Multidisciplinary Reviews

QUESTIONNAIRES APPLICATION
Published Online: February 1, 2025
https://doi.org/10.31893/multirev.2025205

Transformational leadership in education: How PLCs, self-efficacy, and motivation drive innovative teaching

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Abstract Transformational leadership effectively fosters an environment conducive to innovation and motivation, ultimately positively impacting the standard of teaching and learning in school. The main problem currently is teachers' innovation and pedagogical competence are still low. This study explores the role of Professional Learning Communities (PLCs), self-efficacy, and motivation as mediators between transformational leadership and teaching innovative behavior. The research employs a quantitative approach, utilizing data collection instruments to survey 374 teachers chosen through cluster random sampling techniques. The collected data is analyzed using the Structural Equation Modeling (SEM) test with Partial Least Squares (PLS). The findings indicate that transformational leadership indirectly affected teaching innovative behavior. Additionally, PLCs, self-efficacy, and motivation positively impact teachers teaching innovative behavior and mediate the relationship between transformational leadership and teaching innovative behavior. These results highlight the crucial role of PLCs, self-efficacy, and motivation in enhancing the effectiveness of transformational leadership in educational institutions in Indonesia.

Keywords: transformational leadership, self-efficacy, plc's, primary school, sem-pls

1. Introduction

In the context of Indonesia's primary education, there is a need for significant improvements in quality in terms of the SDG indicators until 2030. The main focus of the SDGs in education is to improve teacher qualifications and facilities and increase international collaboration for knowledge exchange and teacher training (Kopnina, 2020). In efforts to support the program through improving the quality of teachers, qualified teachers can implement learning innovations and have good pedagogical competence (Azar & Babatunde, 2023). Teachers can learn and develop themselves in schools because they improve student academic achievement and effectiveness (Özgenel & Mert, 2019). In addition, the quality of education is determined by the quality of learning through innovative teaching behavior.

However, research results indicate that teacher professionalism in innovative learning models must still meet expectations (Khodijah, 2022). The main problem is still teachers' low level of teaching innovation and pedagogical competence. The UNESCO survey results indicate that the quality of teacher performance in Indonesia is 14 out of 14 developing countries, indicating that the qualifications and performance of teachers in Indonesia are still far from the expectations for producing quality students. The reason for the low quality of education in Indonesia is the low quality of teachers. The results of the teacher competency test from 2021--2023 show that approximately 81% of teachers in Indonesia did not reach the minimum score. The 2021 competency test results are still lacking, with scores of 54.05 and 55.46 (Mardhatillah & Surjanti, 2023).

One solution to overcome this phenomenon is to encourage teachers to have ideal pedagogical competencies by applying pedagogical methods, schemes, and strategies in teaching practices on the basis of problem-solving approaches (Toom, 2017), and teachers can actively participate in professional learning communities. Improving teacher competence is a dynamic process of developing knowledge and skills (Blömeke et al., 2015), and the results of competence development contribute to shaping productivity and innovation (Zhu et al., 2013). However, pushing teachers to the ideal state of pedagogical competence requires encouragement from both internal and external sides (Lingard et al., 2003). The external approach explores the organization's role, whereas the internal approach explores the role of the individual.

From an organizational perspective, transformational leadership is the variable used to determine its impact on teachers' innovative teaching behavior. Transformational leadership involves supporting professional development, including training that contributes to teachers' innovation ability (Supermane, 2019) and changes in the school organization. Principals who apply transformational leadership increase teachers' work motivation (Rachma et al., 2023) and contribute to encouraging

their engagement in professional learning communities, which impacts their innovative teaching behavior at school. In terms of individual factors, several factors improve innovative teaching behavior, such as self-efficacy, motivation, and a professional learning community. Self-efficacy is essential in shaping teachers' innovative teaching behavior (Hsiao et al., 2011); efficacy plays a role in mediating professional learning communities and innovative teaching behavior. Furthermore, self-efficacy and motivation can support teachers' innovative teaching behavior together (Klaeijsen et al., 2018). In addition, one of the strong predictors of teachers' innovative teaching is the PLC (Rubenstein et al., 2018); innovative teaching behavior can be improved by strengthening PLC formation through teachers' collective responsibility to improve teaching and learning practices (Harris & Jones, 2010).

