Global Strategy and Leadership Review
Volume 1, Issue 2
ISSN: 3071-4613

Examining the Role of School Leadership in Promoting Experiential Science Learning and STEM Career Readiness in Secondary Schools

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Abstract

In secondary schools, STEM education is an important tool in developing young learners' scientific skills and awareness of scientific career opportunities, and preparing them for the labor market. However, in many schools, leadership support has not yet been implemented to enhance STEM career readiness or to create more meaningful experiential science learning. This study aimed to examine the role of school leadership in improving the achievement of experiential science learning in secondary schools and students' preparedness for STEM careers. A cross-sectional questionnaire survey design was adopted, using a structured questionnaire adapted from prior STEM education research, which was administered to 200 secondary school students across three secondary schools in Capitol Heights, Maryland. The data were analysed using SPSS version 27. The findings revealed that school leadership was significantly and positively associated with the learning of experiential science and readiness for STEM careers. Experiential science learning was also a strong predictor of STEM career readiness and, in part, explained the link between school leadership and STEM career readiness. The results point to the role of practical science learning and innovation in the school setting and the importance of attending to STEM guidance and leadership. The study advances an integrated mediation model elucidating the role of school leadership in enhancing students' readiness to enter STEM pathways.

Keywords: School leadership, experiential science learning, STEM career readiness, secondary schools, STEM education, mediation analysis.

1 Introduction

Science, technology, engineering, and mathematics (STEM) education has become a key to national development, innovation capacity, and the preparation of the future workforce. In particular, science learning is significant at the secondary school level, as students begin developing academic 'selves', identifying their career interests, and developing a sense of being able to enter STEM pathways. STEM preparation goes beyond curriculum coverage to learning environments that provide opportunities for students to learn about scientific concepts by conducting experiments, investigating ideas, reflecting on what they learn, solving problems, working cooperatively with others, and solving authentic problems. Research has indicated that practical science work, inquiry, and experiential STEM activities have been found to enhance students' motivation, science process skills, engagement, confidence, and learning outcomes (Bhardwaj & Saraswat, 2025; Chengere et al., 2025; Meulenbroeks et al., 2024; Sanjito & Hyams-Ssekasi, 2025).

Although this is important, many secondary schools still face obstacles to meaningful science learning. There is insufficient support to bridge the gap between classroom science and future education and occupational options for students due to limited laboratory support, weak teacher instructional support, limited teacher professional development, and a lack of connections between school and industry for STEM areas. These restrictions can also be grounded in leadership, as the school leader influences the school's priorities, the distribution of available resources, teacher capability, external school connections, and the culture of innovation within the school. Based on a review of related studies, school leadership practices are related to student outcomes according to the meta-analytic evidence (Özdemir et al., 2024), and that being able to facilitate instructional management and teacher development, organizational conditions, and external stakeholders is considered to be the key role of school leadership.

Research in science education on school leadership has paid significant attention to how principals influence science

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Received: 3-Jun-2026 Revised: 10-Jul-2026 Accepted: 18-Jul-2026

Global Strategy and Leadership Review
Volume 1, Issue 2
ISSN: 3071-4613

learning, the integration of science into STEM contexts, teacher effectiveness, and the mobilization of resources (Arokiasamy et al., 2025; Geiger et al., 2023; Murphy, 2023; Tan, 2024). Additional studies reveal that experiential science learning has positive effects on students' practical knowledge, inquiry skills, emotional engagement, and problem-solving skills (Chengere et al., 2025; Gillies, 2023; Sanjito & Hyams-Ssekasi, 2025). Other research has focused on STEM career aspirations, self-efficacy, career awareness, and learning opportunities that predict students' readiness to pursue a STEM pathway (Chen et al., 2022; Chen et al., 2024; Nitzan-Tamar & Kohen, 2022; Tomperi et al., 2022). These streams, however, have tended to form independent streams, and consequently, there is sparse empirical evidence on how school leaders can positively support STEM career readiness through science learning experiences.

