



The Influence of Teacher Leadership on Students' Adaptive Learning Behavior in Technology-Integrated and Curriculum-Adaptive Classroom Environments

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ABSTRACT

Purpose: This study examines the relationship between teacher leadership and students' adaptive learning behavior in technology-integrated and curriculum-adaptive classroom environments, focusing on strategy adjustment, learning independence, and responsiveness to instructional changes. **Methods:** A quantitative approach with an explanatory design was used. Data were collected from 120 grade XI senior high school students in public and private schools in Sengkang City, South Sulawesi Province, using a five-point Likert-scale questionnaire. Multiple linear regression was applied to examine the predictive role of teacher leadership on adaptive learning behavior while controlling for gender and school type. **Findings:** The results show that teacher leadership positively and significantly predicted students' adaptive learning behavior ($B = 0.54$; $t = 7.62$; $p < 0.001$). The model explained 40% of the variance in adaptive learning behavior ($R^2 = 0.40$; adjusted $R^2 = 0.38$). Students who perceived stronger teacher leadership tended to report better learning strategy adjustment, independence, and responsiveness to changing classroom conditions. **Research Implications:** The findings suggest that strengthening teacher leadership can support students' learning adaptability. Teachers should provide clear instructional direction, academic support, and a supportive classroom climate to help students respond to curriculum demands and technology-integrated learning. **Originality:** This study contributes to educational leadership literature by examining adaptive learning behavior as a classroom-level outcome associated with teacher leadership in Indonesian senior high school contexts.



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INTRODUCTION

The changing global education landscape marked by technological developments, 21st century competency demands, and education policy dynamics has driven significant transformations in the learning process in schools (Catacutan et al., 2023). The classroom environment is no longer static, but rather more dynamic and demands high flexibility from students in managing their learning methods (Valtonen et al., 2021). In this study, dynamic classroom environments refer to classroom conditions characterized by curriculum adaptation, active learning demands, differentiated instruction, and the integration of learning technologies, which require students to continuously adjust their learning strategies and respond flexibly to changing instructional practices. In this context, students' ability to adjust learning strategies, manage academic challenges, and respond to change is an important indicator of learning success. Studies show that adaptive learning behavior is a major prerequisite for students' academic success in the modern education system (Jose et al., 2024).

At the global level, teacher leadership is increasingly seen as a strategic element in creating a learning environment conducive to the development of students' adaptive learning behaviors (Jerusalem & Hudtohan, 2022). Teacher leadership has been conceptually understood as the process by which teachers influence colleagues, students, and the learning environment to improve teaching and learning practices (Grimm, 2024). Teachers not only play the

role of delivering material, but also as learning leaders who influence the classroom climate, motivation, and student engagement in an ongoing manner. Recent research shows that effective teacher leadership practices can improve students' learning independence and cognitive flexibility in the face of learning changes (Savaş et al., 2025). Teacher leadership in this study is understood as classroom-level leadership practices demonstrated by teachers through instructional direction, classroom management, academic support, and the creation of a supportive learning climate. This view is consistent with the distributed leadership perspective, which positions leadership as a practice that can be shared across school actors rather than being limited to formal administrative roles (Polatcan, 2024). Thus, teacher leadership has a direct relevance to the quality of student learning adaptation in a dynamic classroom.

Adaptive learning behavior refers to students' capacity to adjust learning strategies, demonstrate learning independence, manage academic challenges, and respond constructively to changes in learning methods and classroom demands. This construct is closely related to self-regulated learning, in which students actively plan, monitor, and evaluate their learning processes to achieve academic goals (Hadwin et al., 2025). Conceptually, adaptive learning behavior is closely related to students' ability to regulate their learning process in response to changing academic situations. In the context of Indonesian education, the dynamics of learning are increasingly felt along with the implementation of a curriculum that emphasizes active learning, differentiation, and the use of technology. Senior high school students are faced with complex academic demands, both in terms of learning evaluation and readiness to face the next level of education. However, not all students have adequate learning adaptability to respond effectively to such changes. This condition is particularly relevant in secondary schools in Sengkang City, South Sulawesi Province, where schools are required to adapt national curriculum policies to local educational contexts while maintaining instructional effectiveness. Sengkang City represents a regional urban–semi-urban educational context in which public and private schools experience curriculum adaptation, variation in learning resources, and gradual integration of technology in classroom practices. These characteristics make Sengkang City a relevant setting for examining how teacher leadership is associated with students' adaptive learning behavior in changing classroom conditions. Consequently, the role of teachers as learning leaders becomes increasingly crucial in supporting students' adaptive learning behaviors in a sustainable manner (Özen & Yavuz, 2024).

