

Full Length Research Paper

Effect of transformational leadership on data-informed instruction and student achievement

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The purpose of the study was to better understand the extent to which middle school principals' transformational leadership styles affect teachers' data-informed instruction, the influence of teachers' data-informed instruction on middle school student achievement, and the extent to which transformational leaders affect student achievement through data-informed instruction. Therefore, for this study, survey data were collected using Kenneth Leithwood's Transformational School Leadership Survey, as well as Jingping Sun's Data-Informed Instruction Survey. Additionally, this study used Scantron performance data for sixth-grade math to determine the effects of transformational school leaders on student achievement through data-informed instruction. The results showed that transformational school leadership has no effect on middle school teachers' data-informed instruction, and middle school teachers' data-informed instruction has no significant effect on student achievement, with socioeconomic status controlled. The study also showed that transformational school leadership has no statistically significant effect on student achievement through teachers' data-informed instruction. The results of this study help us understand the extent to which transformational school leadership affects student achievement through teachers' data-informed instruction. It also provides knowledge that will help us better educate aspiring leaders, making them effective transformational leaders in schools.

Key words: Transformational leadership, data-informed instruction, mediation, student achievement.

INTRODUCTION

Educators often encounter various types of leadership throughout their careers. The field of education showcases leaders who are truly inspirational, while others may be quite the opposite. Although each school leader is different, Hauserman and Stick (2013) identified the role of the school principal as the "single most important factor in school effectiveness" (p. 190). Over the years, different forms of leadership have been studied, with two of the most prominent being instructional leadership and

Transformational leadership. In conjunction with transformational school leadership, data-informed instruction was studied to determine the effects of transformational school leadership on student achievement through data-informed instruction. The most powerful path through which school leaders improve student learning is the rational path (Leithwood et al., 2019). By analyzing the rational path, we focused on data-informed instruction placed on this path in this study.

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According to Sun et al. (2016), students must be assessed through their academic performance and common assessments for teachers to be equipped to set goals and plan instruction to further student achievement. When teachers can review student data, they identify weaknesses, determine short-term and long-term goals aligned with overall school goals, and plan remedial activities. This data allows them to prepare lessons for the remainder of the year and communicate goals and progress to parents. School leaders play a vital role in encouraging, developing, and facilitating teachers' use of data (Sun et al., 2016). They can model, create structures, allocate time, and offer continuous professional development to foster teachers' use of data in schools. Transformational school leadership can be particularly effective in enhancing teachers' collective efficacy in implementing data-informed instruction in the classroom due to its demonstrated strength in empowering, inspiring, and developing teachers (Sun et al., 2016).

Studying the effect transformational school leadership has on students through teachers and their instruction is critical for consistent student progress. To initiate the research, the following questions were used:

1. To what extent does transformational school leadership affect middle school teachers' data-informed instruction?
2. To what extent do middle school teachers' data-informed instruction affect student achievement with SES controlled?
3. To what extent does transformational school leadership affect student achievement through teachers' data-informed instruction?

MATERIALS AND METHODS

This study commenced by collecting survey data from public school teachers using Kenneth Leithwood's Transformational School Leadership Survey. Purposeful sampling was employed, involving six school districts that utilized the Scantron Performance Series in the spring of 2020 and were invited to participate. Within these districts, approximately 23 schools with 6th-grade students were identified. The sample size, determined using SPSS G*Power, was established at 82.

Leithwood's Transformational School Leadership survey gathered data along each of the four paths, particularly emphasizing the rational path, akin to transformational school leadership in the dimensions of shared mission and vision and the knowledge and skills of the school staff. Sun's Data-Informed Instruction and Improvement: Teacher Survey were used to collect data assessing the impact of data-informed instruction on student achievement.

The measurement of transformational leadership employed Leithwood's 22-item, 5-point Likert scale Transformational School Leadership Survey. This survey gauges transformational school leadership among principals, assistant principals, and others in informal leadership roles. Cronbach's alpha for the Transformational Leadership Survey was .98, indicating high reliability. This survey proved valuable in predicting organizational commitment and professional teacher behavior in previous studies (Mitchell, 2018).

Sun's 12-item, 6-point Likert scale Teacher Survey: Data-Informed Instruction (DIIS) was utilized to measure the impact of transformational school leadership on student achievement through

data-informed instruction. Cronbach's alpha for the DIIS measure was 0.96, signifying high reliability. The principal component analysis results indicated teachers' collaborative efforts on data-informed instruction and teachers' own instructional efforts based on student data (Sun et al., 2015).

Student achievement in this study was assessed through Scantron Performance Series test results for the winter of 2020-2021. According to the Alabama State Department of Education, students scoring in quartiles 3 or 4 are considered proficient. Test data for 6th-grade math was collected from each public school district participating in the study.

Socioeconomic status (SES) was measured using the percentage of free and reduced lunch status in each school, as determined annually by the United States Department of Education. Students with household incomes ranging from 130 to 185% are eligible for reduced-price meals (Hoffman, 2012). The researcher retrieved the free and reduced lunch numbers from Public School Review's updated 2021 information.

