JUMPA : Jurnal Manajemen Pendidikan
Vol. 04 No. 02 (2023) : 68-81
Available online at https://ejournal.unuja.ac.id/index.php/jumpa/index

Student Involvement as a Competency Catalyst: Uncovering the Influence of Infrastructure Management and Teaching Quality

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Abstract

This study focuses on the influence of infrastructure management and teacher teaching quality on student engagement and its impact on student competence in Vocational High Schools (SMK). The main objective of this study is to analyze how the two factors work synergistically in improving student engagement and their competence. The research method used is a quantitative approach with *an ex post facto type*, where data is collected through a questionnaire distributed to 177 grade XI students majoring in Automotive Light Vehicle Engineering at several vocational schools in Salatiga. Data analysis was carried out using *Structural Equation Modeling* (SEM) to test the causal relationship between the variables studied. The results show that the management of infrastructure facilities and the quality of teachers' teaching have a significant effect on student engagement, which in turn improves their competence. The implications of this study emphasize the importance of a holistic approach in education management, where school managers must pay balanced attention between improving the quality of teaching and managing infrastructure facilities to create an optimal learning environment.

Article History
Received: 22 July 2023
Revised: 15 September 2023
Accepted: 07 December 2023

Keywords: *Infrastructure management, teacher teaching quality, student involvement*

DOI: https://doi.org/10.33650/jumpa.v4i2.9349
How to Cite:
Mahmud, A., Yanto, H., & Mulyono, S. E. (2023). Student Involvement as a Competency Catalyst: Uncovering the Influence of Infrastructure Management and Teaching Quality. *Jumpa: Jurnal Manajemen Pendidikan*, 5(1), 68-71

INTRODUCTION

In the era of increasingly complex globalization, the management of education in various countries faces increasingly greater challenges, especially in ensuring that students not only get quality education, but also actively participate in the learning process (Rusdi et al., 2022; Susilawati & Astuti, 2022; Wijaya & Khoir, 2022). Student engagement has been identified as a key factor that directly affects their learning outcomes and competencies (Johnson, 2022; Chuanchen, 2023; Norman & Paramansyah, 2024). Previous studies have revealed that student engagement is influenced by various factors, including the quality of teacher teaching and the management of existing infrastructure facilities in schools (Kim et al., 2023; Zhang & Lee, 2022; Hernandez & Romero, 2022). However, in the context of education in Indonesia, infrastructure management often does not receive optimal attention (Rahman et al., 2023; Kusuma & Priyono, 2022; Setiawan & Kartika, 2022).

Inadequate infrastructure conditions can hinder the teaching and learning process, which can ultimately reduce student engagement and harm their learning outcomes (Prasetyo & Lestari, 2023; Wardani & Sucipto, 2022; Marzuki & Aziz, 2022). Therefore, this study is important to conduct in order to further explore how infrastructure management, along with the quality of teacher teaching, can affect student engagement and their competence (Ibrahim & Asif, 2023; Walker et al., 2022; Anderson & Patel, 2022).

The main problem that this research focuses on is how the management of infrastructure facilities and the quality of teacher teaching play a role in increasing student involvement, which in turn affects their competence in Vocational High Schools (SMK) throughout Salatiga City (Yusuf & Ali, 2023; Suryadi & Hartono, 2022; Novita & Wicaksono, 2022). Salatiga City, as one of the education cities in Central Java, has a variety of vocational schools that offer various expertise programs, including Automotive Light Vehicle Engineering (TKRO). However, many vocational schools in Salatiga still face obstacles in terms of infrastructure management, which can have an impact on the effectiveness of the teaching and learning process (Chuanchen, 2023; Norman & Paramansyah, 2024; Rusdi et al., 2022)."

One of the main challenges is how these schools can take advantage of limited infrastructure to still provide adequate quality education. Often, the quality of teaching is seen as the main factor that determines student learning outcomes, while infrastructure management is considered a secondary supporting factor. However, in an increasingly competitive educational environment, especially in vocational schools that emphasize the mastery of technical skills, infrastructure management cannot be underestimated. These two aspects should be seen as interrelated components and contribute significantly to student engagement and competence. This problem is even more crucial considering that many schools in Salatiga are still struggling to improve the overall quality of education, despite being faced with limited resources. Thus, this study seeks to identify how infrastructure management and teaching quality can work synergistically to create a learning environment that supports high student engagement and optimal competence in vocational schools throughout Salatiga City.

