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Mediating Effect of Time Management Practices on the Relationship Between Laboratory Environment and Teacher Readiness on Hands-on Science Instruction

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Abstract — Low readiness on hands-on science instruction remains an escalating concern. This study employed a predictive research design and mediation analysis to validate the mediating effect of time management practices on the correlation between the science laboratory environment and teacher readiness. Data from 155 elementary science teachers, gathered via total enumeration, revealed that the mediation is moderate (46.67%) yet significant, affirming the General Systems Theory. To account for the remaining 53.33% of the variance in the mediation's strength, future research should explore qualitative approaches to identify other potential mediators. Consequently, school leaders are encouraged to pair laboratory improvements with capacity-building training on effective time management to maximize teacher readiness in implementing hands-on science instruction.

Keywords: Mediating effect of time management practices, laboratory environment, teacher readiness, hands-on science instruction

I. INTRODUCTION

The Problem and Its Scope

Teacher readiness on hands-on science instruction has increasingly become a central global concern in education systems. Teacher readiness refers to the comprehensive preparedness of teachers in terms knowledge, emotional confidence, pedagogical competence, classroom management, and confidence to facilitate effective inquiry-based learning. It has been known as crucial factor for meaningful learning to happen, yet many reports across the globe confirm that teachers continue feeling inadequately prepared in designing in implementing and facilitating effective learning.

International research has significantly recorded similar existent problems on teachers' readiness. The Organization for Economic Co-operation and Development for instance, has presented that substantial count of teachers across participating countries expressed the need for further professional preparation and instructional support to effectively perform their teaching responsibilities (OECD, 2019). Similarly, one study highlighted that teachers in various academic institutions have moderate level of readiness (Papagiannopoulou et al., 2023). In Indonesia, similar problem on teacher readiness was also documented where many science teachers claimed to have low readiness for STEM-related and experimental learning (Sulaeman, 2022). Scholarly investigations on teacher readiness was also conducted in other countries and the result revealed teachers in Saudi Arabia rated their overall readiness as acceptable (Alnajar et al., 2025) while only one quarter (26.4%) of teachers in Spain felt adequately prepared (Triviño-Amigo et al., 2022).

In the Philippine context, teacher readiness has similarly been documented as a growing major problem across curriculum and institutions. In particular, Baniqued and Bautista (2024) reported that science teachers only have sub-optimal readiness. Furthermore, Ramos et al. (2025) discovered that significant amount of science teachers in the Philippines had poor readiness on creating interesting lessons. In Mindanao, several regions have also noted concerns regarding teacher readiness. For Instance, it was established in the findings of Sakib and Obra (2019), that teachers in Western Mindanao demonstrated limited understanding on certain curriculum components indicating a gap in teacher readiness in effective science teaching. Evidence on poor

readiness among teachers was likewise reported in Cagayan de Oro and Zamboanga (Ramirez, 2021).

These international and national findings underscore that teacher preparedness persists across academe. Studies emphasized that teachers who are underprepared may struggle delivering effective instruction and meeting the curriculum standards which would then result to decreased engagement and lower learning achievement (Darling-Hammond et al., 2023). Unpreparedness undermines not only teachers' confidence but also compromises the quality of learning outcome. Other studies also emphasized that poor teacher readiness may lessen students' interest and motivation to pursue STEM-related professions in the future (Sulaeman et al., 2022).

Considering these adverse consequences, it is imperative to further investigate underlying factors influencing teacher readiness. Despite existing research on teachers' readiness, there remains limited empirical evidence about how other contextual and instructional variables contribute to teachers' readiness, particularly among elementary science teachers. Therefore, this study was conducted to further examine teacher readiness in science instruction. Specifically, it explores the science laboratory environment and time management practices as variables that may be associated with teachers' readiness in planning and implementing effective hands-on science instruction.