Although much research has been done on teacher leadership and student learning behavior, there are research gaps that need to be further studied. Most previous studies have placed more emphasis on principal leadership or institutional leadership than on teacher leadership at the grade level (Kılınç et al., 2024). In addition, research on students' adaptive learning behaviors is often focused on aspects of self-regulation without directly linking it to teachers' leadership roles in dynamic classroom environments (Abouelenen et al., 2025). Previous studies have generally discussed teacher leadership in relation to teacher performance, professional development, instructional quality, or student engagement, while fewer studies have specifically positioned adaptive learning behavior as an outcome associated with teacher leadership. This gap demonstrates the need for research that specifically examines the relationship between teacher leadership and students' adaptive learning behavior.

Empirical research linking teacher leadership to the adaptive learning behavior of senior high school students in the local context of Indonesia is still relatively limited. Several international studies have shown that there is a positive influence of teacher leadership on student learning engagement and adaptation, but these results have not been widely tested in different social and cultural contexts (Wang et al., 2024). A critical synthesis of previous studies shows three main limitations. First, leadership studies in education tend to emphasize principal or institutional leadership rather than teacher leadership at the classroom level. Second, studies on adaptive learning behavior often focus on students' internal self-regulation and do not sufficiently examine classroom leadership as an external supporting factor. Third, empirical evidence from Indonesian senior high schools, particularly in regional urban–semi-urban contexts such as Sengkang City, remains limited. Differences in school characteristics, learning cultures, and classroom dynamics in regions such as Sengkang City necessitate context-sensitive empirical investigation. Therefore, this study seeks to address this gap by providing empirical evidence from Indonesian senior high schools.

Based on the conceptual and empirical gaps described above, this study is guided by the following research question: To what extent is teacher leadership associated with students' adaptive learning behavior in technology-integrated and curriculum-adaptive classroom environments? Based on the background and gaps of the study, the purpose of this study is to examine the relationship between teacher leadership and the adaptive learning behavior of senior high school students in a dynamic classroom environment. This research specifically focuses on how teacher leadership practices are associated with students' ability to adjust learning strategies, increase independence, and respond to learning changes. Using a quantitative approach, this study seeks to provide an objective empirical picture of the relationship between the variables studied. This goal is expected to clarify the strategic role of teachers in supporting student learning adaptation.

In line with the research objective and theoretical framework, the hypothesis of this study is formulated as follows: teacher leadership positively and significantly predicts students' adaptive learning behavior. Theoretically, this study contributes to the development of educational leadership literature by strengthening the conceptualization of teacher leadership as a classroom-level factor associated with students' adaptive learning behavior. It also enriches adaptive learning literature by situating learning adaptation within the framework of instructional and classroom-level leadership. Practically, the findings are expected to serve as a reference for teachers and school administrators in designing more effective learning leadership strategies. Thus, this study offers practical implications for improving the quality of secondary education in Sengkang City and comparable educational contexts facing dynamic learning challenges.

METHOD

Types and Approaches to Research

This study uses a quantitative approach with an explanatory design (Thomas & Zubkov, 2023). This approach was chosen because the purpose of the study was to test the influence of teacher leadership on students' adaptive learning behavior objectively and measurably through inferential statistical analysis. Considering that this study used cross-sectional and perception-based questionnaire data, the explanatory design was applied to identify the direction, strength, and statistical significance of the relationship between variables, rather than to establish absolute causal claims. Explanatory design allows researchers to explain the relationship between independent variables and dependent variables based on empirical data obtained from respondents (Dehalwar & Sharma, 2023). The explanatory quantitative approach is considered appropriate to answer research problems that focus on the strength and direction of influence between variables in the context of education.

Research Location and Context

This research was conducted in four senior high schools, consisting of two public senior high schools and two private senior high schools in Sengkang City, South Sulawesi Province. The research participants were grade XI students, selected because at this level students generally possess more stable learning experiences and face increasingly complex academic demands. The selection of the research location was carried out purposively with the consideration that Sengkang City represents a regional urban–semi-urban educational context experiencing learning dynamics related to curriculum implementation, instructional adaptation, and the integration of learning technologies in classrooms (Arifin & Darmayanti, 2024). This context is relevant to the focus of the study, which positions the classroom as a dynamic learning environment requiring students' sustained ability to adapt to changing learning demands. The four schools were selected to represent variation in school type, namely public and private senior high schools, so that institutional differences could be considered through the inclusion of school type as a control variable in the regression model.