Previous research relevant to this topic has been conducted by Chen and Wei (2020), who found that a good educational infrastructure significantly increases student engagement in learning, which in turn has a positive impact on their academic competence. In addition, Johnson and Hsu (2021) highlight the importance of teaching quality in driving better learning outcomes, although their research places less emphasis on the mediating role of student engagement. Another study by Lee et al. (2020) showed that interaction between teachers and students is key in improving student competence, but their research did not consider how infrastructure management can affect these dynamics.

The gap that exists between these studies suggests that while there is awareness about the importance of quality teaching and teacher-student interaction, there is still little attention paid to how infrastructure management can serve as a catalyst that strengthens student engagement in learning. This study seeks to fill this gap by exploring the important role of infrastructure management in the context of student involvement and their competence.

The novelty of this study lies in a holistic approach that integrates infrastructure management and teaching quality as variables that are interrelated and have a direct impact on student engagement and competence. Unlike previous studies that tended to separate the analysis between teaching quality and infrastructure, this study offers a new perspective by looking at how these two factors can collaborate to create a more effective learning environment. This novelty is important because it can provide a new, more comprehensive view of how schools in Indonesia can improve the overall quality of education, not only through improved teaching, but also through better management of infrastructure. Thus, this research not only contributes to the academic literature, but also provides practical recommendations that can be implemented by education managers.

The main objective of this study is to identify and analyze the influence of infrastructure management and teacher teaching quality on student engagement and their competence. This research was conducted with great urgency given that student engagement is a key factor in educational success, and understanding how the factors that influence it can have a great positive impact on student learning outcomes. Through this research, it is hoped that effective strategies can be found in managing infrastructure facilities and improving the quality of teaching, which will ultimately increase student involvement and their competence in learning. This research is also expected to provide a basis for better education policies, which can be applied in various educational contexts in Indonesia.

RESEARCH METHOD

This study uses a type of quantitative research with an ex post facto approach. This approach was chosen because this study aims to test the causal relationship between variables that have occurred, without manipulating the independent variables (Ghozali, 2021; Creswell & Creswell, 2020; Hair et al., 2021). Ex post facto is suitable for use when the researcher cannot control or manipulate independent variables, but only observes existing phenomena and analyzes their influence on dependent variables. This method was chosen compared to experimental or qualitative because the purpose of this study is to understand the influence of infrastructure management and teacher teaching quality on student engagement and their competence, which is a naturally occurring phenomenon and cannot be intervened by researchers.

The data collection technique was carried out through a survey using a questionnaire distributed to grade XI students majoring in Automotive Light Vehicle Engineering (TKRO) at the Vocational High School (SMK) in Salatiga City, Central Java. The research location was chosen because it has a population of students relevant to the research topic, as well as easy access for data collection. The full address of the research location is SMK Negeri 2 Salatiga, Jalan Kartini No.3, Salatiga, Central Java, 50711. The population in this study is all students of grade XI TKRO at the vocational school, with a total population of 316 students. The proportional random sampling technique was used to determine the research sample with the Slovin formula and an error rate of 5%, so that a sample of 177 students was obtained. The use of this technique provides an equal opportunity for each member of the population to be selected as a sample, ensuring that the sample used is proportionally representative of the population and valid.

The data analysis technique used in this study is Structural Equation Modeling (SEM) with the help of AMOS software. SEM was chosen because it allows researchers to analyze complex relationships between multiple variables at once, both direct and indirect, and can model the influence of mediation, as applied in this study with student engagement as a mediating variable (Kline, 2021; Schumacker & Lomax, 2022; Byrne, 2021). The data collected from the questionnaire is first tested for validity and reliability to ensure that the instruments used are reliable. Afterwards, the data was analyzed using SEM to test the theoretical models that had been developed, as well as to identify causal relationships between the variables studied. The use of SEM provides an advantage in terms of accuracy and rigor in analyzing complex data, making it a method that is perfectly suited to the purpose of this study.