Significance of the Study

This study supports the United Nations Sustainable Development Goal 4 (Quality Education) by contributing to the improvement of teacher readiness in elementary science instruction. The findings provide insights for school administrators, educational leaders, and the Department of Education in developing policies, training programs, and support systems that strengthen science laboratory environments and promote effective time management practices among teachers. The results also help elementary science teachers recognize the importance of time management in organizing and delivering meaningful laboratory-based science learning. Moreover, the study aligns with the mission and vision of Holy Cross of Davao College by reinforcing its commitment to providing transformative, values-oriented, and quality education that develops competent and socially responsible learners. Lastly, this study may serve as a

reference for future researchers to explore other variables that may influence teacher readiness and further expand research in science education.

Statement of the Problem

This study was aimed at determining the mediating effect of time management practices on the correlation between science laboratory environment and teacher readiness among elementary science teachers. Specifically, to determine the following objectives:

1. To determine the levels of science laboratory environment in terms of student cohesiveness, open-endedness, integration, rule clarity, and material environment; time management practices in terms of short-range planning, time attitude, and long-range planning; and teachers readiness for hands-on science instruction in terms of cognitive preparedness, affective readiness, instructional self-efficacy, and instructional commitment;
2. To determine the significant relationship between science laboratory environment, time management practices, and the teachers' readiness.
3. To determine the significance of the direct effect of science laboratory environment on teacher readiness while controlling for time management practices.
4. To determine the significance of the indirect effect of science laboratory environment on teacher readiness through time management practices.
5. To determine the significance of the total effect of science laboratory environment on teacher readiness

Hypotheses:

H**o**1: Science laboratory environment and time management practices do not significantly correlate with teacher readiness.

H**o**2: The direct effect of science laboratory environment on teacher readiness while controlling for time management practices is not significant.

H**o**3: The indirect effect of science laboratory environment on teacher readiness through time management practices is not significant.

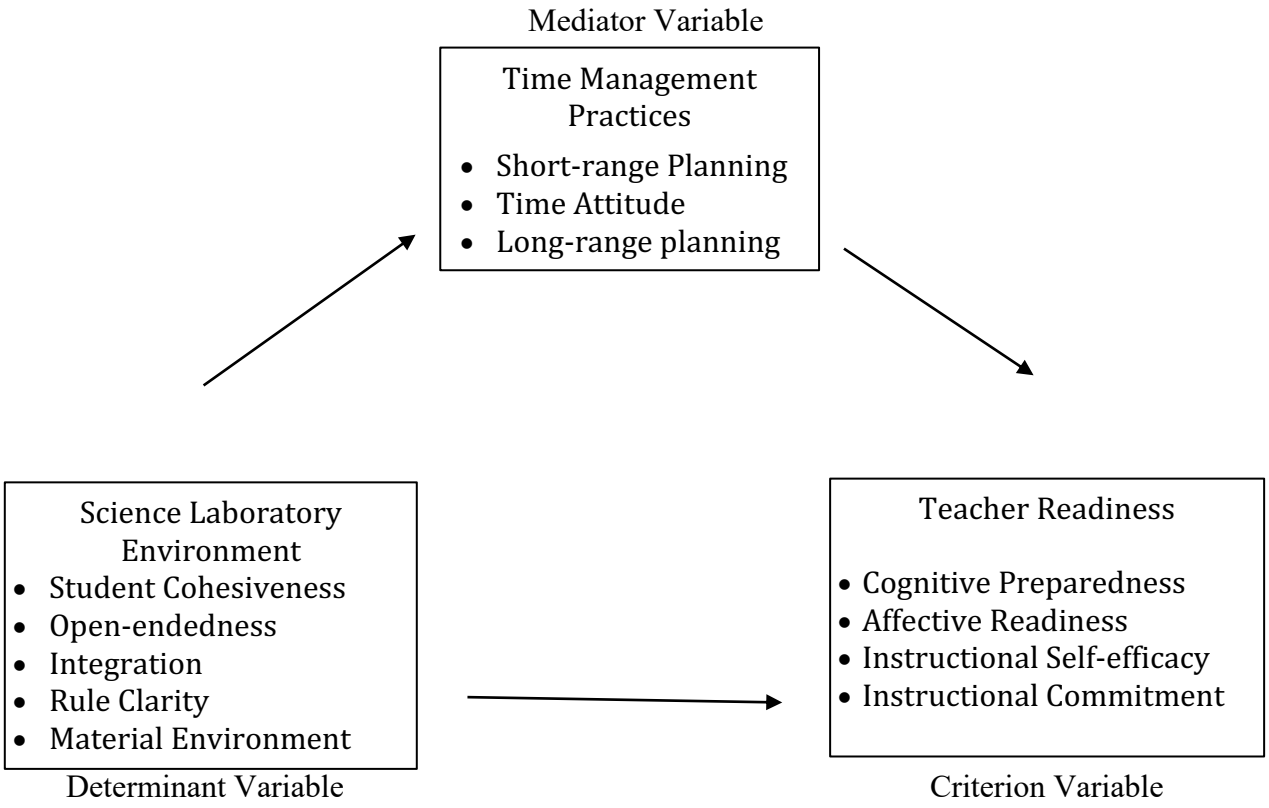
H**o**4: The total effect of science laboratory environment on teacher readiness is not significant.