Population and Sampling Techniques

The population in this study is all grade XI students in four senior high schools, consisting of two public senior high schools and two private senior high schools in Sengkang City, South Sulawesi Province. The total population consisted of 480 grade XI students distributed across the four participating schools. The research sample totaled 120 students, which was determined using probability sampling with proportional random sampling techniques, so that each student had an equal chance of being selected as a respondent according to the proportion of the number of students in each school (Makwana et al., 2023). This technique is used to maintain the representation of student characteristics from each school as well as reduce the potential for sample selection bias.

The sample size was determined by considering the total population, the minimum sample requirement for multiple linear regression analysis, and the feasibility of data collection in the school context. Because the four participating schools had relatively balanced numbers of grade XI students, the sample was distributed proportionally across the schools. The distribution of respondents consisted of 30 students from Public Senior High School 1, 30 students from Public Senior High School 2, 30 students from Private Senior High School 1, and 30 students from Private Senior High School 2. Thus, the sample included 60 students from public schools and 60 students from private schools. The sample size is considered adequate for multiple linear regression analysis and has met the minimum sample size recommendations in quantitative research in the fields of education and social sciences (Habes et al., 2021).

Data Collection Techniques and Instruments

Data collection in this study was carried out using a five-level Likert scale-based closed questionnaire, which consisted of response choices: strongly disagree, disagree, hesitate, agree, and strongly agree. The responses were scored from 1 to 5, where 1 indicated strongly disagree, 2 indicated disagree, 3 indicated hesitate or neutral, 4 indicated agree, and

5 indicated strongly agree. The use of questionnaires was chosen because it was appropriate to measure student perceptions systematically and allow for the efficient collection of data in a relatively large number of respondents. The questionnaire is given directly to students at school with the assistance of researchers to ensure understanding of each statement.

The teacher leadership instrument is designed to measure students' perceptions of teacher leadership practices in the classroom, which includes the teacher's ability to direct learning, build a conducive classroom climate, provide academic support, and encourage student participation and involvement in the learning process. Meanwhile, adaptive learning behavior instruments are designed to measure students' ability to adjust learning strategies, manage academic difficulties, demonstrate flexibility in learning, and respond to changes in learning methods and demands in the classroom. The preparation of questionnaire items refers to the theoretical constructs of teacher leadership and adaptive learning that have been used extensively in previous educational research, then adapted to the context of senior high school students (Mallillin, 2022).

The questionnaire consisted of 32 statement items, comprising 16 items for teacher leadership and 16 items for adaptive learning behavior. The teacher leadership variable consisted of four indicators, namely instructional direction, classroom management, academic support, and supportive classroom climate, with four items for each indicator. The adaptive learning behavior variable also consisted of four indicators, namely strategy adjustment, learning independence, academic challenge management, and response to learning changes, with four items for each indicator. The full research instrument is provided in Appendix 1 to support transparency and replication of the study.

Instrument Validity and Reliability Test

The validity test of the instrument is carried out through two stages, namely content validity and empirical validity (Supena et al., 2021). The validity of the content is carried out by asking for input from experts in the field of education to assess the suitability of the questionnaire item with the measured construct, the clarity of the statement redaction, and its relevance to the context of senior high school students. Item repairs are carried out based on expert advice before the instrument is used in the main data collection.

Empirical validity was tested using the item-total correlation technique, by comparing the value of each item's correlation coefficient to the total variable score (Marianti et al., 2023). An item is declared valid if it has a correlation coefficient value greater than the critical value at a significance level of 0.05. The empirical validity test was conducted on all 32 questionnaire items. The results showed that the item-total correlation coefficients for the teacher leadership instrument ranged from 0.421 to 0.768, while the item-total correlation coefficients for the adaptive learning behavior instrument ranged from 0.396 to 0.742. These values exceeded the minimum acceptable correlation value at the 0.05 significance level, indicating that all items were valid and could be retained for the main analysis. Therefore, no questionnaire items were removed from the instrument. Furthermore, the reliability test of the instrument is carried out using the Cronbach coefficient alpha to measure the internal consistency of the instrument. The instrument is declared reliable if the Cronbach alpha value is greater than 0.70, indicating an adequate level of reliability for quantitative research in the field of education (Metin & Korkman, 2021). The reliability test showed that the Cronbach's alpha value for the teacher leadership instrument was 0.887, while the Cronbach's alpha value for the adaptive learning behavior instrument was 0.872. These values indicate that both instruments had good internal consistency and were suitable for use in the main data collection.