FINDINGS AND DISCUSSION

Instrument Validity and Reliability Test

Validity tests are conducted to ensure that each research instrument actually measures what it is intended to measure. In this study, the validity test was carried out using a trial sample involving 20 respondents who were not included in the main research sample. Several questionnaire items from the variables of infrastructure management, teacher teaching quality, student engagement, and student competence were declared invalid because the Correlated Item – Total Correlation value was below the r value of the table. These items were then removed from further analysis to maintain the accuracy of the research results. Reliability tests are carried out to ensure the consistency of measurement results if repeated under the same conditions. The Alpha Cronbach values for each variable indicate that all instruments used have good reliability, with all values above 0.70, which is the minimum limit for declaring an instrument reliable.

Table 1. Reliability Test

Variable	Cronbach Alpha	Conclusion
Infrastructure Management	0.837	Reliable
Teacher Teaching Quality	0.790	Reliable
Student Engagement	0.814	Reliable
Student Competencies	0.856	Reliable

Based on the results of the reliability test presented in Table 1, it can be concluded that the instrument used to measure the variables in this study has a good level of reliability. The Cronbach Alpha value for the infrastructure management variable is 0.837, indicating that the instrument used for this variable has high internal consistency and can be trusted in measuring infrastructure management. Similarly, the variable of teacher teaching quality has a Cronbach Alpha value of 0.790, which also shows good reliability. The variables student engagement and student competence have Cronbach Alpha values of 0.814 and 0.856, respectively, which shows that the instruments for these two variables are very reliable. Overall, the Cronbach Alpha values obtained for all variables are above the minimum threshold of 0.70, which is the general standard for stating that an instrument is reliable. Thus, it can be concluded that the instruments used in this study are quite consistent and reliable to measure each of the research variables.

Descriptive Variable Frequency

Descriptive frequency analysis was used to provide an overview of how respondents assessed the variables studied. This is important to understand the distribution of respondents' perceptions of infrastructure management, teacher teaching quality, student engagement, and student competence. Descriptive data showed that the majority of respondents rated infrastructure management in the "Quite Good" category, indicating the potential for further improvement. The quality of teacher teaching was also assessed by most respondents in the "Quite Good" category, which indicates that although it is adequate, there is still room for improvement. As for student engagement, the majority of respondents rated it in the "Good" category, which shows a fairly high level of student involvement in the learning process.

Finally, student competence is also assessed by the majority in the "Good" category, indicating that most students feel quite competent in their area of expertise.

Table 2. Descriptive Variable Frequency of Infrastructure Management

Interval	Frequency	Percent (%)	Category
67.2 - 80	2	1%	Excellent
54.4 - 66.2	62	35%	Good
41.6 - 53.4	98	55%	Pretty Good
28.8 - 40.6	15	8%	Bad
16 - 27.8	0	0%	Very Not Good
Sum	**177**	**100%**	

Based on Table 2 which displays the frequency distribution of infrastructure management variables, it can be seen that the majority of respondents rated the management of infrastructure facilities in their schools in the category of "Quite Good". A total of 98 respondents, or 55% of the total sample, gave an assessment in the score range of 41.6 to 53.4, which is included in the "Moderately Good" category. Furthermore, 62 respondents (35%) rated infrastructure management as "Good" with a score between 54.4 to 66.2. Only 2 respondents (1%) gave a "Very Good" rating, indicating that very few felt that the management of infrastructure facilities in their schools was optimal. On the other hand, 15 respondents (8%) gave an assessment of "Not Good", and no respondents rated infrastructure management in the category of "Very Bad". Overall, the data indicate that while most respondents feel that infrastructure management is adequate, there is still room for improvement in order to achieve a higher assessment.