Previous research has proved that the transformational leadership style significantly creates an ideal environment to support innovation and motivation which can directly impact the quality of teaching and learning. In previous literature, transformational leadership commonly related with intrinsic motivation, organizational commitment, and teacher professional development (Andriani et al., 2018). Therefore, previous studies on innovative behavior have focused mostly on information literacy and teacher coworking. Therefore, the novelty of this study is the use of transformational leadership variables to encourage teachers' innovative teaching behavior, which provides a new concept because previous studies have measured inclusive leadership. Second, this state-of-the-art study tests a model with PLCs, efficacy, and motivation mediators in SEM PLS analysis.

This study aims to specifically examine the role of professional learning communities (PLCs), self-efficacy, and motivation as mediators between transformational leadership and teaching innovative behavior in East Java via SEM PLS analysis. The research addresses the following problem: "Does the presence of professional learning communities (PLCs), self-efficacy, and motivation mediate transformational leadership and teaching innovative behavior among elementary schoolteachers?"

2. Literature Review

2.1. Transformational leadership

Studies have shown that transformational leadership creates a supportive environment for innovation and motivation, thus positively impacting the quality of teaching and learning (Thien & Liu, 2024). Explained that teacher self-efficacy acts as a mediator between instructional leadership and professional learning, increasing teacher self-efficacy, which promotes professional learning. Research (Supermane, 2019) emphasized the importance of knowledge management training for leaders to drive teaching innovation (Özdemir et al., 2024). Noted that training and mentoring strengthened teachers' commitment to duty. Transformational leaders change teachers' attitudes toward collaboration and the use of resources (Sliwka et al., 2024a) and increase teachers' trust in the principal, improving their performance and innovation. According to (Abuhassira et al., 2024), transformational leadership practices in private secondary schools significantly influence classroom interactions. Indicators of transformational leadership include direction setting, relationship building, organizational development, and the refinement of learning programs (Leithwood et al., 2023).

2.2. Professional learning communities

Several studies have shown that engagement in a professional learning community (PLC) can improve teacher performance. PLCs allow teachers to collaborate and share best practices, positively impacting their competence and effectiveness. Indicators such as "supportive and shared leadership" facilitate supportive leadership and shared responsibility, enhancing positive interactions between principals and teachers (Liu, 2020). PLCs also support "shared values and vision," strengthen the collective commitment to school quality, and facilitate collective learning through collaboration and reflection (Parlar et al., 2020). Furthermore, a culture of trust and commitment in a PLC environment encourages collaboration and innovation in teaching.

Other studies mentioned that PLCs facilitate better interactions between principals and teachers, increasing teachers' self-reflection and self-renewal capacity (Furqon et al., 2018; Tayag, 2020). The indicator "collective learning and application of learning" is critical in creating opportunities for teachers to learn together and apply new knowledge in their practice. Effective PLC implementation also improves student learning achievement (Kin & Kareem, 2021) and allows teachers to analyze data to make strategic decisions in teaching (O'Connor & Park, 2023). Finally, PLCs support innovation and the sharing of teaching practices that help improve teacher professionalism and student performance (Akram et al., 2023; Clark et al., 2023; Wangmo, 2021). The "shared personal practice" indicator also allows teachers to share personal experiences in teaching practice, thus enriching the learning process within the community and creating stronger bonds between teachers.