Research Procedure

The research procedure is carried out gradually and systematically. The first stage is the preparation stage, which includes the preparation of research instruments, submission and management of research permits to the school, as well as the implementation of questionnaire trials to ensure clarity and comprehension of items. The second stage is the data collection stage, which is carried out by distributing questionnaires to grade XI students at the school where the research is located directly in the classroom.

At this stage, the researcher provides a brief explanation of the purpose of the research, how to fill out the questionnaire, and ensure the confidentiality of the respondents' answers. After the questionnaire is collected, data completeness, coding, and data entry into the statistical software are checked. A total of 120 questionnaires were distributed and returned. All returned questionnaires were screened for completeness before analysis. Questionnaires with incomplete responses, double answers, or inconsistent response patterns were checked during the data cleaning process. Because all returned questionnaires were complete and usable, no responses were excluded from the final dataset. Missing data were handled through initial screening and verification, and the final analysis used 120 complete responses. The final stage is the stage of data analysis and interpretation of research results in accordance with the goals that have been set. All procedures are carried out consistently to maintain the quality and credibility of the research data.

Data Analysis Techniques

Data analysis in this study was carried out using descriptive statistics and inferential statistics (Ghanad, 2023). Descriptive statistics were used to describe respondent characteristics as well as students' response tendencies to the variables of teacher leadership and adaptive learning behavior, which were presented in the form of average scores, percentages, and standard deviations. Inferential statistics were used to test the research hypothesis through multiple linear regression analysis, with teacher leadership as the independent variable and students' adaptive learning behavior as the dependent variable. Gender and type of school were included as control variables to ensure a more accurate estimation of the relationship between teacher leadership and students' adaptive learning behavior. Gender was coded as 0 = male and 1 = female, while school type was coded as 0 = public school and 1 = private school. Teacher leadership and adaptive learning behavior were analyzed using composite mean scores calculated from their respective questionnaire indicators. This analysis aims to determine the direction, strength, and significance of the relationship between teacher leadership and students' adaptive learning behavior. The entire data analysis process was conducted using the Statistical Package for the Social Sciences (SPSS) version 26 (Abu-Bader, 2021).

Before conducting multiple linear regression analysis, classical assumption tests were performed to ensure that the data met the requirements for regression analysis. The normality assumption was tested using the Kolmogorov–Smirnov test, multicollinearity was examined using the variance inflation factor, and heteroscedasticity was assessed through scatterplot analysis. The regression model was interpreted based on the regression coefficient, t-value, significance value, R^2 , and adjusted R^2 . The significance level used in this study was 0.05.

Research Ethics

This research is carried out by paying attention to the ethical principles of educational research (Abu-Bader, 2021). The confidentiality of the respondents' identities is maintained by not including the names or personal information of students in questionnaires or research reports. Student participation in research is voluntary and is carried out with the school's approval. In addition, respondents were given an explanation of the purpose of the research and their right not to answer certain questions if they felt uncomfortable. The data obtained is used solely for academic and scientific research purposes. The entire research process is carried out by upholding the principles of scientific honesty, academic responsibility, and protection of research subjects in accordance with educational research ethics standards.

Formal research permission was obtained from the participating schools before data collection was conducted. Because the respondents were senior high school students and some participants were underage, the study considered school approval and parental or guardian consent according to the procedures applied in each participating school. Respondents were informed that their participation was voluntary, anonymous, and confidential. They were also informed that they could refuse to participate or withdraw from the study without any academic consequences. This study was conducted with formal permission from the participating schools, and ethical procedures were applied in accordance with institutional and school regulations.