Table 3. Descriptive Variable Frequency of Teacher Teaching Quality

Interval	Frequency	Percent (%)	Category
50.4 - 60	13	7%	Excellent
40.8 - 49.4	48	27%	Good
31.2 - 39.8	106	60%	Pretty Good
21.6 - 30.2	10	6%	Bad
12 - 20.6	0	0%	Very Not Good
Sum	**177**	**100%**	

Based on the results of the analysis shown in Table 3 regarding the frequency distribution of teacher teaching quality assessments, the majority of respondents, namely 60% (106 respondents), rated the quality of teaching in their schools in the category of "Quite Good", with a score between 31.2 to 39.8. In addition, 27% (48 respondents) rated teaching as "Good", while only 7% (13 respondents) gave an "Very Good" rating, indicating that very few students felt that the quality of teaching was optimal. On the other hand, 6% (10 respondents) rated the quality of teaching in the "Not Good" category, and no one rated it as "Very Not Good". Overall, these data show that although the quality of teaching is considered adequate by most students, there is significant room for improvement, both in teaching methods and teacher-student interactions, to improve the quality of teaching to a higher level.

Table 4. Descriptive Variable Frequency of Student Engagement

Interval	Frequency	Percent (%)	Category
54.6 - 65	7	4%	Excellent
44.2 - 53.6	109	62%	Good
33.8 - 43.2	60	34%	Pretty Good
23.4 - 32.8	1	1%	Bad
13 - 22.4	0	0%	Very Not Good
Sum	**177**	**100%**	

Based on Table 4 which displays the distribution of assessment frequency for the student engagement variable, the majority of respondents, namely 62% (109 respondents), rated student engagement in their school in the "Good" category, with a score between 44.2 to 53.6. A total of 34% (60 respondents) rated student engagement as "Quite Good", while only 4% (7 respondents) gave a rating of "Very Good", indicating that only a few students felt that their involvement in the learning process was optimal. On the other hand, 1% (1 respondent) rated student engagement in the "Not Good" category, and no respondents rated it in the "Very Bad" category. Overall, this data shows that student engagement in the learning process is rated quite high by most respondents, but there is still room for further improvement for more students to achieve optimal levels of engagement.

Table 5. Descriptive Variable Frequency of Student Competencies

Interval	Frequency	Percent (%)	Category
46.2 - 55	44	25%	Excellent
37.4 - 45.2	88	50%	Good
28.6 - 36.4	43	24%	Pretty Good
19.8 - 27.6	2	1%	Bad
11 - 18.8	0	0%	Very Not Good
Sum	**177**	**100%**	

Based on Table 5 which displays the distribution of assessment frequency to student competency variables, the majority of respondents, namely 50% (88 respondents), assessed their competencies in the "Good" category, with a score between 37.4 to 45.2. A total of 25% (44 respondents) gave a "Very Good" rating, indicating that a quarter of the total sample felt that they had very adequate competence.

In addition, 24% (43 respondents) rated their competence as "Quite Good", indicating that although they feel quite competent, there are still aspects that need to be improved. Only 1% (2 respondents) rated their competence in the "Not Good" category, and no respondents gave an assessment in the "Very Not Good" category. Overall, this data shows that most students feel competent in their field of study, but there is potential for improvement to elevate more students to a higher level of competence.

Analysis Structural Equation Modeling (SEM)

The analysis using Structural Equation Modeling (SEM) aims to test the relationship between the variables studied and to validate the theoretical model that has been developed. SEM was chosen because it allows researchers to not only examine the direct relationship between variables, but also to evaluate indirect influences through mediating variables such as student engagement.

In this study, the results of the SEM test show that the model used has six indicators that meet the criteria of goodness of fit. These indicators include CMIN/DF, GFI, RMSEA, TLI, and CFI values, all of which indicate that the model is fit enough for further analysis. Although there are some indicators that do not meet the criteria (such as Chi-square and AGFI values), overall, the model is considered adequate and does not require further modifications.