DATA ANALYSIS

One survey assessed transformational leadership, while a second survey measured data-informed instruction. Using SPSS G*Power with $\alpha = 0.05$, $a = 0.50$, and power = 0.8, the determined sample size was 82. However, it was found that 80 subjects would be sufficient for mediation. Mediation, a process determining the causal relationship between two variables through a third variable (mediator), helps understand how the independent variable impacts the outcome variable. Data were disaggregated by school. To test for mediation, regression equations were used, including regressing the mediator on the independent variable, regressing the dependent variable on the independent variable, and regressing the dependent variable on both the independent variable and the mediator (Baron and Kenny, 1986). Socioeconomic status (SES) was measured, and two assumptions were required: no error in measurement in the mediator, and the mediator is not caused by the dependent variable.

According to Baron and Kenny (1986), a variable serves as a mediator when it meets criteria such as alterations in the independent variable representing alterations in the potential mediator and alterations in the mediator representing alterations in the dependent variable. SES was used as a control variable, identified by the percentage of students receiving free or reduced lunch.

Regression with mediation was used to determine the significance of transformational leadership on student achievement through data-informed instruction. SPSS PROCESS was used for mediation analysis, a tool within SPSS that automatically computes information, saving time for the researcher (Field, 2013). If the association between the predictor and outcome is reduced by including the mediator, this confirms mediation. Perfect mediation occurs when the mediator significantly impacts the relationship, making it equal to zero (Leech et al., 2015). Stepwise regression-controlled SES for Research Question Two, calculating the R square change.

Six school districts participated, with eligibility based on

schools having 6th-grade students taking the Scantron math winter test in the 2020-2021 school year. Seventeen schools participated within the six districts, with an average of 15 surveys received from each school. The number of surveys varied based on the number of teachers at each school, resulting in approximately 230 responses at the end of data collection.

The analysis of the reliability of the survey items revealed that for the 26 data-informed instruction items, the Cronbach alpha coefficient was computed, resulting in a value of .950. This value, slightly above the average range, indicates good internal consistency reliability, suggesting that the items form a scale with high reliability. Similarly, the Cronbach alpha for the 22-item transformational leadership survey was 0.973, also slightly above average, confirming the reliability of the transformational leadership survey.

For Research Question One, examining the extent to which transformational school leadership affects middle school teachers' data-informed instruction, a correlation was computed. However, three assumptions were not met: the linear relationship between the two variables, normal distribution of scores for each variable, and the presence of outliers. Due to these shortcomings, there was no statistically significant relationship found between transformational leadership and data-informed instruction.

Moving on to Research Question Two, exploring the impact of middle school teachers' data-informed instruction on student achievement with socioeconomic status (SES) controlled, a correlation was computed with similar assumptions. Again, the linear relationship assumption was not met, scores were not normally distributed for each variable, and outliers were identified. Consequently, no statistically significant relationship was established between student achievement and data-informed instruction.

Finally, to investigate the relationship between student achievement and data-informed instruction with SES controlled, a partial correlation was computed. Unfortunately, the assumptions for this test were not met either, leading to the conclusion that there was no statistically significant difference between student achievement and data-informed instruction when socioeconomic status was controlled.

For Research Question 3, which investigates the extent to which transformational school leadership affects student achievement through teachers' data-informed instruction, the analysis was conducted in multiple parts.

In the first part, a single linear regression was performed to assess the effect of transformational leadership on student achievement. The results indicated that transformational leadership does not have a significant effect on student achievement ($F(1,15) = 2.143, p = .164$).

The regression equation used is $y = a + b_1x_1$, where a is the intercept (1.845), b_1 is the coefficient of the independent variable (10.016), and y is the dependent variable (Leech et al., 2015).

In the second part, statistical mediation analysis was conducted to examine whether data-informed instruction mediates the relationship between transformational leadership and student achievement. The analysis showed that data-informed instruction did not significantly mediate this relationship ($b = -2.9502, \text{BootCI} [-9.87185, 3.3767]$).

The third part of the analysis focused on whether transformational leadership and socioeconomic status have a significant effect on student achievement. A multiple regression was conducted, revealing that the best prediction model for student achievement includes transformational leadership and socioeconomic status ($F(2, 16) = 11.572, p = .001$). The regression equation used is $y = a + b_1x_1 + b_2x_2$, where a is the constant (53.983), b_1 is the coefficient for transformational leadership (4.126), b_2 is the coefficient for socioeconomic status (-0.513), and y is the dependent variable. The effect size ($R = 0.79$) is considered large according to Cohen's guidelines, and the R-squared value (0.62) indicates that approximately 62% of the variance in student achievement can be explained by the model.

Additionally, a multiple linear regression was conducted to determine the significance of all three factors combined (socioeconomic status, data-informed instruction, and transformational leadership) on student achievement. The assumption of normality was met based on the skewness of the variables distributed for each other (skewness = 0.756).

There were two outliers in the student achievement data, approximately 12% of the data points, which is a relatively acceptable number. However, there was only one outlier in the data-informed instruction data; meanwhile, there were five outliers in the transformational leadership data.

