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The Mediating Effect of Attitudes Toward Science in the Perceptions of Science Classroom Environment, Family Involvement, and Science Self-Efficacy with Science Achievement

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ABSTRACT

Previous research has indicated that attitudes influence various factors contributing to scientific achievement. Inadequate performance in science can limit career opportunities, underscoring the importance of comprehending how attitudes towards science can enhance overall scientific achievement. This study explored the mediating effect of attitudes towards science for the relationships between perceptions of science classroom environment, family involvement, and science self-efficacy with science achievement. This research was conducted as a non-experimental quantitative research. Questionnaires from modified established instruments, Test of science-Related Attitudes, What Is Happening In this Class, Family Involvement Questionnaire- High School Version, Sources of science Self-Efficacy, and science Achievement Test, were sent out to participants via Google Form in different days for a span of two weeks. A total of 148 Form 2 upper-secondary school students from various districts in Sabah participated in this study. Data were analyzed using the Partial Least Squares Structural Equation Modeling method. The results revealed that Social Implications of science had a significant positive mediating effect between perceptions of science classroom environment and science achievement. Additionally, there was no significant mediating effect of attitudes toward science on the relationship between science self-efficacy, and family involvement with science achievement. Overall, this study suggests that an aspect of attitudes toward science, the Social Implications of science, was an important mediator between students' perceptions of science classroom environment and science achievement. This meant that students would perform better in science when they perceived their science classroom better, in the condition that they value the implications that science brings to real life.

Keywords: attitudes toward science, family involvement, science achievement, science classroom environment, self-efficacy

INTRODUCTION

The ability of students to achieve science has been influenced by various factors over the years. These factors include perceptions of the classroom environment, attitudes towards science [1], family involvement [2], and students' self-efficacy [3]. Despite numerous studies which had explored these factors, there are still inconsistencies in our understanding of their relationships and mechanisms of influence. In recent years, there has been a discernible discrepancy in Malaysian students' performance in the domains of science and Mathematics. The 2022 Programme for International Student Assessment (PISA) results revealed that Malaysian students exhibited a performance below the average scores of Organizations for Economic Co-operation and Development (OECD, 2023). This observed deficiency in problem-solving abilities has raised significant concerns among governmental entities, employers, and industrial stakeholders in Malaysia.

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Of particular concern is the state of Sabah, which has consistently ranked among the most economically challenged regions in Malaysia. The youth of Sabah necessitate the acquisition of requisite skills to access higher-paying employment opportunities, where academic achievement is crucial for understanding current economic trends. Recent analyses indicate that Malaysian students possess limited scientific knowledge they could apply to real life situation [4]. Thus, Malaysian Ministry of Education had slowly overhauled its syllabus, to lean more towards problem-solving. While criticisms have been directed at the perceived difficulty of the new syllabus under the KSSM framework, analysis of science SPM results from 2018 to 2021 reveals little difference in average grades [4]. This was despite the fact that in 2019, Sijil Pelajaran Malaysia (SPM) examination was the last batch under the KBSM format. Therefore, while this study considers the new syllabus to be an essential factor, it may not be sufficient in understanding the various reasons that affect students' science achievement.

Several studies had observed the association between attitudes and science achievement [5]; [6]; [7]; [8]. Educators would be able to evaluate potential interventions to increase enrolment in advanced science classes and encourage students to pursue subjects geared towards science careers [1]. Research suggested that student attitudinal factors, such as liking and valuing science, have a moderate influence on achievement in science, indicating that students with positive attitudes towards science have significantly higher achievement [9]. Despite Malaysia's goal to have 60% of students enrolled in science courses, this objective has not been achieved since 1967. According to Datuk Seri Madius Tangau, the then Minister of science, Technology and Innovation, lack of interest in science contributes greatly to students' lack of desire to pursue science courses, as indicated in the 2015 science Report [10]. Poor achievement in science may lead to fewer opportunities for pursuing science courses and careers, and this lack of interest reflects students' attitudes toward science. Additionally, previous studies have illustrated the influence of attitudes on various factors contributing to scientific achievement.

The growth and development of students in educational settings are directly related to their achievement. This study aimed to determine science achievement by evaluating students' overall scores on a science test. Several factors that directly affect science achievement was identified, which included the perceptions of science classroom, self-efficacy, and family involvement in their learning. However, an indirect factor may be influencing these three variables, such as attitudes towards science. Attitudes towards science had been proven to significantly impact on students' science achievement [5]; [11]; [8].

Attitudes toward science refer to the evaluation of science learning domains [12]. Osborne et al., [13] listed a wide-ranging measure of attitudes towards science based on previous studies, which included the perception of science teachers, student' feeling of anxiety concerning science, the value of science, self-esteem, motivation, enjoyment, peers' and parents' attitudes towards science, the classroom environment, science achievement, and failure apprehension [13]. In essence, attitudes towards science denote students' perceived behavior towards science. When students perceive that positive behavior towards science is acknowledged and rewarded, there is a higher likelihood of sustained positive engagement [14]. Consequently, this impact extends to their motivation to acquire scientific knowledge, thus influence their performance in science examinations. Evaluating students' attitudes toward science can be achieved by appraising their perception of the

subject's significance in daily life, manifestation of scientific attitudes, and overall enjoyment of the subject. These factors are connected to students' experiences in science, including their classroom environment, confidence in the subject, and upbringing. By comprehending these elements, educators can create interventions to improve students' attitudes toward science and promote their interest and motivation to learn the subject.