2.3. Self-efficacy

Phan & Ngu, (2014) used the Academic Well-Being Experience Questionnaire (AWEQ) to measure academic well-being through dimensions such as academic engagement and academic motivation. The relationship between self-efficacy and academic achievement suggests that increasing teacher self-efficacy positively impacts student engagement. Teachers with high levels of self-efficacy can engage students more effectively, create a more interactive learning atmosphere, and improve

learning outcomes. This statement is reinforced by the findings of (Granziera & Perera, 2019), who stated that teachers' self-efficacy affects their psychological well-being and ability to engage students more profoundly.

In addition to student engagement, the efficacy of teaching strategies also plays a vital role in teacher well-being. According to (Bing et al., 2022), self-efficacy in implementing learning strategies enhances teachers' ability to develop a positive learning environment and is supported by (Lee et al., 2024), who emphasize that empowering teachers to plan and commit to education contributes to improved well-being. On the other hand, efficacy in classroom management is also an important indicator (Han et al., 2020), emphasizing that self-efficacy in classroom management, emotional management, and administrative tasks increases job satisfaction and results in more positive educational outcomes.

2.4. Motivation

Teacher motivation plays a crucial role in improving innovative teaching performance. Highly motivated teachers tend to be more actively involved in the teaching process and strive for more extraordinary achievements (Bastian et al., 2022; Hartinah et al., 2020). The positive emotions experienced by teachers can increase job satisfaction and commitment, contributing to improved performance (Sudarman et al., 2021; Sukmawaty et al., 2021). Good relationships between teachers and their coworkers can also strengthen motivation, creating a collaborative environment that favors innovations in teaching (Auliana et al., 2021).

Motivation is a significant mediator between transformational leadership and teacher performance. Leaders who create a positive environment and support motivate teachers to innovate teaching methods. In this context, the teacher's achievement can affect their motivation, where recognition of achievements will encourage them to continue innovating (Juhji et al., 2022; Noor, 2019). PERMA theory provides a framework for exploring the influence of motivation on teacher performance. Positive emotion, engagement, connection, meaning, and accomplishment contribute to increased motivation and innovative teaching behavior (Fahmi et al., 2022; Nugroho et al., 2023). Thus, educational leaders need to implement leadership strategies that focus on developing motivation to encourage innovation in teaching (Bardach & Klassen, 2021).

2.5. Teaching innovative behavior

Innovative teaching behaviors include a series of stages that begin with opportunity exploration, where teachers recognize opportunities to make changes or improvements in the learning process (Baharuddin et al., 2020), which is supported by (Lambriex-Schmitz et al., 2020). Opportunity exploration involves teachers' awareness of potential changes, either from existing problems or new developments in the work environment, that can be used to improve teaching methods (Kmieciak, 2020; Rafique et al., 2022; van Zyl et al., 2021). Once opportunities are discovered and ideas are generated, teachers create new solutions, find alternative approaches, and develop innovative ideas to improve teaching and learning (Amtu et al., 2020; Ayoub et al., 2023).

Once the idea is generated, the next step is idea promotion, where the teacher introduces and socializes the idea to colleagues and school stakeholders to gain support and approval (Khan et al., 2020; Khaola & Oni, 2020; Sudibjo & Prameswari, 2021; Vermeulen et al., 2022; Zainal & Mohd Matore, 2021). The process concludes with idea realization, the implementation stage, which involves developing a plan, modifying it if necessary, and using appropriate resources to integrate the idea into teaching. These four stages are interrelated and contribute to improving teachers' innovative performance in supporting the success of the learning process.

The research model in this study comprises transformational leadership as a variable X, teacher performance as a variable Y, and the professional learning community as a variable Z. On the basis of the model described above, the following research hypotheses are formulated:

H1= Transformational leadership has a direct effect on teachers' innovative teaching behavior.
H2= The learning community mediates the effect of transformational leadership on teachers' innovative teaching behavior.
H3= Teachers' self-efficacy mediates the effect of transformational leadership on teachers' innovative teaching behavior.
H4= Motivation mediates the effect of transformational leadership on the performance of teachers' innovative teaching behavior.