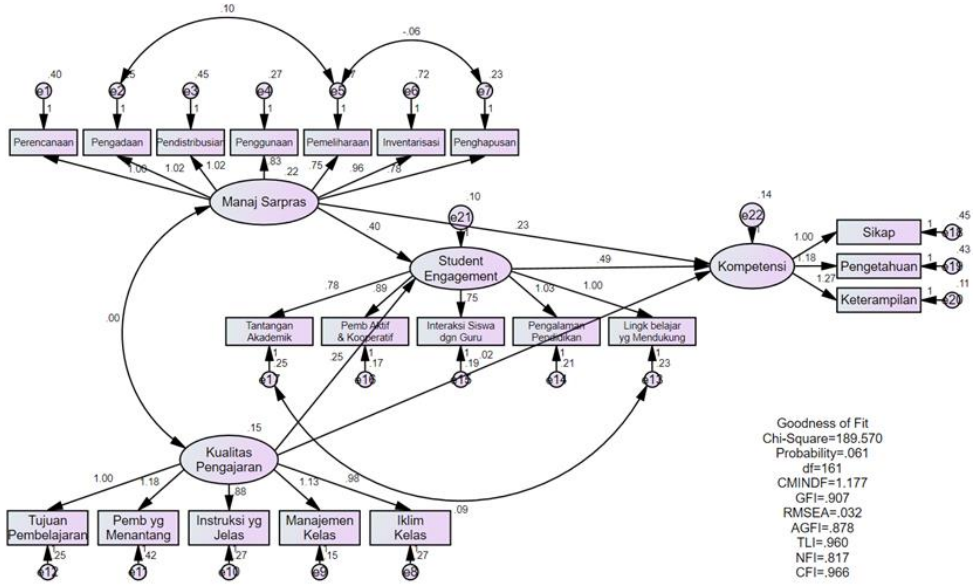

Figure 1. Structural Equation Modeling

Based on the results of the Structural Equation Modeling (SEM) model test shown in Figure 1, it is found that infrastructure management and teaching quality have a significant influence on student engagement, which in turn affects student competence. Infrastructure management is measured through several indicators such as planning, procurement, distribution, use, maintenance, and inventory, all of which contribute positively to increased student engagement. Similarly, teaching quality, which is measured through indicators such as learning objectives, challenge delivery, clear instruction, classroom management, and classroom climate, also showed a positive influence on student engagement.

Furthermore, student engagement has been shown to have a significant influence on student competence, which is measured through attitudes, knowledge, and skills. The model also shows that most of the Goodness of Fit indicators such as CMIN/DF (1.177), RMSEA (0.032), GFI (0.907), TLI (0.960), and CFI (0.966) support that the model is fit and good enough to be used in further analysis, although there are some aspects that only achieve Marginal Fit (AGFI = 0.878) and Bad Fit (NFI = 0.817). Overall, these findings suggest that to improve student competence, schools need to focus on managing good infrastructure and improving the quality of teaching, both of which can significantly increase student engagement in the learning process.

Tabel 6. Goodness of Fit Model

Indeks Goodness of Fit	Expected value	Result	Results
Chi-square	Expected small	189.750	Bad Fit
Significance	≥0.05	0.061	Good Fit
CMIN/DF	<2.00	1.177	Good Fit
GFI	>0.90	0.907	Good Fit
RMSEA	≤0.08	0.032	Good Fit
AGFI	≥0.90	0.878	Marginal Fit
TLI	≥0.90	0.960	Good Fit
NFI	≥0.90	0.817	Bad Fit
CFI	≥0.94	0.966	Good Fit

Based on the results *of the Goodness of Fit* model test shown in Table 6, overall, the model used in this study shows a fairly adequate fit despite some weaknesses. The Chi-square index shows *a Bad Fit* with a value of 189,750, but most other indices, such as significance (0.061), CMIN/DF (1,177), GFI (0.907), RMSEA (0.032), TLI (0.960), and CFI (0.966) show *Good Fit*, indicating that this model is in line with the expected data. AGFI has a value of 0.878, which only achieves *a Marginal Fit*, while the NFI shows *a Bad Fit* with a value of 0.817, which is below the expected limit. Nonetheless, overall, the model is acceptable and quite feasible for further analysis as most indicators show a good fit with the data.