This is important because we cannot understand students' readiness for STEM career success by relying on either individual motivation or class exposure alone. It is influenced by institutional contexts that shape the accessibility of experiential science learning, its support, institutionally provided resources, and links to career development. This is the novelty of the present study, which combines three special factors: school leadership, experiential science learning, and STEM career readiness into one mediation quantitative study model. The study goes beyond the immediate linkages between leadership and outcomes by exploring experiential science learning as a mediating function linking the two and understanding how leadership manifests in students' readiness for futures in STEM.

Therefore, this study is designed to explore how school leadership affects students' science learning contexts, including experiential learning and readiness for STEM career paths, in secondary schools. The study is theoretically relevant due to the confluence of the transformational leadership and experiential learning perspectives. empirically relevant by testing the direct and indirect relationships between the three constructs, and practically relevant for guidance of leadership practice, science learning improvement, STEM career orientation, and school-community partnerships.

2 Literature Review

The relationship between school leadership, science learning and students' STEM career readiness is related to both leadership-oriented educational improvement and experiential understanding of educational improvement. As one who provides instructional accountability, the school leader's role extends beyond instruction to prescribing contextual structures and practices that enable meaningful learning, such as conditions of learning, professional cultures, systems of resources, and connections to networks. In particular, it is relevant to the fields of science, technology, engineering, and mathematics (STEM)-based education, which require laboratory preparation, teacher competence and ability, inquiry-based learning, project-based learning, and institutional support for practical education. Research on leadership has shown that instructional and transformational leadership styles correlate with learning outcomes, particularly in improving teaching quality, teacher development, and organizational climate and stakeholder engagement (Özdemir et al., 2024).

This research first examines the construct of school leadership. Recent research highlights how effective school leaders can help improve STEM, including establishing a shared STEM vision, facilitating teacher STEM professional learning, allocating school resources, fostering innovative teaching efforts, and fostering partnerships beyond the school (Geiger et al., 2023; Murphy, 2023). In addition, findings from field research on science/mathematics leadership reveal that principals' instructional behaviors can impact science and mathematics instruction through their attitudes, classroom observations, and teacher growth (Arokiasamy et al., 2025; Tan, 2024). These findings indicate that leadership becomes an enabling condition for science learning, not a far-removed organizational factor.

Learning enhanced by direct engagement, experimentation, inquiry, reflection, and real-world application is known as experiential science learning, the second construct. The results of the inquiry-based education, laboratory-based education, cooperative learning, and problem-based learning studies show that experiential approaches in science learning can enhance science process skills, affect learning, conceptual understanding, and problem-solving skills in science learning (Chengere et al., 2025; Gillies, 2023; Meulenbroeks et al., 2024; Pozuelo-Muñoz et al., 2023). Conducting practical science work also positively affects secondary school students' learning outcomes, as evidenced by a meta-analysis showing that when activities are structured, purposeful, and aligned with conceptual understanding, they improve learning outcomes (Sanjito & Hyams-Ssekasi, 2025). The evidence is thus representative of experiential science learning, a way of teaching that has been acknowledged to enable students to acquire academic capability and confidence about STEM.

The third construct is career readiness in STEM. The construct comprises students' STEM self-efficacy, science self-confidence, awareness of STEM career options, career aspirations, problem-solving skills, and desire to study or work in a STEM field. Previous studies indicate that deepening STEM learning experiences, STEM professional identity, self-concept, parental expectations, and STEM experiences in school are significant factors shaping STEM aspirations and readiness (Chen et al., 2022; Chen et al., 2024; Tomperi et al., 2022). Additionally, research on STEM activities and career interests shows that meaningful experiences in STEM may reinforce students' understanding of future career options in science- and technology-related careers (Ribeirinha et al., 2025).