3. Research Method

3.1. Design

This research employs a quantitative approach to measure the relationships among the developed variables. The analysis uses structural equation modeling (SEM) to assess the impact between variables. SEM analysis is divided into two measurement models: the outer and inner models.

3.2. Research participants

This study uses a quantitative approach to test a model of the impact of transformational leadership on teachers' innovative teaching behavior. The model developed involves exogenous variables (transformational leadership) and mediating variables (professional learning community, efficacy, and motivation) to measure teachers' innovative teaching behavior.

The study population included 163,570 public primary school teachers in East Java. The research sample included 400 teachers, as determined via the Slovin formula, with an error rate of 5%. The sample withdrawal method uses probability sampling, with a cluster random sampling technique, by taking from several clusters: North Cluster (Surabaya), South Cluster (Malang), West Cluster (Madiun), and East Cluster (Jember). Among the 400 questionnaires distributed, 374 were returned and completed by the teacher respondents in the study. Most respondents were female, with 290 people (77.5%), indicating that women dominate the teaching profession in this study. In addition, 84 (22.5%) male respondents were included.

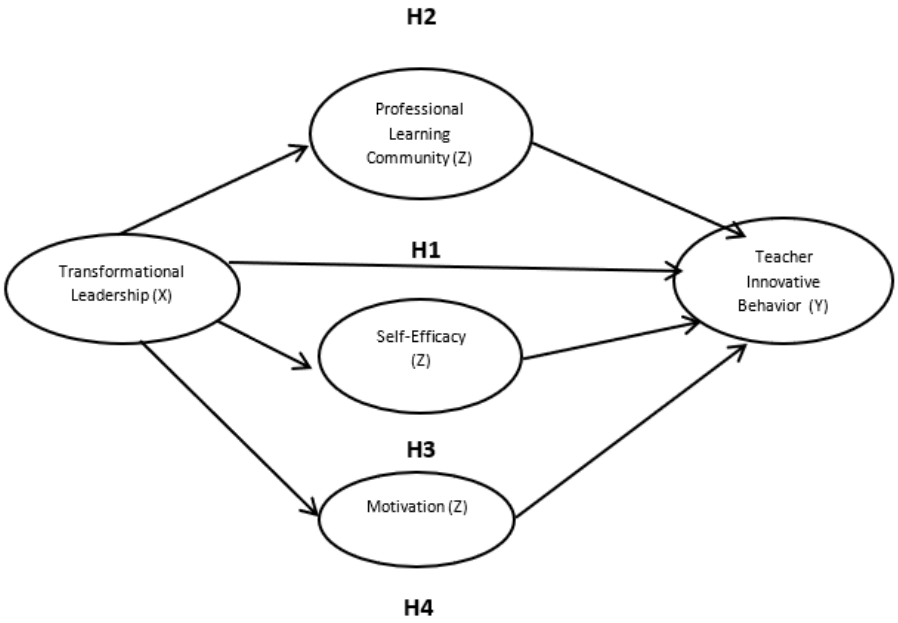

Figure 1 Research model.

3.3. Research instruments

This research instrument uses a 5-point Likert scale as its measurement scale, namely, Strongly Agree (SS), Agree (S), Disagree (KS), Disagree (TS), and Strongly Disagree (STS). The questionnaire consists of 2 parts: the first part explores data on the demographic conditions of the respondents, and the second part measures the research variables. The instrument used to measure transformational leadership was adapted from Leithwood et al. (2023b). We adapted PERMA (Phan & Ngu, 2017) to measure and assess motivation, whereas for self-efficacy, we adapted the instrument from Phan et al. (2018). The Professional Learning Community Assessment Questionnaire (PLCAQ) developed by Hipp & Huffman (2003) was used to measure PLCs, and innovative teaching behavior was adapted from Baharuddin et al. (2020).