Direct and Indirect Influence Test

The direct influence test was carried out to see the extent to which independent variables (infrastructure management and teacher teaching quality) directly affected the dependent variable (student competence), as well as the extent to which the mediation variable (student engagement) affected the final result. The results of the direct influence test show that infrastructure management has a positive and significant influence on student competence and student engagement. In contrast, the quality of teacher teaching only has a significant influence on student engagement, but not on student competence. This suggests that although teacher teaching is important, its influence on student competence may be more indirect through increased student involvement in the learning process. This is as shown in the following table, to provide data visualization.

Table 7. Direct Impact Test

Variable Relationship	East	S.E.	C.R.	p	Results
Student Engagement <- Infrastructure Management	.367	.099	3.724	***	Accepted
Student Engagement <- Quality of Teacher Teaching	.235	.097	2.420	.016	Accepted
Student Competencies <- Infrastructure Management	.264	.111	2.365	.018	Accepted
< Student Competencies- Student Engagement	.498	.157	3.171	.002	Accepted
Student Competence <- Teacher Teaching Quality	.009	.108	.083	.934	Rejected

Based on the results of the direct influence test shown in Table 7, it was found that infrastructure management had a positive and significant influence on student engagement with an estimated influence (Est) of 0.367 and a C.R. value of 3.724 ($p < 0.001$). Likewise, the quality of teacher teaching showed a positive and significant influence on student engagement with an estimated influence of 0.235 and a C.R. of 2.420 ($p = 0.016$). In addition, infrastructure management also had a significant effect on student competence with an estimated influence of 0.264 and C.R. of 2,365 ($p = 0.018$), and student engagement showed a strong and significant influence on student competence with an estimated influence of 0.498 and C.R. of 3.171 ($p = 0.002$).

On the other hand, the quality of teacher teaching does not show a significant influence on student competence, with an estimated influence of 0.009 and a C.R. of 0.083 ($p = 0.934$), so this hypothesis is rejected. In conclusion, infrastructure management and student engagement have an important role in improving student competence, while the quality of teacher teaching has more influence on student involvement than directly on their competence.

Furthermore, an indirect influence test was carried out using the Sobel test method to determine whether there was a significant mediation influence of student engagement. The results show that student engagement mediates the influence of infrastructure management on student competence significantly, but does not mediate the influence of teacher teaching quality.

Table 8. Indirect Influence Test

Indirect Influence	Calculation	p Value	Conclusion
Infrastructure Management > Student Competencies through Student Engagement	2.4101	0.0159	Signifikan
Teacher Teaching Quality - > Student Competencies through Student Engagement	0.0833	0.9336	Insignificant

Based on the results of the indirect influence test shown in Table 8, it was found that infrastructure management had a significant indirect influence on student competence through student engagement, with a tcal value of 2.4101 and a p value of 0.0159. This shows that student engagement mediates the influence of infrastructure management on student competence, which means that good infrastructure management can increase student engagement, which in turn increases their competence. On the other hand, the quality of teacher teaching did not show a significant indirect influence on student competence through student engagement, with a tcal value of 0.0833 and a p value of 0.9336. This shows that although the quality of teacher teaching has a positive effect on student engagement, the influence is not strong enough to significantly improve student competence through student engagement mediation.

Thus, infrastructure management plays a key role in improving student competence, especially through increasing their involvement in the learning process. The results of this study revealed that the management of infrastructure facilities and the quality of teacher teaching have a significant effect on student engagement, which then affects student competence. These findings reinforce research by Chen and Wei (2020), which found that a good educational infrastructure can increase student engagement in learning activities, which in turn strengthens their academic abilities. On the other hand, the results of this study contradict the findings by Johnson and Hsu (2021), which show that the quality of teaching has a significant direct influence on student competence, without the need for mediation from student involvement. Their findings emphasize that a good teaching approach directly affects competency improvement, in contrast to the results of this study which shows that the influence of teaching quality on student competence is more effective through increased student engagement. In addition, this study is also contrary to the findings from Lee et al. (2020), which identified that teacher-student interaction directly strengthens student competencies without being affected by infrastructure.