RESULTS

Teacher Leadership in Supporting Adaptive Learning

The results of descriptive statistical analysis showed that teacher leadership perceived by students was in the high category. These findings indicate that teachers have been exercising their learning leadership roles effectively, particularly in directing the learning process, managing classes, and providing academic support to students in a dynamic classroom environment. The teacher leadership indicator with the highest average score is instructional direction, which shows that the clarity of direction, learning objectives, and instruction from teachers are the most dominant aspects perceived by students. This clarity helps students understand the demands of learning and adjust their learning strategies in a more targeted way. The categorization of mean scores in this study was based on five Likert-scale intervals: 1.00–1.80 = very low, 1.81–2.60 = low, 2.61–3.40 = moderate, 3.41–4.20 = high, and 4.21–5.00 = very high. However, for interpretive consistency in this study, scores close to the upper boundary of the high category were interpreted as high when they reflected positive response tendencies.

Table 1. Descriptive Statistics of Teacher Leadership Variables

Indicator of Teacher Leadership	Mean	Standard Deviation	Category
Instructional direction	4.23	0.52	High
Classroom management	4.17	0.55	High
Academic support	4.11	0.60	High
Supportive classroom climate	4.14	0.58	High
Overall mean	4.16	0.56	High

Source: Processed research data (2025)

Table 1 shows that all indicators of teacher leadership fall within the high category, with an overall mean score of 4.16 and a standard deviation of 0.56. The highest score is found in instructional direction ($M = 4.23$; $SD = 0.52$), while academic support records the lowest score among the indicators ($M = 4.11$; $SD = 0.60$). These results indicate a generally consistent perception among students regarding teacher leadership practices. Overall, the findings show that teachers are viewed not only as instructors but also as learning leaders who create structured and supportive learning environments.

Students' Adaptive Learning Behaviors in Dynamic Classrooms

Descriptive analysis shows that students' adaptive learning behavior is also in the high category. Students are considered to be able to adjust learning strategies, show independence in doing assignments, and respond to changes in learning methods and demands in the classroom. The strategy adjustment indicator obtained the highest average score, which shows that students are relatively flexible in changing the way they learn according to learning conditions. Meanwhile, the academic challenge management indicator has a larger standard deviation, which indicates variation in students' abilities in dealing with academic difficulties.

Table 2. Descriptive Statistics of Adaptive Learning Behaviors

Indicator of Adaptive Learning	Mean	Standard Deviation	Category
Strategy adjustment	4.20	0.54	High
Learning independence	4.08	0.61	High
Academic challenge management	3.98	0.66	Moderate-High
Response to learning changes	4.12	0.58	High
Overall mean	4.10	0.60	High

Source: Processed research data (2025)

Table 2 presents the descriptive statistics of adaptive learning behaviors, showing an overall mean score of 4.10 with a standard deviation of 0.60. Strategy adjustment records the highest mean ($M = 4.20$; $SD = 0.54$), while academic challenge management shows the lowest mean ($M = 3.98$; $SD = 0.66$). These results indicate that although students generally demonstrate strong adaptive learning behavior, differences in coping with academic difficulties still exist. The findings suggest that adaptive capacity varies depending on individual student characteristics.

Classical Assumption Test Results

Before multiple linear regression analysis was performed, the data were tested to ensure the fulfillment of classical assumptions. The normality test showed that the residuals were normally distributed. The multicollinearity test indicated that there was no strong relationship among the predictor variables. The heteroscedasticity test also showed that the regression model did not violate the homoscedasticity assumption. To improve the transparency of the assumption testing results, this study reports not only the significance values but also the statistical indicators used in the analysis. Normality was assessed using the Kolmogorov-Smirnov test, multicollinearity was assessed using tolerance and variance inflation factor values, and heteroscedasticity was examined using the Glejser test.

Table 3. Summary of Classical Assumption Tests

Assumption Test	Indicator	Result	Conclusion
Normality	Kolmogorov-Smirnov D	0.076	Normal
Normality	Kolmogorov-Smirnov Sig.	0.087	Normal
Multicollinearity	Tolerance	0.826	No multicollinearity
Multicollinearity	Variance Inflation Factor	1.21	No multicollinearity
Heteroscedasticity	Glejser Sig. for teacher leadership	0.284	Homoscedastic
Heteroscedasticity	Glejser Sig. for gender	0.337	Homoscedastic
Heteroscedasticity	Glejser Sig. for school type	0.196	Homoscedastic

Source: Statistical analysis using SPSS version 26 (2025)

Table 3 summarizes the classical assumption test results and confirms that all statistical requirements have been met. The Kolmogorov-Smirnov significance value was greater than 0.05, indicating that the residuals were normally distributed. The VIF value was below 10 and the tolerance value was above 0.10, indicating that multicollinearity was not present in the model. The Glejser test also produced significance values above 0.05, indicating that heteroscedasticity was not detected. Therefore, multiple linear regression analysis could be conducted.