4. Results

4.1. Measurement of the outer model

The measurement model (outer model) utilized to evaluate the validity and reliability of the model involves conducting tests for convergent validity, discriminant validity, and composite reliability. Convergent validity is assessed via factor loading values on the latent variable with indicators, with an expected value greater than 0.7. Discriminant validity is determined through cross-loading factor values and involves comparing the value of the targeted construct with the value of other constructs. Composite reliability is measured to assess the reliability value, with a value greater than 0.7 indicating high reliability. The average variance extracted (AVE) is expected to be at least 0.5. Additionally, Cronbach's alpha is calculated to validate the composite reliability results, with a minimum of 0.6.

4.2. Test validity and reliability

As part of this research, the convergent validity was tested by measuring the magnitude of the outer loading on each indicator. The results of the outer loading analysis in this research are presented in the following table:

The results of the indicator validity test in Table 1 above show the loading factor value for each construct in the research model. For the efficacy construct, the tested indicators, such as MI10 to MI20, have factor loading values ranging from 0.713

to 0.858, indicating that most indicators have good values for convergent validity. For the Innovative construct, indicators MT10, MT12, and MT14 have factor loading values of 0.877, 0.818, and 0.843, respectively, indicating strong validity. In the motivation construct, indicators such as SE10, SE11, and SE12 have factor loading values that vary from 0.715 to 0.818, which still meet the requirements of good validity. For the PLC construct, indicators PLC1 to PLC23 have factor loading values that range from 0.722 to 0.861, with most indicators showing values above 0.737, indicating good validity. Finally, for the transformational construct, indicators TL1 to TL21 had factor loading values between 0.729 and 0.868, indicating good consistency and validity for this construct. Overall, all indicators tested showed adequate factor loading values, supporting the validity of the constructs in this research model.

Table 1 Validity test.

	Efficacy	Innovative	Motivation	PLC	Transformational
SE10	0,756				
SE11	0,734				
SE12	0,818				
SE4	0,715				
SE5	0,769				
SE6	0,784				
SE7	0,764				
SE8	0,809				
SE9	0,761				
MI10		0,771			
MI13		0,830			
MI14		0,791			
MI15		0,828			
MI16		0,850			
MI17		0,858			
MI18		0,803			
MI19		0,771			
MI20		0,768			
MI3		0,773			
MI4		0,752			
MI5		0,713			
MI6		0,799			
MI7		0,809			
MI8		0,819			
MI9		0,736			
MT10			0,877		
MT12			0,818		
MT14			0,843		
PLC1				0,761	
PLC10				0,849	
PLC11				0,825	
PLC12				0,861	
PLC13				0,811	
PLC14				0,816	
PLC15				0,845	
PLC16				0,748	
PLC17				0,830	
PLC18				0,837	
PLC19				0,747	
PLC21				0,854	
PLC22				0,752	
PLC23				0,824	
PLC5				0,737	
PLC6				0,722	

PLC7	0,855	
PLC8	0,798	
PLC9	0,849	
TL1		0,768
TL10		0,846
TL11		0,841
TL12		0,845
TL13		0,861
TL14		0,729
TL15		0,841
TL16		0,808
TL17		0,827
TL18		0,755
TL19		0,750
TL2		0,829
TL20		0,783
TL21		0,868
TL3		0,830
TL6		0,743
TL7		0,777
TL8		0,814
TL9		0,826

In PLS-SEM, reliability testing is carried out in addition to validity testing. A reliability test determines whether the questionnaire used to collect data on research variables is reliable. The questionnaire is reliable if the same results are obtained when the questionnaire is remeasured. The rule of thumb for assessing construct reliability is that the composite reliability value must be > 0.70. Therefore, this study's questionnaire is valid and reliable.

Table 2 Reliability test.