Theoretical and Conceptual Framework

This study is firmly anchored on the Input-Process-Output Model of General Systems Theory (Bertalanffy, 1968). The theory postulates that systems operate through the interaction of components that receive inputs from the environment, transform them through internal processes, and produce outputs. Expanding upon this premise, scholars later operationalized this systemic flow into the Input–Process–Output (IPO) framework, where inputs represent resources, processes refer to the mechanisms that transform them, and outputs represent the resulting outcomes.

In this study, science laboratory environment as determinant variable indicated by student cohesiveness, open-endedness, integration, rule clarity, material environment (Fraser, et.al.,1993) functions as the input as emphasized in the theory; the time management practices as mediator variable indicated by short-range planning, time attitude, and long-rang planning (Britton, and Tesser, 1991) which represent as the process as highlighted in the theory; finally the teacher readiness as criterion variable indicated by cognitive preparedness, affective readiness, instructional self-efficacy, and instructional commitment (Papagiannopoulou et.al., 2023) serves as the output as specified in the theory.

Based on the associations among the variables and the assumptions of the theory, the conceptual framework of the study is fully grounded on the General Systems Theory.



II. METHODOLOGY

This chapter outlines the research design, locale of the study, sample and sampling technique, data gathering technique, data analysis, and ethical considerations.

Research Design

In pursuit of the objectives, the study applied a predictive research design, a quantitative approach that seeks to ascertain whether one or more variables can predict or explain the outcome of another variable through statistical analysis. Predictive design is commonly used when research aims to examine the influence of predictor variables on an outcome variable and estimate possible results. This design is advantageous because it allows researchers to analyze relationships among variables and generate evidence-based predictions (Hayes, 2022). This design was deemed

appropriate in this study because it examined not only the direct influence of the laboratory environment but also the indirect pathway through which time management predicts readiness.

Locale of the Study

This research was undertaken in the two northernmost districts of the Davao City Division, Region XI. The locale included a diverse range of schools categorized as small, medium, and mega schools, representing both urban and rural educational settings. These districts were selected because they provide a diverse context for examining the relationship between science laboratory environment, time management practices, and teacher readiness. Moreover, schools within these districts met the inclusion criteria of having a total of 155 elementary science teachers, which allowed for comprehensive data collection and ensured adequate representation of the target population. Given the diversity in size, resources, and teaching contexts, these schools from both districts offered a fitting and meaningful setting for investigating the variables of the study and were therefore considered the most suitable locale for this research.

Sample and Sampling Technique

The focal respondents of this study consisted of 155 public elementary teachers currently employed in the selected districts during the school year 2025–2026 who are assigned to teach either one of science 3 to 6 subjects. These teachers were selected because they are directly involved in the implementation of science instruction and hands-on science activities, making them the most appropriate source of information regarding the science laboratory environment, time management practices, and teacher readiness.