These literature streams together indicate a logical relationship among the study variables. The school leadership can enhance experiential science learning by providing resources, supporting teachers, encouraging the teaching of inquiry, and facilitating cooperation with universities, industry, and community actors. The hands-on teaching and learning model can be used to improve student STEM career preparedness to develop inquiry skills, confidence, collaboration, creativity, problem-solving, and real-world STEM applications. The literature is, however, still quite disjointed.

There have been numerous studies that focus on leadership and achievement, experiential learning and science outcomes, and STEM aspirations, as well as a few that combine these three elements in an explanatory framework, but none that address each of these aspects in combination. Specifically, the interpretations of the relationship between school leadership and STEM career readiness in the context of experiential science learning have not been sufficiently explored. The present research assumes that school leadership positively impacts experiential science learning, that experiential science learning positively impacts STEM career readiness, that school leadership directly impacts STEM career readiness, and that experiential science learning mediates the relationship between school leadership and STEM career readiness. The present study thus benefits from this literature review in explaining how a leadership-supported science learning environment is related to students' preparedness to pursue academic pathways in STEM fields.

2.1 Conceptual Framework

The conceptual model of the present study shows the role of school leadership in assisting career readiness in STEM by using experiential science learning. In the model, school leadership is the independent variable, experiential science learning is the mediational variable and career readiness in STEM is the dependent variable (See Figure 1). The framework will serve as a blueprint for supporting school leadership in experiential science learning by providing them with the resources and innovative pedagogy, support for science teachers, and a STEM learning environment. Through experiential science learning, students' STEM confidence, STEM problem-solving abilities, career awareness, and readiness for STEM academics and career pathways are improved. The framework also suggests that school leadership has a direct influence on the preparedness of students for STEM careers and explores the impact of experiential learning in science as the connection between school leadership and student preparedness.

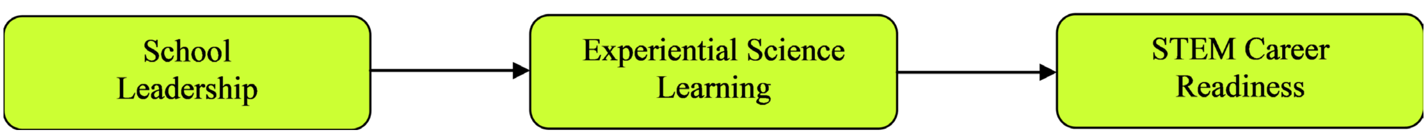

Figure 1 Conceptual Framework

3 Research Methodology

3.1 Research Design and Approach

The study used a quantitative, cross-sectional, explanatory survey design to investigate the relationships among school leadership, experiential science learning, and STEM career readiness in secondary schools. The study was quantitative because it examined testable relationships among clearly defined variables. The cross-sectional design allowed data to be collected within the same time period, and the explanatory design allowed testing of the direct and indirect relationships among the study variables. This research was conducted to test: the effect of school leadership on experiential science learning; the effect of experiential science learning on STEM career readiness; the direct effect of school leadership on STEM career readiness; and the mediating role of experiential

Global Strategy and Leadership Review
Volume 1, Issue 2
ISSN: 3071-4613

science learning between the effects of school leadership and STEM career readiness.

3.2 Population and Sample

The total population included 841 secondary school students from three schools, Central High School, New Visions Academy, and Village Academy of Maryland, in Capitol Heights, Maryland. A total of 200 students participated. In particular, 140 students from Central HS, 30 from New Visions Academy, and 30 from Village Academy of Maryland were selected. Since the study examined three constructs (perceived school leadership support, experiential science learning opportunities, and STEM career readiness), only the student population was chosen. This allowed the unit of analysis to be the same and allowed the mediation model to be examined at the student level.

3.3 Sampling Technique

The study employed a disproportionate stratified sampling technique. The selected schools were treated as separate strata, and participants were drawn from within each stratum by school size, accessibility and availability. This method worked well as there were major differences across the number of students in the selected schools. A strictly proportional sampling approach would have resulted in a much smaller number of responses from the two smaller schools (New Visions Academy and Village Academy of Maryland), so disproportionate stratification was used to ensure that the study includes enough responses from these two smaller schools, but still a larger number of responses from the highest enrollment school (Central High School).