	Cronbach's Alpha	rho_A	Reliability Komposit	Rata-rata Varians Diekstrak (AVE)
Efficacy	0,913	0,915	0,928	0,590
Innovative	0,960	0,962	0,964	0,629
Motivation	0,801	0,803	0,883	0,716
PLC	0,970	0,971	0,973	0,652
Transformational	0,970	0,971	0,973	0,654

The results of the reliability and validity tests in Table 2 show that all the constructs in this study have adequate values. For the efficacy construct, the Cronbach's alpha value is 0.913, the rho_A value is 0.915, and the composite reliability is 0.928, with an average variance extracted (AVE) of 0.590. The Innovative construct showed excellent values, with a Cronbach's alpha of 0.960, a rho_A of 0.962, a composite reliability of 0.964, and an AVE of 0.629. Motivation also showed good results, with a Cronbach's alpha of 0.801, a rho_A of 0.803, a composite reliability of 0.883, and a high AVE of 0.716. The PLC and transformational constructs had excellent results, with a Cronbach's alpha of 0.970, a rho_A of 0.971, a composite reliability of 0.973, and AVEs of 0.652 and 0.654, respectively. These values indicate that all the constructs in this research model have high reliability and good construct validity, meeting the standards expected in quantitative research.

Table 3 Fornell–Larcker analysis.

	Efficacy	Innovative	Motivation	PLC	Transformational
Efficacy	0,768				
Inovative	0,651	0,793			
Motivation	0,549	0,666	0,846		
PLC	0,627	0,655	0,618	0,808	
Transformational	0,556	0,539	0,514	0,850	0,808

The Fornell–Larcker test results in Table 3 show that all the constructs in this research model have adequate discriminant validity. The square root values of the average variance extracted (AVE) for each construct, namely, efficacy (0.768), innovation (0.793), motivation (0.846), PLC (0.808), and transformation (0.808), are greater than the correlations between the construct and other constructs. In other words, each construct shows good discriminant validity, as its AVE value exceeds the correlation

with other constructs, except for a slight difference in the correlation between the PLC and Transformational. Overall, these results confirm that the constructs in this research model have solid discriminant validity.

4.3. Testing the relationships between variables

The measurement model (inner model), also known as the structural model, focuses on specifying the relationships between latent variables and describes the interactions between variables on the basis of the substantive theory of research. On the basis of the analysis test results, the path coefficient values between variables and their significance are described in the following table.

Table 4 Hypothesis test results.

Hypothesis	Variable Relationships	Original Sample (O)	Mean Sample (M)	Standard Deviation	T Statistik	P Values
H1	Transformational -> Innovative	-0,076	-0,076	0,069	1,095	0,274
H2	Transformational -> Efficacy -> Innovative	0,171	0,174	0,030	5,689	0,000
H3	Transformational -> Motivation -> Innovative	0,175	0,175	0,043	4,075	0,000
H4	Transformational -> PLC -> Innovative	0,269	0,270	0,071	3,802	0,000

The outcome of the hypothesis test analysis from Table 4 provides the following interpretation:

The results of the analysis reveal several significant relationships between the variables in this study. First, efficacy has a significant positive effect on innovation, with a path coefficient of 0.308 and a t value of 5.871, indicating that an increase in efficacy significantly increases innovation. The same applies to motivation, which positively affects innovation, with a path coefficient of 0.340 and a t value of 5.213, showing that motivation is vital in driving innovation. In addition, a professional learning community (PLC) has a significant positive effect on innovation, with a path coefficient of 0.316 and a t value of 3.830.

On the other hand, transformational leadership strongly influences several variables. The relationship between transformational leadership and efficacy is highly significant, with a path coefficient of 0.556 and a t value of 11.211, indicating that transformational leaders can increase efficacy substantially. The effect of transformational leadership on motivation is also strong, with a path coefficient of 0.514 and a t value of 9.181. In addition, the most vital relationship was observed between transformational leadership and the PLC, with a path coefficient of 0.850 and a t value of 33.870, indicating the tremendous impact of transformational leadership on PLC formation. However, the relationship between transformational leadership and innovation was insignificant, with a path coefficient of -0.076, a t value of 1.095, and a p value of 0.274. This suggests that although transformational leadership strongly influences efficacy, motivation, and the PLC, its influence on innovation is not significant enough in the context of this study.