Considering the population size and accessibility, the researcher used the total enumeration sampling, a technique in which all members of the identified population are included as respondents. This method is commonly applied when the population size is relatively small and accessible, allowing the researcher to obtain comprehensive data from the entire group while minimizing sampling bias and improving representativeness of the findings (Etikan & Bala, 2023).

Data Gathering Technique

The study utilized survey technique, a technique of collecting quantitative data through structured questionnaires administered to a specific group of respondents. It is generally applied when researchers aim to acquire information about participants' perceptions, behaviors, or practices within a large population in a systematic and efficient manner (Goodfellow, 2023; Prasad, 2024). One of its primary advantages is that it allows the collection of standardized data that can be easily analyzed statistically to determine patterns and relationships among variables (Creswell & Creswell, 2023).

There were three adapted and modified survey questionnaires employed in the collection of data. First, the Science Laboratory Environment Inventory (SLEI) developed by Fraser et al. (1993) was used to measure the science laboratory environment and consists of five domains with 35 items, with a Cronbach's alpha of 0.894. For mediator variable is the Time Management Questionnaire (TMQ) by Britton and Tesser (1991) was used to measure time management practices and includes 18 items across three domains, with a reliability coefficient of 0.927. Lastly, to measure the teacher readiness is the Tri-STEM Scale developed by Papagiannopoulou et al. (2023), which contains 24 items under four domains and has a Cronbach's alpha of 0.942. All three instruments were adapted, contextualized, and validated for elementary science teachers and utilized a 4-point Likert-type scale. The high reliability coefficients signify strong internal consistency, confirming that the instruments are reliable for use in the study.

After establishing the reliability of the research instruments, the researcher secured an ethics certification from the HCDC SMILE Ethics Review Committee to ensure that the study adhered to ethical research standards. Subsequently, permission to conduct the study was sought from the Schools Division Superintendent, followed by the respective District Supervisors of the two districts and the school heads of the participating schools. Upon obtaining the necessary approvals, informed consent was secured from the respondents prior to the administration of the survey questionnaire. Data were collected through both face-to-face and online survey methods, allowing respondents to participate at their most convenient time. After the completion of data collection, the responses were carefully encoded, tabulated, and submitted for statistical analysis.

Data Analysis Technique

In this study, the data analysis technique utilized were descriptive analysis, correlation analysis, and mediation analysis.

Descriptive analysis is a statistical procedure used to summarize and describe the basic characteristics of data in a study by presenting patterns, distributions, and general trends of the variables. It is commonly used in quantitative research to provide an overview of the collected data before conducting further statistical analysis. One advantage of descriptive analysis is that it simplifies large sets of data into meaningful summaries that allow researchers to clearly interpret the level and condition of the variables (Creswell & Creswell, 2023). Variables in this study were descriptively analyzed using mean and standard deviation

Correlation analysis is a statistical treatment used to measure the strength and direction of the relationship between two variables. It is commonly used to determine whether variables are significantly associated with each other. Its advantages include helping identify relationships among variables, which may provide a basis for further predictive or causal analysis (Hair et al., 2022). To relationship between variables mentioned in this study were analyzed using Pearson Product–Moment Correlation Coefficient.

Mediation analysis is a statistical method used to establish whether a third variable explains the relationship between a determinant variable and a criterion variable. It is used to understand the underlying mechanism through which one variable influence another through an intervening variable. One of its advantages is that it allows researchers to determine whether the effect of an independent variable on a dependent variable occurs directly or indirectly(Hayes, 2022). Path analysis was conducted to evaluate the hypothesized directions and structural associations between the study's constructs.