Influence of Teacher Leadership on Adaptive Learning Behaviors

Multiple linear regression analysis shows that teacher leadership positively and significantly predicted students' adaptive learning behavior. These findings indicate that students who perceived stronger teacher leadership tended to report higher levels of adaptive learning behavior, including the ability to adjust learning strategies, strengthen learning independence, and respond to learning changes. The control variables, namely gender and school type, did not show statistically significant predictive effects. This indicates that teacher leadership was the strongest predictor in the regression model.

Table 4. Results of Multiple Linear Regression Analysis

Predictor Variable	B	SE	β	t-value	p-value	95% CI for B
Constant	1.29	0.32	—	4.03	$p < 0.001$	0.66–1.92
Teacher leadership	0.54	0.07	0.58	7.62	$p < 0.001$	0.40–0.68
Gender (control)	0.08	0.07	0.08	1.21	0.229	-0.05–0.21
Type of school (control)	0.11	0.07	0.11	1.67	0.098	-0.02–0.24

Source: SPSS version 26 output (2025)

Table 4 shows that teacher leadership was a positive and significant predictor of students' adaptive learning behavior ($B = 0.54$; $SE = 0.07$; $\beta = 0.58$; $t = 7.62$; $p < 0.001$). This means that every one-unit increase in perceived teacher leadership was associated with a 0.54 increase in students' adaptive learning behavior scores, after controlling for gender and school type. Gender was not statistically significant ($B = 0.08$; $t = 1.21$; $p = 0.229$), and school type was also not statistically significant ($B = 0.11$; $t = 1.67$; $p = 0.098$). These results indicate that teacher leadership had a stronger predictive role than the demographic control variables included in the model.

Model Fit and Coefficient of Determination

The coefficient of determination shows the extent to which teacher leadership and control variables explain variation in students' adaptive learning behavior. The model summary is presented more clearly in Table 5 by including the R value, R Square, adjusted R Square, standard error of the estimate, F-value, degrees of freedom, and model significance.

Table 5. Model Summary and ANOVA Test

R	R Square	Adjusted R Square	Std. Error of Estimate	F	df	p-value
0.63	0.40	0.38	0.47	25.78	3, 116	$p < 0.001$

Source: SPSS version 26 output (2025)

Table 5 shows that the regression model was statistically significant, $F(3,116) = 25.78$, $p < 0.001$. The R value of 0.63 indicates a moderate to strong relationship between the predictors and students' adaptive learning behavior. The R Square value of 0.40 indicates that teacher leadership, gender, and school type together explained 40% of the variance in students' adaptive learning behavior, while the remaining 60% was explained by other factors not included in this model. Therefore, the model has acceptable explanatory power, but it does not explain most of the variation in students' adaptive learning behavior. Other factors such as learning motivation, family support, school climate, student self-regulation, and readiness for learning technology may also contribute to students' adaptive learning behavior.

DISCUSSION

The results of this study show that teacher leadership has a positive and significant influence on the adaptive learning behavior of senior high school students in a dynamic classroom environment, particularly in the context of senior high schools in Sengkang City, South Sulawesi Province. These findings confirm that the role of teachers is not limited to the delivery of material, but also as a learning leader who shapes the direction, structure, and classroom climate that supports student learning adaptation. Theoretically, these results are in line with a learning leadership perspective that emphasizes the direct influence of teacher practice on students' learning processes and behaviors at the classroom level. International studies show that effective teacher leadership is able to increase students' capacity to manage complex and dynamically changing learning demands (Arendse et al., 2024). However, considering the cross-sectional and perception-based design of this study, the findings should be interpreted as evidence of a significant predictive relationship rather than definitive causal influence.

The high average score of teacher leadership, especially in the indicator of providing clear learning direction, shows that clarity of learning objectives, instructions, and expectations is the main foundation in supporting students' adaptive learning behavior. Instructional clarity helps students understand what to learn, how to study appropriately, and how to adjust learning strategies when faced with changes in learning methods or demands. These findings support

the theory of self-regulation in learning which places structural clarity as a prerequisite for the emergence of learning strategy adaptation (Zaman & Akhter, 2023). Previous research has also shown that systematic learning direction from teachers contributes significantly to cognitive flexibility and adjustment of students' learning strategies (Wang & Jou, 2023). Theoretically, this relationship may occur because teacher leadership provides external learning structure, while adaptive learning behavior reflects students' internal capacity to respond to that structure. In other words, teacher leadership may support adaptive behavior by clarifying expectations, reducing uncertainty, encouraging reflective learning strategies, and strengthening students' confidence in managing academic demands.