3.4 Research Instrument

The data were collected using a structured, closed-ended questionnaire adapted from Chen et al. (2024), which investigated opportunities to participate in STEM learning activities in school, students' STEM self-concept, perceptions of STEM professions, and students' aspirations for a future STEM career. Items from the original questionnaire were adapted for the current research on school leadership, experiential science learning, and STEM career readiness. There were two sections of the instrument. The total number of items in the survey was 6 (in Section A) and 26 (in Sections B, C, and D) Likert-scale items. School leadership was assessed using 8 items, including support for science teachers, provision of resources for science teachers, innovative teaching practices, science-related activities, external partnerships, support for STEM career guidance, STEM vision, and leadership support. The items used to measure experience science learning involved activities in the science laboratory, hands-on activities, project-based learning, inquiry, real-life applications, collaborative investigation, science exhibitions or field experiences, and reflection, for a total of 8 items. STEM career readiness was assessed by 10 items that tapped into STEM confidence, career awareness, knowledge about STEM careers, interest in future STEM study, future STEM study plans, problem-solving skills, career decision preparedness, the link between science learning and future STEM careers, STEM information seeking motivation, and perceived future academic and career preparedness. Responses to all scale items were on a five-point scale ranging from strongly disagree to strongly agree.

3.5 Pilot Testing of the Research Instrument

The questionnaire was then pre-tested with 40 individuals to check the clarity of items, the appropriateness of the responses, the time taken to complete the questionnaire and internal consistency. A soft questionnaire was conducted using Google Forms. Before filling out the questionnaire, the researcher described the purpose of the study, the design of the questionnaire, and how to answer the questionnaire. No one found it difficult or confusing or had any major issues when filling out the questionnaire. The instrument was found to be easily completed by secondary school students, with a mean completion time ranging from 12 minutes to 14 minutes. The internal consistency of the 26 Likert items that measure school leadership, experiential science learning, and STEM career readiness all had acceptable alpha values of α: 0.817 and α: 0.802, respectively, for the pilot reliability (Table 1).

Table 1 Pilot Study Reliability Results

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of Items
α: 0.817	α: 0.802	26

3.6 Data Collection Procedure

Data were collected after obtaining permission from the selected schools. The questionnaire in Google Form was given to the selected participants. The purpose of the study and the voluntary nature of participation were presented to the participants, as well as the confidentiality of the responses. Every student was invited to fill out the questionnaire independently, and the questionnaires were verified before coding for analysis. Data that were missing in whole or in part were removed from the final data set to yield accurate and reliable statistical information.

3.7 Data Analysis Strategy

The collected data was analyzed using SPSS 27th version. Descriptive statistics (frequencies, percentages, means, and standard deviations) were used to summarize the demographic characteristics and responses. A reliability analysis was made by performing Cronbach's alpha of questionnaire items to analyse the internal consistency. To explore the relationship between school leadership, experiential science learning, and STEM career readiness, Pearson correlation was used. This study tested the direct and indirect effects as hypothesized in the conceptual model by using regression-based mediation analysis. This mediated effect of school leadership on STEM career readiness was discovered by analyzing the indirect effect of school leadership via this mediation.

3.8 Assessment of Common Method Bias

Common method bias is evaluated through self-report questionnaire-based studies, including self-report questionnaire-based studies like the present one, to see if measurement-source effects have biased the relations among the study variables. At first, Harman employed a single-factor test to diagnose. Further, the values of variance inflation factors were calculated to check for possible multicollinearity and methodological bias. These procedures enhanced the methodological rigor of this study by minimizing the likelihood that common method variance was the primary cause of the relationships among school leadership, experiential science learning, and STEM career readiness.