Detailed in succeeding page, are the basis for interpreting the descriptive level of the variables:

Scale	Level	Science Laboratory Environment	Time Management Practices	Teacher Readiness
3.75-4.00	Very High	Very Good	Very Good	Very Good
2.50-3.74	High	Good	Good	Good
1.75-2.49	Low	Poor	Poor	Poor
1.00-1.74	Very Low	Very Poor	Very Poor	Very Poor

The following is the Standard Deviation Value Ranges and Interpretation:

SD Range	Description	Intepretation
SD≤ 0.50	Highly Consistent Responses	Indicates strong agreement and uniformity in respondents' perception
SD = 0.51 – 1.00	Moderately Consistent Responses	indicates acceptable consistency in respondents' responses
SD = 1.01 – 1.50	Low Consistency Responses	Indicates varied responses among respondents
SD > 1.50	Very Low Consistency Responses	Indicates high variability and lack of consensus among respondents

In this study, the significance of the correlation is tested at 0.05 confidence level. The following is the standard measure for the interpretation scale of *r*-value, the following scheme is used:

Computed r	*Descriptive Interpretation*
+/- 1.00	Perfect correlation
Between +/- 0.75 – +/- 0.99	High correlation
Between +/- 0.51 – +/- 0.74	Moderately high correlation
Between +/- 0.31 – +/- 0.50	Moderately low correlation
Between +/- 0.01 – +/- 0.30	Low correlation
0.00	No correlation

The standard measure for the interpretation of the strength of the mediation is detailed below:

Proportion Mediated	*Interpretation*
< 0.20	Weak Mediation
0.20 – 0.50	Moderate Mediation
> 0.50	Strong Mediation

Ethical Consideration

In the conduct of the study, the researcher adhered to the strict ethical standards to maintain the integrity and credibility of the study. It followed the protocols of Holy Cross of Davao College under the SMILE framework and complied with the provisions of the Data Privacy Act of 2012 hence safeguarded participant's personal information. Prior to data collection, informed consent was obtained from all respondents. The research instruments underwent validation and reliability testing to guarantee the accuracy and trustworthiness of the findings. Most importantly, permission

from the Department of Education was formally secured to conduct the study within public schools under its jurisdiction.

III. RESULTS

Presented herein are the descriptive, correlation and mediation results along with the corresponding analysis and interpretation of results, and summary of findings.

Descriptive Results

Table 1 is the descriptive table containing the variables of this study, namely time management practices, science laboratory environment, and teacher readiness with its respective indicators; number of samples, standard deviation, mean and the corresponding description.

TABLE 1
DESCRIPTIVE STATISTICS (N = 155)

Variables	Number of Samples (N)	Standard Deviation	Mean	Descriptive Level
Time management practices	**155**	**0.47**	**3.60**	**High**
Short-range planning		*0.43*	*3.66*	*High*
Time attitude		*0.51*	*3.54*	*High*
Integration		*0.46*	*3.61*	*High*
Science laboratory environment	**155**	**0.43**	**3.63**	**High**
Student cohesiveness		*0.40*	*3.60*	*High*
Open-endedness		*0.36*	*3.70*	*High*
Integration		*0.37*	*3.75*	*Very High*
Rule clarity		*0.41*	*3.70*	*High*
Material environment		*0.60*	*3.42*	*High*

Readiness of Elementary Science teachers	**155**	**0.44**	**3.65**	**High**
Cognitive preparedness		*0.38*	*3.73*	*High*
Affective readiness		*0.44*	*3.64*	*High*
Instructional self-efficacy		*0.44*	*3.62*	*High*
Instructional commitment		*0.48*	*3.62*	*High*

Table 1 specifically displays that time management practices obtained a mean of 3.60 which is described as high. It signifies that time management practices of elementary teachers are good. All its indicators are described as high. The SD 0.47 described as highly consistent responses, indicates strong agreement and uniformity in teacher perception.

As for the Science laboratory environment, it obtained a mean of 3.63 which was described as high, this indicates that science laboratory environment is good. Among its indicators, integration was described as very high, while the rest of its indicators were all described as high. The SD of 0.43 is described as highly consistent responses, hence indicates strong agreement and uniformity in respondents' perception.