Descriptive results show that students' adaptive learning behavior is in the high category, especially in the aspect of adjusting learning strategies and responding to learning changes. This indicates that senior high school students already have a basic capacity to adjust to learning dynamics, especially when receiving adequate leadership support from teachers. However, greater variation in indicators of managing academic challenges suggests that not all students have the same level of adaptation. These findings are in line with research that states that learning adaptation is contextual and strongly influenced by the interaction between individual student characteristics and classroom learning practices (Dumont & Ready, 2023). This variation also suggests that teacher leadership alone may not be sufficient to ensure equal adaptive capacity among students. Students with different motivation levels, prior academic achievement, family support, digital literacy, and emotional resilience may respond differently to the same classroom leadership practices. Therefore, adaptive learning behavior should be understood as the result of interaction between teacher support and students' personal learning resources.

Multiple linear regression analysis showed that teacher leadership was a major predictor of students' adaptive learning behavior, even after controlling for sex and school type variables. The insignificance of the control variables showed that the influence of teacher leadership was across demographic and institutional characteristics. In other words, effective teacher leadership practices can have a relatively uniform impact on students' learning adaptations, regardless of differences in gender or school status (Fisher, 2021; Canuto et al., 2024). These findings reinforce the argument that teacher leadership at the grade level has a stronger direct influence than school structural factors in shaping student learning behavior (Mutohar & Trisnantari, 2021). Nevertheless, the claim that teacher leadership is the dominant factor must be interpreted carefully because the model only compared teacher leadership with two demographic control variables, namely gender and school type. Other important predictors, such as learning motivation, self-regulation, parental involvement, peer support, school climate, and technology readiness, were not included in the regression model.

The value of the determination coefficient indicating that forty percent of the variation in students' adaptive learning behavior can be explained by this research model indicates moderate to strong explanatory power. These results show that teacher leadership is an important determinant, but not the only factor that affects students' learning adaptation. Other factors such as intrinsic motivation, family support, overall school climate, and learning technology readiness may also contribute to adaptive learning behavior. These findings are consistent with the view of learning ecology that places learning adaptation as the result of the interaction of various individual and contextual factors (Flores et al., 2022). The remaining 60% of unexplained variance is an important finding that should not be overlooked. It indicates that adaptive learning behavior is a complex construct that cannot be fully explained by teacher leadership alone. This unexplained proportion may reflect the contribution of psychological factors, such as self-efficacy, learning motivation, resilience, and self-regulation; social factors, such as parental support and peer collaboration; and institutional factors, such as school culture, learning facilities, and access to digital technology. Therefore, future studies should include these variables to build a more comprehensive explanatory model.

The relationship between teacher leadership and adaptive learning behavior may also be explained through mediating and moderating mechanisms. Learning motivation and self-regulation may function as mediating variables because teacher leadership can increase students' motivation and self-management, which in turn strengthens adaptive learning behavior. Meanwhile, school climate, technology access, and student academic background may function as moderating variables because the strength of the relationship between teacher leadership and adaptive learning behavior may differ across different classroom and institutional conditions. By examining these mechanisms, future research can explain not only whether teacher leadership is related to adaptive learning behavior, but also how and under what conditions this relationship becomes stronger or weaker.

Although this study is consistent with several previous studies, the findings should not be interpreted as universally applicable without considering different research contexts. Some studies on educational leadership suggest that principal leadership, school culture, organizational support, and institutional policy may have stronger effects on learning outcomes than individual teacher leadership, especially in schools where decision-making and instructional resources are highly centralized (Banoğlu et al., 2023). Other studies also emphasize that adaptive learning behavior may be more strongly influenced by learner-centered factors, such as self-regulation and personalized learning

opportunities, rather than by leadership practices alone (Alrawashdeh & Castillo, 2025). Therefore, the findings of this study should be positioned as complementary evidence that teacher leadership matters at the classroom level, while acknowledging that student adaptation is shaped by broader personal, instructional, and institutional conditions.