3.9 Ethical Considerations

The ethical issues for studying secondary school children were followed in this study. Participants were not obligated to participate in this study and were told they did not have to continue their involvement in the study without any penalty if they chose to withdraw. Participants' names and other identifying information were not collected, nor was it used, and no restrictions were necessary to maintain the confidentiality and anonymity of the participants. The aggregated data were only used for academic research. The study received permission from within the school. These procedures ensured that the rights, privacy and welfare of the participants were protected throughout the research process.

4 Results

The findings of quantitative analysis of the relationships among school leadership, experiential science learning, and STEM career readiness are presented in this section. The analysis involves data screening, demographic distribution, reliability and factorability analysis, descriptive statistics, correlation analysis, direct-effect testing, mediation analysis, common method bias analysis, and summarization of hypotheses.

4.1 Data Screening and Demographic Profile

The student responses collected were 200. There were no missing data on demographic, questionnaire, or computed scales scores in all 200 responses. Hence, all of the responses were saved for analysis. Table 2 shows the distribution of valid responses by the three selected schools. A total of 140 students (70.0%) were from Central High School. Each school contributed an equal number of students (30 from New Visions Academy and 15.0% from Village Academy of Maryland). There were 841 students in the school's total student population, and 200 were in the final sample.

Table 2 Sample Distribution by School

School	Enrollment	Valid responses	Percentage
Central High School	754	140	70.0
New Visions Academy	40	30	15.0
Village Academy of Maryland	47	30	15.0
Total	841	200	100.0

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Table 3 presents the demographic profile of the subjects. The table shows the ratio of males was 54.5% (109), whereas the ratio of females was 44% (88), and 1.5% preferred not to report their gender (3). The distribution of grades was relatively balanced, with 28% participants in Grade 9 (56), 27% in Grade 10 (54), 22.5% in Grade 11 (45), and 22.5% in Grade 12 (45). The age distribution was 14-19 years, with 55 respondents (27.5%) aged 15 and 55 (27.5%) aged 16.

Table 3 Demographic Profile of Respondents

Variable	Category	Frequency	Percentage
Gender	Male	109	54.5
	Female	88	44.0
	Prefer not to say	3	1.5
Grade	9	56	28.0
	10	54	27.0
	11	45	22.5
	12	45	22.5
Age	14	16	8.0
	15	55	27.5
	16	55	27.5
	17	50	25.0
	18	20	10.0
	19	4	2.0

4.2 Reliability and Preliminary Measurement Checks

Table 4 presents the internal consistency reliability of the study constructs. Based on the results of Cronbach's alpha analysis, the reliability of school leadership was good (Cronbach's alpha = 0.893), the reliability of learning in experiential science was good (α: 0.851), and STEM career readiness was excellent (α: 0.912). The general scale (26 items) yielded an α of 0.928, which is considered to have very good internal consistency of the instrument.

Table 4 Reliability Analysis of the Study Constructs

Construct	Number of items	Cronbach's alpha	Interpretation
School Leadership	8	0.893	Good
Experiential Science Learning	8	0.851	Good
STEM Career Readiness	10	0.912	Excellent
Overall scale	26	0.928	Excellent

Table 5 shows the preliminary factorability and validity checks. The KMO value was 0.930, which is excellent for factor analysis. Bartlett's test of sphericity was significant, $\chi^2(325) = 2463.251$, $p < .001$, which means that the item correlation matrix was appropriate for factor analysis. The three-factor solution explained 54.81 % of

Table 5 Factorability and Preliminary Validity Checks

Test / Indicator	Result	Interpretation
KMO measure of sampling adequacy	0.930	Excellent
Bartlett's test of sphericity	$\chi^2(325) = 2463.251$, $p < .001$	Significant
Variance explained by the three-factor solution	54.81%	Acceptable

the total variance, and the three factors were positively correlated with school leadership, experiential science learning, and STEM career readiness.