In addition, the readiness of elementary science teachers obtained an overall mean of 3.65 which was described as high. All its indicators were described as high thereby highlighting that teacher readiness are good. With the SD of 0.44, it indicates a highly consistent response hence shows that the respondents have strong and uniform perception

Overall, time management practices, science laboratory environment, and teacher readiness were all interpreted at a high level, indicating generally favorable conditions for implementing hands-on science instruction.

Correlation Results

Presented below in Table 2 are the correlational results between predictive variables and criterion variable. It also includes the number of samples, *r*-value, p-value, decision on null hypothesis, and the equivalent interpretation.

TABLE 2
CORRELATIONAL TABLE (N =155)

Variables	Readiness of Elementary Science Teacher			
	r-value	p-value	Decision on *Ho*	Interpretation
Time management practices	0.793	0.000	Reject Ho	Positive and significant high correlation
Science laboratory environment	0.787	0.000	Reject Ho	Positive and significant high correlation

Level of Significance: 0.05
Decision Rule: Reject H_0 if $p < 0.05$

As detailed above, the correlation between Time management practices obtained a p-value of 0.000 which is less than the 0.05 level of significance, hence the null hypothesis is rejected

indicating that its correlation with teacher readiness is significant. The corresponding r-value of 0.793 established a high correlation between the variables mentioned. This result suggests that as time management practices improve teachers' readiness also increases.

Moreover, the correlation between science laboratory environment obtained a p-value of 0.000 which is less than the 0.05 level of significance, hence the null hypothesis is rejected which signifies that its correlation with teacher readiness is significant. The corresponding r-value of 0.787 implies a high correlation between science laboratory environment and teacher readiness. This suggests that a better science laboratory environment is strongly linked to a higher level of readiness among teachers.

The findings revealed that both time management practices and the science laboratory environment are strongly and positively associated with teacher readiness in implementing hands-on science instruction. This indicates that teachers tend to demonstrate greater readiness when they effectively manage their time and when the laboratory environment is more supportive and conducive to learning.

Mediation Results

The mediation analysis results are summarized in Table 3. It includes the number of samples, determinant variable SL (Science Laboratory Environment), mediator variable TM (time management practices), and the criterion variable, TR (Teacher Readiness). It also contains the estimate beta, standard error, Z-value, p-value, decision on null hypothesis and equivalent interpretation.

TABLE 3
MEDIATION TABLE (N =155)

Label	Path/Effect	Estimate	SE	Z-value	p-value	Decision	Interpretation
a	SL – TM	0.99	0.06	16.52	0.000	Reject Ho	Significant
b	TM – TR	0.42	0.12	3.43	0.000	Reject Ho	Significant
c’	SL – TR	0.48	0.14	3.54	0.000	Reject Ho	Significant
a x b	Indirect effect	0.42	0.11	3.69	0.000	Reject Ho	Significant
c (Total Effect)	SL – TR	0.90	0.06	13.99	0.000	Reject Ho	Significant

Level of Significance: 0.05

Decision Rule: Reject Ho if p < 0.05

% Mediation: Indirect 46.67%; Direct 53.33%

As reflected, the direct effect of science laboratory environment on teacher readiness while controlling for time management practices obtained an estimate beta of 0.48, with p-value of 0.000 which is less than the 0.05 degree of significance resulting to the null hypothesis being rejected. This indicates that the direct effect of science laboratory environment on teacher readiness while controlling for time management practices is significant.

Similarly, the indirect effect of science laboratory environment on teacher readiness through time management practices obtained an estimate beta of 0.42, with p-value of 0.000 which is less than the 0.05 level of significance; hence the null hypothesis was rejected. This suggests that the indirect effect of science laboratory environment on teacher readiness through time management practices is significant. Lastly, the total effect of science laboratory environment on teacher readiness obtained an estimate beta of 0.90 with the p-value of 0.000 is less than the 0.05 level of significance resulting to null hypothesis rejection. This indicates that total effect of science laboratory environment on teacher readiness is significant.