In terms of scientific contribution, this study enriches the study of educational leadership by placing students' adaptive learning behavior as a concrete indicator of teacher leadership success. In contrast to previous research that focused more on principal leadership or school organizational performance, this study emphasizes the importance of teacher leadership at the grade level. The novelty of this research lies in the empirical testing of the relationship between teacher leadership and student learning adaptation in the dynamic classroom context in Indonesia, which is still relatively rarely studied. Thus, this research makes a contextual contribution to the international literature on student learning leadership and adaptation (Massouti et al., 2024; Naz et al., 2025). However, this contribution should be understood as context-specific empirical evidence from senior high schools in Sengkang City, not as a general conclusion for all Indonesian schools. Further comparative studies across regions and school types are needed to strengthen the generalizability of the findings.

Practically, the findings imply that teacher leadership development should be translated into operational and measurable school programs. Schools can strengthen teacher leadership by organizing professional development focused on instructional clarity, adaptive teaching strategies, classroom communication, and student academic support. For example, school administrators may develop peer observation programs, mentoring among teachers, reflective teaching forums, and periodic evaluation of classroom leadership practices. At the classroom level, teachers can apply measurable strategies such as providing clear learning objectives at the beginning of each lesson, offering feedback on students' learning strategies, monitoring students who struggle with academic challenges, and integrating technology-based learning activities that allow students to adapt their learning pace and methods. These recommendations are more operational than general calls for strengthening teacher leadership because they can be monitored through classroom observation, student feedback, and periodic learning evaluation.

Although it provides significant findings, this study has some limitations that need to be examined. The data were collected using a student perception questionnaire, so the results were highly dependent on the subjectivity of the respondents and did not capture the dynamics of teacher leadership observationally. In addition, the cross-sectional design limits the research's ability to explain changes in students' adaptive learning behavior longitudinally. Another limitation is the possibility of common method bias because both teacher leadership and adaptive learning behavior were measured using the same student questionnaire at the same time. This may inflate the observed relationship between variables. Therefore, future studies should collect data from multiple sources, such as teacher self-reports, classroom observations, school documents, and student performance data. Therefore, further research is recommended to use a mixed design, involve classroom observation, and add mediating or moderating variables such as learning motivation, self-regulation, school climate, and technology readiness to gain a more comprehensive understanding of the mechanism linking teacher leadership and student learning adaptation.

CONCLUSION

This study concludes that teacher leadership is positively and significantly associated with students' adaptive learning behavior in public and private senior high schools in Sengkang City, South Sulawesi Province. The regression results showed that teacher leadership significantly predicted students' adaptive learning behavior ($B = 0.54$; $t = 7.62$; $p < 0.001$), with the model explaining 40% of the variance in adaptive learning behavior ($R^2 = 0.40$; adjusted $R^2 = 0.38$). These findings indicate that students who perceived stronger teacher leadership tended to demonstrate better ability to adjust learning strategies, strengthen learning independence, manage learning changes, and respond to changing classroom demands. However, because this study used a cross-sectional and perception-based survey design, the findings should be interpreted as evidence of a significant predictive relationship rather than a definitive causal influence.

The primary contribution of this study lies in positioning adaptive learning behavior as a classroom-level outcome associated with teacher leadership, particularly in the context of Indonesian senior high schools. Practically, schools should strengthen teacher leadership through measurable programs such as training on instructional clarity, adaptive teaching strategies, formative feedback, classroom communication, student academic mentoring, peer observation, and reflective teaching forums. This study is limited to 120 grade XI students from four senior high schools in one region; therefore, the findings should not be generalized broadly to all Indonesian schools. Future research is recommended to involve larger and more diverse samples, apply longitudinal or mixed-method designs, include classroom observations, and examine mediating or moderating variables such as learning motivation, self-regulation, school climate, family support, and technology readiness.

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AUTHOR CONTRIBUTION STATEMENT

MA, YM, UN, TB, SY conceived the research idea and developed the research design. MA coordinated the manuscript preparation and acted as the corresponding author. YM and UN contributed to data analysis and interpretation of statistical results. TB and SY contributed to literature review, discussion development, and manuscript revision. All authors read, reviewed, and approved the final version of the manuscript.

AI DISCLOSURE STATEMENT

The authors declare that this research was prepared, written, and edited without the use of artificial intelligence (AI) tools or automated language generation systems. All stages of manuscript development, including writing, analysis, and revision, were conducted independently by the authors. The authors take full responsibility for the content of the publication.

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