4.3 Descriptive Statistics

Table 6 presents the descriptive statistics for the three main variables. For school leadership, students' scores averaged 3.695 (SD = 0.575), suggesting that, overall, students felt positive about how well their school leaders supported science and STEM learning. The average score (SD = 0.509) for experiential science learning was 3.596, which means that students achieved a moderate-to-good score in experiential science learning. With a mean score of 3.684 (SD = 0.618) across the STEM career readiness construct, generally, scores for STEM confidence, STEM career awareness, and STEM career readiness were in the positive range.

Table 6 Descriptive Statistics of the Main Variables

Variable	N	Minimum	Maximum	Mean	SD	Skewness	Kurtosis
School Leadership	200	2.125	5.000	3.695	0.575	0.036	-0.501
Experiential Science Learning	200	2.125	5.000	3.596	0.509	-0.146	-0.053
STEM Career Readiness	200	2.100	5.000	3.684	0.618	-0.229	-0.500

4.4 Correlation Analysis

Table 7 presents the Pearson correlation coefficients among study variables. The correlation between school leadership and experiential science learning was positive and significant ($r = 0.505$, $p < .001$), and between school leadership and STEM career readiness was positive and significant ($r = 0.416$, $p < .001$). Experiential science learning was also positively and significantly correlated with STEM career readiness ($r = 0.542$, $p < .001$). The preliminary support for proposed relationships in the conceptual model is based on these results.

Table 7 Correlations among the Study Variables

Variable	1	2	3
1. School Leadership	1		
2. Experiential Science Learning	0.505***	1	
3. STEM Career Readiness	0.416***	0.542***	1
Mean	3.695	3.596	3.684
Standard deviation	0.575	0.509	0.618

4.5 Direct Effects and Hypothesis Testing

Table 8 presents the results of the direct-effect tests. The labels on the path include SL (school leadership), ESL (experiential science learning), and SCR (STEM career readiness). The school leadership model was supported, as its results have a significant influence on experiential science learning; the value of R2 is 25.5%, $t = 8.226$, $p < 0.001$. The same applied to experiential science learning, which had a significant positive effect on the students' readiness for STEM careers ($B = 0.657$, $\beta = 0.542$, $t = 9.067$, $p < .001$), accounting for 29.3% of the variance. School leadership also had a significant positive impact on students' STEM career readiness ($B = 0.446$, $\beta = 0.416$, $t = 6.429$, $p < .001$), accounting for 17.3% of the variance.

4.6 Mediation Analysis

Table 9 presents the mediation analysis for H4. The overall effect of school leadership on Students'

Table 8 Direct Effects and Hypotheses Testing

Hypothesis	Path	B	β	SE	t	p	R^2	Decision
H1	SL → ESL	0.447	0.505	0.054	8.226	< .001	0.255	Supported
H2	ESL → SCR	0.657	0.542	0.072	9.067	< .001	0.293	Supported
H3	SL → SCR	0.446	0.416	0.069	6.429	< .001	0.173	Supported

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readiness for STEM careers was 0.446. The results of the direct effect remained significant at 0.205. If experiential science learning was added as the mediator, the indirect effect through experiential science learning was 0.241. 95% bootstrap confidence interval: 0.161 - 0.336, p < .001, but not including zero. The findings show that experiential science learning partially mediates the relationship between school leadership and readiness for a STEM career.

Table 9 Mediation Analysis

Hypothesis	Indirect path	Total effect	Direct effect	Indirect effect	95% bootstrap CI	p	Decision
H4	SL → ESL → SCR	0.446	0.205	0.241	0.161 to 0.336	< .001	Partial mediation; supported