Collectively, the result establishes that time management practices partially mediate the relationship between the science laboratory environment and teacher readiness for hands-on science instruction. This means that while a supportive laboratory environment directly enhances teacher readiness, it also improves readiness indirectly by fostering better time management practices among teachers.

Summary of Findings

Based on the results of the correlational and mediation analyses, several key findings were identified:

1. Both science laboratory environment and time management practices are significantly correlated with teacher readiness.
2. The direct effect of science laboratory environment on teacher readiness while controlling for time management practices is significant.
3. The indirect effect of science laboratory environment on teacher readiness through time management practices is significant.
4. The total effect of science laboratory environment on teacher readiness is significant.

IV. DISCUSSIONS

In this chapter, the findings are discussed. Likewise, the conclusion and recommendations are presented.

Science Laboratory Environment and Time Management Practices and Teacher Readiness Correlation

The findings of this study indicated that both science laboratory environment and time management practices are significantly correlated with teacher readiness. This result affirms the study of Mendez & Senining (2023) asserting that a well-equipped conducive science laboratory

environment enhances the effectiveness of science instruction as it provides the necessary resources and conditions for teachers to get ready in conducting hands on science activities. Similarly, the current finding aligns with Öztürk and Deniz (2023) who demonstrated that participation in structured laboratory practices significantly improved prospective teacher laboratory skills and preparedness for conducting science experiments. However, this current finding stands in opposition to the claim that even in equipped environments, a lack of specific pedagogical training often leads to underutilized spaces and poorly planned hands-on activities (Vasconcelos and Rocha, 2025).

Moreover, the result of this study that time management practices correlate with teacher readiness supports the previous study stating that effective planning resource utilization, and prioritization improves teachers' ability to perform instructional tasks effectively (Vasconcelos and Rocha, 2025). Similarly, this present finding corroborates the claima of Cubero (2025) asserting that teachers who effectively practice time management through planning, prioritization, and monitoring of instructional tasks tend to create more productive and supportive learning environments, indicating the importance of time management in effective teaching.

Opposing this view, Satuoquia and Espiritu (2025) suggest that time management practices may not be enough to ensure teacher readiness, noting that administrative burdens and institutional demands play a significant role in limiting preparedness.

Science Laboratory Environment and Teacher Readiness as Mediated by Time Management Practices

The result of this study establishes that time management practices partially mediate the relationship between the science laboratory environment and teacher readiness on science instruction. This result is parallel to the findings of the recent study affirming that time management significantly mediates the relationship between organizational learning capability and teachers' social-emotional competence, suggesting that institutional conditions influence teacher outcomes through effective time management practices (Timon and Baguio, 2026). Additionally, the finding of this study is consistent with the idea of Kaur and Zhao (2023) that

external resources like facilities are most effective when coupled with internal self-regulatory skills like time allocation.

In contrast, the result of this study contradicts to the study of Saleem and Akhtar (2025) asserting that time management did not function as a mediating variable but rather as a strengthening factor between teaching competencies and classroom performance among teachers. Their study revealed that time management strengthened the relationship between teaching competencies and classroom performance rather than a mediating one.

Conclusion

Based on the findings, it is concluded that the mediating effect of time management practices on the correlation between science laboratory environment and teacher readiness among elementary science teachers is moderately (46%) significant. This conclusion affirms the Input-Process-Output Model of general systems theory (Bertalanffy, 1968), which posits that systems operate through the interaction of components that receive inputs from the environment, transform them through internal processes, and produce outputs.

Recommendations

Based on the conclusion, the researcher recommends pursuing further studies that explore other mediating variables not covered in the study to account for the remaining 54% variance in the relationship between science laboratory environment and teacher readiness. Future researchers may also conduct qualitative studies to gain deeper insights into teachers' readiness and the challenges they encounter in managing laboratory-based instruction, which may help generate additional variables for further investigation. Moreover, school leaders are encouraged to improve the science laboratory environment by strengthening teachers' time management practices, such as effective planning, prioritization of instructional tasks, and efficient scheduling of laboratory activities, to enhance teachers' readiness for science instruction.

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