The results of this study provide a new perspective that student involvement is an important mediating factor, especially in a context where infrastructure management and teacher teaching quality are integrated to improve student competence. This perspective adds to the academic literature by highlighting the importance of a holistic learning environment, where good educational facilities and teaching methods must go hand in hand to achieve optimal outcomes.

The contribution of this research in the field of education management lies in strengthening the understanding of the importance of integration between infrastructure management and teaching quality in improving student competence through their active involvement in the learning process. This study underlines that effective infrastructure management not only supports the physical learning process, but also motivates students to be more engaged, which in turn improves their learning outcomes. Additionally, the study shows that the quality of teacher teaching, while important, has a greater impact when accompanied by efforts that encourage student engagement. These findings provide new insights for education managers to not only focus on one aspect, such as teaching or infrastructure, but also on how the two can be optimized together to create a more comprehensive and effective learning environment. Thus, this research contributes to the development of a more holistic education management strategy, which can be adopted by schools in an effort to improve the overall quality of education.

CONCLUSION

This study reveals that the management of infrastructure facilities and the quality of teacher teaching play an important role in improving student competence through the mediation of student engagement. These findings provide new insights that student involvement in the learning process is not only influenced by the quality of teaching provided by teachers, but also by how well the facilities and infrastructure in schools are managed. This study shows that effective infrastructure management can create a conducive learning environment, which in turn increases student engagement and significantly improves their competence.

A key lesson that can be drawn from this study is the importance of a holistic approach to education management, where attention is paid not only to the quality of teaching, but also to environmental factors that support active student engagement. Theoretically, this study strengthens the understanding of the role of mediation in the relationship between teaching quality, infrastructure management, and student learning outcomes, while practically, this research encourages education managers to focus more on the management of educational facilities as an integral part of the strategy to improve the quality of education.

This research makes a significant contribution by enriching the existing literature in the field of education management through a more comprehensive approach to factors that affect student competence. By introducing student engagement as an important mediating variable, this study renews the existing perspective on how teaching quality and infrastructure management together affect learning outcomes. However, this study has some limitations, including limited scope to specific contexts of specific schools, so the results may not be fully generalizable to all educational settings.

In addition, the research method used relies more on quantitative data, so it lacks qualitative aspects of student and teacher experiences. To get a more comprehensive picture, further research is needed by considering contextual variations, such as differences in gender, age, and socio-economic background, as well as the use of more diverse methods, including qualitative approaches that can explore students' experiences and perceptions in more depth. This research is expected to be the foundation for the development of more holistic and effective education policies, which can be implemented in various different educational contexts.

ACKNOWLEDGMENT

Praise and gratitude to the author to the presence of Allah SWT who has bestowed His grace and guidance so that the author can write a thesis with the title "The Influence of Infrastructure Management and Teacher Teaching Quality on Students' Automotive Engineering Skills Competencies with Student Engagement as a Mediator Variable (Empirical Study at Vocational Schools in Salatiga City)" can be completed as a requirement to obtain a Master of Education degree at the Semarang State University Postgraduate Education Administration Study Program. The success of writing this thesis cannot be separated from the help, motivation, support and prayers from various parties. Therefore, the author would like to express his thanks to Prof. Heri Yanto, M.B.A., Ph.D. (Supervisor I) and Dr. Sungkowo Edy M., S. Pd., M. Si. (Supervisor II) who has guided me in the preparation of this thesis wholeheartedly.

The researcher would like to thank all parties who have contributed to this research effort, in particular: (1) Chancellor Prof. Dr. Fathur Rokhman M.Hum Postgraduate UNNES, who has provided opportunities and advice during the education, research and thesis writing process. (2) Prof. Dr. Arief Yulianto, S.E. M.M., Study Program Coordinator, and Secretary of the UNNES Postgraduate Education Administration Study Program for their support and assistance in preparing this thesis. (3) Mr. and Mrs. UNNES Postgraduate lecturers who have provided a lot of knowledge to researchers during their education. (4) The parties we respect include the teachers and students of the Salatiga City Vocational School, who have actively participated and made valuable contributions in facilitating the research process.

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