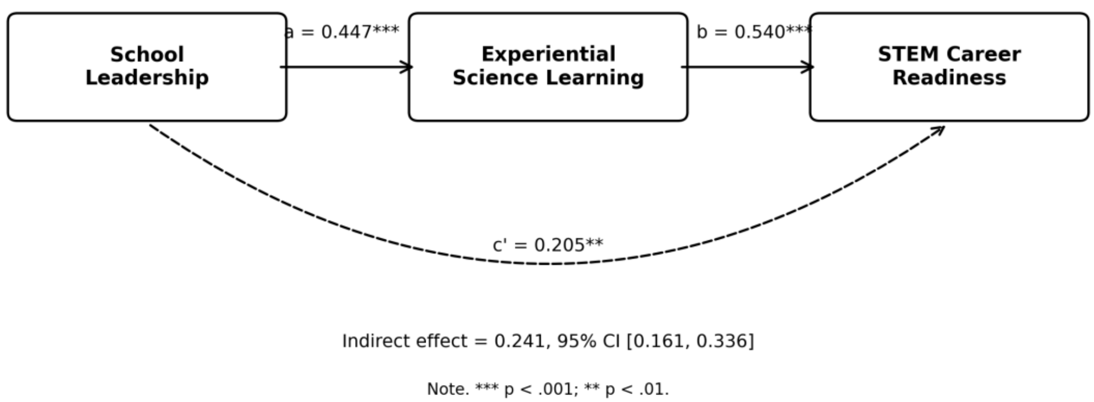

Figure 2 Empirical Mediation Model

Figure 2 shows the empirical mediation model based on the regression results. The path from school leadership to experiential science learning was significant (a = 0.447, p < .001), and the path from experiential science learning to STEM career readiness was also significant when controlling for school leadership (b = 0.540, p < .001). The direct effect of school leadership on STEM career readiness is still present when the mediator is accounted for (c' = 0.205, p < .01), which is evidence of partial mediation.

4.7 Common Method Bias and Multicollinearity Assessment

Table 10 presents the results of the common method bias and multicollinearity assessments. The variance for the first unrotated factor obtained by Harman's single-factor test was 35.88%, which was below 50%, indicating that common method bias was not significant. The school leadership variable, experiential science learning, also had a VIF of 1.342, with VIF values for all collinear variables ranging from 1.395 to 1.634. These values were much lower than the accepted ones, indicating no multicollinearity.

Table 10 Common Method Bias and Multicollinearity Results

Test / Indicator	Result	Interpretation
Harman's single-factor variance	35.88%	Below 50%; no serious common method bias
Predictor VIF: School Leadership	1.342	Acceptable
Predictor VIF: Experiential Science Learning	1.342	Acceptable
Full collinearity VIF: School Leadership	1.395	Acceptable
Full collinearity VIF: Experiential Science Learning	1.634	Acceptable
Full collinearity VIF: STEM Career Readiness	1.472	Acceptable

4.8 Summary of Hypotheses

Table 11 summarizes the decisions for all hypotheses. The findings confirmed H1, H2, H3 and H4. The overall findings indicate that school leadership is a significant contributor to school children's experiential science learning and STEM career readiness, and experiential science learning significantly accounts for a portion of the relationship between school leadership and STEM career readiness.

Table 11 Summary of Hypotheses Testing

Hypothesis	Statement	Decision
H1	School leadership has a significant positive effect on experiential science learning.	Supported
H2	Experiential science learning has a significant positive effect on STEM career readiness.	Supported
H3	School leadership has a significant positive effect on STEM career readiness.	Supported
H4	Experiential science learning mediates the relationship between school leadership and STEM career readiness.	Supported

*Note. B = unstandardized coefficient; β = standardized coefficient; SE = standard error; SD = standard deviation; CI = confidence interval; *** p < .001; ** p < .01.*

4.9 Discussion

The present study explored the role of school principals in experiential science learning and in STEM futures of secondary school students. The results offer empirical evidence for the proposed model, suggesting that school leadership is directly related to students' readiness to engage in STEM pathways, and that students' readiness can be strengthened indirectly through school leadership by increasing their experiential science learning opportunities. This is important because it means that leadership influence is present not only in support, but also in students' learning experiences.

