis, Validation. All authors discussed the results and contributed to the final manuscript.

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Declarations

The authors declare that there is no conflict of interest regarding the publication of this article.

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