The statistical test results show that transformational leadership significantly influences innovation through three mediation paths: efficacy, motivation, and professional learning community (PLC). For the transformational path, "Efficacy" > "Innovative path", a positive influence is observed, with a coefficient value of 0.171 and a T statistic of 5.689, which indicates a statistically significant strength of influence (p value of 0.000). Similarly, for the transformational -> motivation -> innovative pathway, the effect of transformational leadership on innovation through motivation is also significant, with a coefficient value of 0.175 and a T statistic of 4.075, indicating that motivation plays a vital role in driving innovation. In addition, in the Transformational -> PLC -> Innovative pathway, the PLC is also a significant mediator, with a coefficient of 0.269 and a T statistic of 3.802. These three pathways show that transformational leadership can increase innovation by strengthening efficacy and motivation and forming professional learning communities, with all pathways having a p value of 0.000, which is highly significant.

5. Discussion

Testing the first hypothesis of this study reveals that transformational leadership has no significant influence on innovative teaching behavior. In educational organizations, transformational leadership is one of the key factors in encouraging teacher innovation in the learning process. Inspirational, visionary leaders who motivate their subordinates can create an environment that supports teacher change and creativity. However, the results of the analysis in this study show that the relationship between transformational leadership and innovation is less strong than expected. With a path coefficient of -0.076, transformational leadership has a weak negative relationship with innovation. The results of the analysis indicate that the greater the application of transformational leadership in schools is, the more likely it is to slightly reduce the level of teacher innovativeness in teaching, although the effect is very small.

These findings indicate that transformational leadership does not significantly influence teachers' innovative teaching behavior in schools. The results of this study are in line with the research results (Polatcan et al., 2024; Kılınç et al., 2024) that

there is no direct relationship between transformational leadership and teacher innovation. Research (Messmann et al., 2022) has shown that teacher innovation is not formed directly by transformational leadership. Research results contradict those of (Sliwka et al., 2024b), which suggests a positive relationship between transformational leadership style and teachers' ability to innovate in secondary schools in Germany. On the basis of the above analysis, fostering teacher innovation must be supported by other factors, such as self-efficacy, motivation, and PLCs. The second hypothesis of this study suggests that although transformational leadership does not have a significant direct relationship with innovation, the effect may occur through the mediation of the professional learning community (PLC) and reflects the direct path coefficient between transformational leadership and innovation, which shows a weak negative relationship and is not statistically significant. However, when the PLC serves as a mediator, it has different results; for example, the PLC significantly mediates the relationship between transformational leadership and innovation.

Thus, although transformational leadership does not directly influence innovation, its effects can be realized through PLCs' activeness and effective management, and research results (Paletta & Alimehmeti, 2023) support that PLCs act as a mediator between principal leadership and teachers' innovative teaching behavior. PLCs act as platforms or media for collaboration between teachers, shared learning, and professional competency development (Owen, 2016), thus increasing the innovation capacity of individuals and organizations. These results emphasize the importance of managing and developing PLCs as important mechanisms capable of amplifying the positive impact of transformational leadership on teachers' teaching innovation in schools (Kilag et al., 2023). Educational organizations that want to improve teachers' innovation ability should consider inspirational leadership and create a conducive collaborative learning environment through PLCs.

In testing the third hypothesis, the analysis results show a significant positive effect of transformational leadership on innovation through teachers' self-efficacy to achieve the desired results. The statistical value shows that transformational leadership positively increases innovation when mediated by efficacy. The stronger the transformational leadership implemented, the more teachers' beliefs or efficacy in schools increase, strengthening their innovative ability. Transformational leadership can indirectly influence innovation by increasing teacher efficacy in schools and linearly with research (Abdullah et al., 2016), which indicates that self-efficacy mediates the relationship between transformational leadership and teachers' innovative teaching ability. Transformational leaders who can provide vision, inspiration, and support tend to increase teachers' belief in their ability to perform tasks effectively (Zaini et al., 2022). When efficacy increases, teachers can face challenges and create innovations in the teaching and learning process (Cai & Tang, 2021). Therefore, this pathway emphasizes the importance of building self-confidence and belief in teachers' abilities as an essential step toward improving school innovation.