The first significant result is that school leadership had a positive and significant effect on ESL. This finding indicates that when school leaders actively support science instruction, science learning tools are provided, challenging pedagogy is supported, science projects and activities are encouraged, and the application of scientific concepts is utilized in the real world, students are more likely to experience laboratory work, hands-on activities, investigation-based science, project-based tasks, and real-world science applications. The results are consistent with previous studies on leadership that link leadership to learning outcomes, as it shapes the learning environment, teacher practices, school climate, and school resources (Özdemir et al., 2024). From the results of the present study, it can be said that leadership serves not only as an administrative factor but also as an enabling factor in the experiential science learning process.

The second finding shows that the learning process in experiential science significantly influences students' preparedness for a STEM career. This implies that students who show greater levels of practical, inquiry-based, and applied science learning will be more likely to report higher levels of confidence, awareness of science career choices, interest in science, problem-solving skills, and a desire to undertake further study or pursue a career in a STEM-related field. This has been consistent with previous studies that reported increased connection with meaningful STEAM experiences, intentions to pursue a STEM career, and involvement in STEM (Chen et al., 2024). The discovery also bolsters the notion that preparing students for science careers also requires an active approach to learning science, not just through career information or general academic science teaching.

The third finding was that school leaders had significant direct effects on their students' readiness for STEM careers. This means that the actual experiences of leadership are only one piece of the puzzle related to how leadership can influence students' STEM readiness; other STEM readiness-related activities within the school, which might involve the STEM vision, career advising, STEM club opportunities, science fairs, STEM partnerships with external entities, and a culture fostering student engagement with STEM-oriented and future-focused pathways, are also important. This study builds on previous research that proved that students' perceptions of leadership support are correlated with their intention to pursue STEM pathways.

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The mediation analysis revealed that experiences in learning science, most importantly, partially mediated the link between school leadership and STEM career readiness. This can be seen in a school leader who provides students with more opportunities to engage in experiential science, the foundation of STEM career readiness, and helps students become more prepared for STEM careers. The partial mediation result is theoretically significant since it demonstrates that there is more than one path to influencing STEM readiness among STEM leaders. Instead, leadership has both direct and indirect influence through learning experiences. This study contributes to the body of evidence by combining three strands of leadership for learning, experiential science learning, and STEM career readiness into a single explanatory model.

The results have implications for schools, science educators, and science policy makers. Leadership practices that enhance students' readiness in STEM go beyond routine administration and directly support the infrastructure for experiential learning, teacher development, lab practice, project-based learning, STEM competitions, and collaboration with universities and STEM professionals. However, the present study suffers from a cross-sectional design, reliance on self-reported data, and a local context. Future studies can expand this model by incorporating a longitudinal design, larger sample sizes, multiple school comparisons, and additional factors such as STEM self-efficacy, teacher motivation, parental involvement, and digital science learning. Overall, the results underscore the importance of school leadership in shaping students' STEM futures by providing opportunities for rich experiential science learning.

5 Conclusion

The present study investigated the influence of school leadership on the promotion of experiential science learning and secondary students' readiness for STEM careers. The results showed that school Leadership had a significant effect on experiential science learning and STEM career readiness, and that experiential science learning strongly predicted students' readiness for STEM-related academic and career pathways. The mediation test also revealed that experiential science learning partially mediated the relationship between school leadership and STEM career readiness. The study findings directly addressed the study aims by demonstrating the effects of school leadership and experiential science learning, and the mediating role of experiential science learning between school leadership and these effects. In theory, the study makes an impact in the fields of educational leadership, STEM education, and leadership support and STEM career readiness because the three components are explained simultaneously. The results have practical implications for leadership practices that support laboratory, inquiry-based, project-based, STEM-oriented, and school-community-based classroom activities. The novelty of this study lies in its explanation of leadership-supported experiential science learning, which fosters student readiness in the STEM field. The present study was limited by its cross-sectional design and reliance on self-reported data. It is confined to a select group of schools within a specific local context. Longitudinal designs, larger sample sizes, and other factors that contribute to students' readiness for STEM could be examined in future studies. In general, it shows that to foster conditions for experiential learning and prepare students for STEM futures, we must have effective school leadership.

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