To meet the assumption of collinearity, the independent variables should register a Tolerance level of 0.80 to 1.00. The independent variables should also register a VIF level of 1.00 to 1.20 (Morgan, 2011). However, there is a large amount of multicollinearity in this model. This implies that independent variables explain a lot of the same information in the dependent variable. As a result, the findings will be inflated and appear to be more significant than they really are. Nevertheless, the model is a significant predictor of student achievement ($p = 0.03$).

$R = 0.806$ (this is the effect size). There is a large effect size according to Cohen (1988) guidelines for the social sciences. $R^2 = 0.649$ (R^2 indicates the percentage of variance of the dependent variable (student achievement) explained by the regression model). In this case, the model comprised of SES, DII, and TL explains approximately 65% of the variance in student achievement. The regression equation is $y = a + b_1x_1 + b_2x_2 + b_3x_3$, where $a = 13.786$, $b_1 = -0.606$ (SES); $b_2 = 11.864$ (DII), and $b_3 = 1.132$ (TL); $y = 13.786 - 0.606(x_1) + 11.864(x_2) + 1.132(x_3)$.

A regression was computed controlling for SES. $R = 0.805, R^2 = 0.648$, and R^2 change = 0.044. Since $p = 0.206$, the results are not significant. For the second regression, the equation is $y = a + b_1x_1 + b_2x_2$, where $a = 12.999, b_1 =$

13.114 (DII), and $b_2 = -0.622$ (SES); $y = 12.999 + 13.114(x_1) + -0.622(x_2)$.

The fourth part posed the question: does data-informed instruction mediate the relationship between a model comprised of transformational leadership and socioeconomic status and student achievement? Statistical mediation analysis was conducted to determine if data-informed instruction mediates the relationship between a model comprised of transformational leadership and socioeconomic status and student achievement. However, data-informed instruction did not significantly mediate the relationship between the model comprised of transformational leadership and socioeconomic status and student achievement, $b = 2.9942$, BootCI [-3.7155, 9.1585]. When the range includes zero, the mediating variable did not statistically mediate the relationship between the independent variable and the dependent variable (Leech et al., 2014; Field, 2018).

The purpose of this study was to determine the effect transformational leadership has on middle school teachers' data-informed instruction, the effect middle school teachers' data-informed instruction has on student achievement with socioeconomic status controlled, and the effect transformational school leadership has on student achievement through data-informed instruction. After collecting data through surveys to measure data-informed instruction and transformational leadership along with Scantron math data, the results showed that transformational leadership does not have a significant effect on teachers' data-informed instruction, there is no statistical significance between data-informed instruction and student achievement with socioeconomic status controlled, and there is not a statistical significance on transformational leadership and its effect on student achievement through data-informed instruction.

DISCUSSION

The first research question for this study asked, "To what extent does transformational school leadership affect middle school teachers' data-informed instruction?" Since transformational leadership is known for providing support, intellectual stimulation, and developing teachers, it was anticipated to have a significant effect on student achievement through data-informed instruction (Leithwood et al., 2019). However, the results show there is not a statistically significant relationship between transformational leadership and data-informed instruction.

The next research question asked, "To what extent does middle school teachers' data-informed instruction affect student achievement with SES controlled?" The tests conducted found that there was not a statistically significant relationship between student achievement and data-informed instruction. This 2021 study found that there was no significant effect of data-informed instruction on student achievement. This could be due to the lack of participants in the study, resulting in a small sample size,

as well as the result of using an achievement test used by very few districts. The results could have been much different and possibly showed significance if there had been a change in these factors. Additionally, perhaps due to the measured data-informed instruction, its validity still needs to be tested. Future research using this survey should test the validity.

The last research question asked, "To what extent does transformational school leadership affect student achievement through teachers' data-informed instruction?" In short, there is not a statistically significant relationship between transformational leadership and its effect on student achievement through data-informed instruction. Several other previous studies produced varying results using similar factors. This 2021 study aligns with Heck and Marcoulides (1996) in that transformational leadership has no significant effect on student achievement through data-informed instruction. The data for student achievement in this study was not a state test but a district progress monitoring test, which could have slightly skewed the results. Additionally, Leithwood's survey used for this study is strictly based on transformational leadership and does not include questions regarding data, which could have also skewed the results. Changing these two factors could possibly yield varying results.

With non-significant results, one might question the factors that may have influenced the data. This study was conducted during COVID-19, a national pandemic that disrupted every aspect of normal living. This pandemic alone could have certainly skewed the results of the study. Additionally, the instruments used for collecting data were reliable according to Cronbach alpha, but they could be in need of further development specific to this study to yield more reliable results.

This study set out to determine the effect transformational leadership has on middle school teachers' data-informed instruction, the effect middle school teachers' data-informed instruction has on student achievement with socioeconomic status controlled, and the effect transformational school leadership has on student achievement through data-informed instruction. Although this was a non-significant study, transformational school leaders improving student learning through data-informed instruction is the most powerful path, which fills the gap in this study.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

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