The final hypothesis of this study is that transformational leadership significantly influences innovation through motivation. Transformational leadership positively increases motivation, leading to increased innovation (Anzarwati, 2021). The stronger the transformational leadership implemented is, the greater the motivation felt by teachers, which contributes to an increase in teachers' innovative abilities in carrying out their roles at school. These results indicate that effective transformational leadership not only inspires and influences the behavior of organizational members but also increases their internal motivation. This finding is supported by (Bin Saeed et al., 2019), who reported that transformational leadership has a strong positive relationship with innovative work behavior when intrinsic motivation is high. Transformational leaders who provide a clear vision, emotional support, and new challenges tend to increase morale and teacher motivation (Thoonen et al., 2011). When motivated, teachers are more encouraged to think creatively, take initiative, and contribute to innovative efforts in classroom learning. Thus, motivation is an important predictor that allows the impact of transformational leadership on innovation to be realized. Schools that want to promote innovation should consider how principals can increase teacher motivation, as motivation is important for forming an innovative environment.

6. Conclusion

This study emphasizes the important role of the professional learning community (PLC), self-efficacy, and teacher motivation as significant mediators in strengthening the influence of principals' transformational leadership style on teachers' innovative teaching behavior. The principal's transformational leadership style, characterized by a clear vision, inspiration, and drive for positive change, is a key driver for teachers to innovate in learning. This leadership encourages teachers to think creatively and proactively, opening up opportunities to initiate various innovations in the classroom learning process. Teachers under this transformational leadership approach are inspired to adopt new and more effective learning methods and act as change agents who can provide creative solutions to educational challenges that arise in schools.

However, the influence of transformational leadership can only partially change teachers' innovative teaching behavior with strong internal support. Teachers need high self-efficacy, enabling them to believe in their ability to make changes. In addition, strong intrinsic motivation must encourage teachers to remain consistent in developing and implementing new approaches to learning, even amid various obstacles. In this context, participation in PLC activities is an important element, where teachers can share knowledge, ideas, and best practices, boosting their confidence and providing the necessary motivational boost.

Thus, the combination of PLCs, self-efficacy, and motivation proved crucial in mediating the effectiveness of principals' transformational leadership. These three factors work synergistically to create a learning environment that supports innovation, where teachers feel empowered to continue innovating and improving the quality of learning. A transformational leadership style balanced with strong internal support from teachers significantly impacts the creation of an innovative school culture.

7. Limitations

One notable limitation of this study is its narrow focus on teachers exclusively in East Java. Given Indonesia's extensive geographic and demographic diversity, the findings of this research may not comprehensively represent the entire teacher population in the country. Various factors, including cultural distinctions, economic circumstances, access to educational resources, and regional leadership styles, can vary significantly across different regions.

To gain a more comprehensive understanding of the influence of transformational leadership and the role of professional learning communities (PLCs), self-efficacy, and motivation on teacher innovative behavior, expanding this research to include other regions in Indonesia, particularly the Eastern Indonesian islands, is essential. Enlarging the scope of the study to encompass these areas will provide valuable insights into how local factors affect the implementation of PLCs and the impact of transformational leadership. Consequently, more inclusive research outcomes can offer a more comprehensive and accurate perspective for developing effective education strategies throughout Indonesia.

Acknowledgment

Thank you for the participation from all of the respondents and for the appreciation of the Ministry of Higher Education, Research and Technology for supporting this research.

Ethical Considerations

The authors observed ethical considerations throughout the research process, including obtaining respondents' consent to publish their information.

Conflict of Interest

The authors declare that they have no conflicts of interest.

Funding

This research received financial support from the Ministry of Higher Education, Research and Technology.

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