The environment in a science classroom is an important factor that can influence attitudes towards science. This psychosocial environment is formed by different social contexts and teachers' style of instructions and behaviors [15]. Attitudes and behavior are closely connected. Students who exhibit positive behavior and have positive expectations generally view their classroom environment positively. Previous studies have demonstrated that students' perform better academically with positive perceptions of their classroom environment [16]; [17]; [18]; [19] and improve their attitudes towards science [20]; [21]; [22]; [23]; [24]; [25]; [26]; [27]; [19]. Attitudes towards science can shape students' perceptions regarding their science classroom environment, which can be assessed through their perceptions of their teachers, classroom tasks, cooperation, and treatment in class. Therefore, the first hypothesis is that positive attitudes towards science can lead to better perceptions of the science classroom environment. By understanding how science classroom environment affects attitudes towards science, educators can design interventions that foster positive attitudes and perceptions, which can potentially enhance students' academic success and engagement in science.

Family involvement can play a role in students' science achievement, as attitudes towards science can be influenced by the attitudes of their parents. According to [28], parents act as decision-makers, paid paraprofessionals, bystanders, classroom volunteers, teachers at home, and even learners. Previous research has shown that parental support positively affects students' academic achievement and attitudes towards science [29]; [2]; [30]; [31]; [32]; [33]; [34]; [35]. Some forms of parental involvement would be home supervision, school participation, home discussion, and school communication {36]. The attitudes of students towards science are influenced by their own expected outcomes of their actions. When students anticipate positive reactions from their parents regarding their science achievements, they are likely to be more motivated to excel, resulting in a more favorable attitude toward science. This proposition constitutes the foundation for the second hypothesis in this study.

Positive attitudes and motivation in learning are important signs of academic success, which can be seen through favorable attitudes. In science education, students' confidence in their abilities is referred to as science self-efficacy. Science self-efficacy refer to students' beliefs about their aptitudes to succeed at different levels in science subjects, which influences their experiences during science lessons [37]. So, students with positive attitudes tend to feel confident in their capability to excel in science, and this, in turn, can affect their science performance. Previous research has shown that high science self-efficacy affect science achievement positively [38]; [39]; [40]; [41]. Science self-efficacy can be measured by examining students' experiences, the performance of others, the impact of that performance on the student, students' emotions, and perceived encouragement from others. The third hypothesis for this study was formed by examining the effect of science self-efficacy to attitudes towards science.

Research Aim and Research Questions

The research aim was to determine the mediating effect of attitudes towards science for the relationships of perceptions of science classroom environment, family involvement, and science self-efficacy with sience achievement.

This study addressed the following research questions;

i. Does attitudes towards science mediate the relationship between perceptions of science classroom environment and science achievement among Form 2 students?
ii. Does attitudes towards science mediate the relationship between family involvement and science achievement among Form 2 students?
iii. Does attitudes towards science mediate the relationship between self-efficacy and science achievement among Form 2 students?

Figure 1 showed all the independent and dependent variables, as well as attitudes towards science as the mediator. The aspects of each variable would be measured to represent the perceptions of the science classroom environment, family involvement and science self-efficacy.

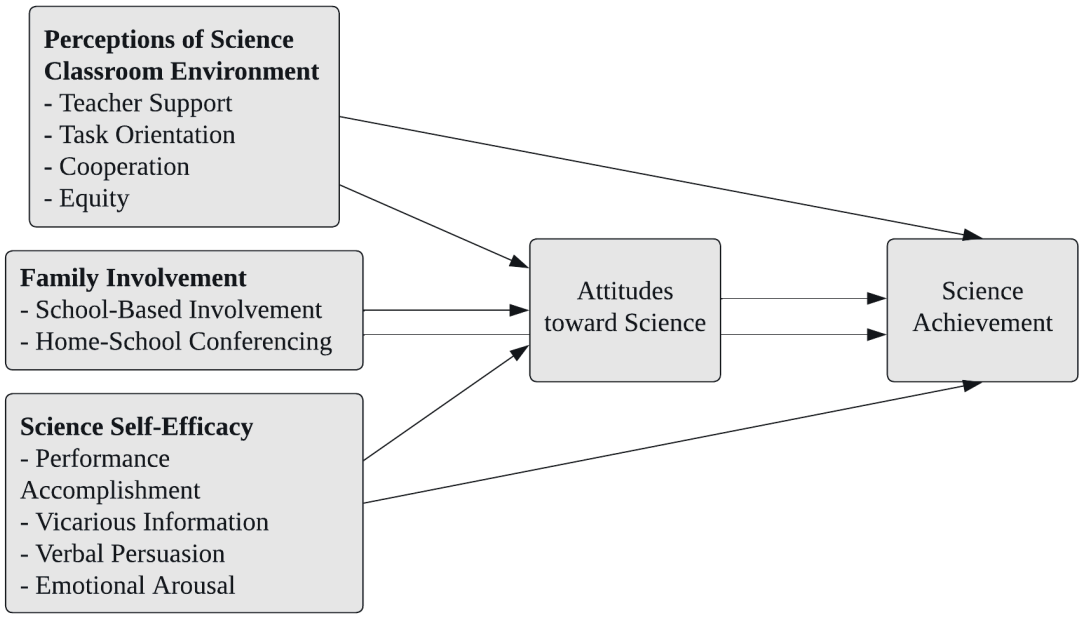


Figure 1. Conceptual Framework

The research aim was to explore on the mediating effects of attitudes towards science in the relationship between the perceptions of the science classroom environment, family involvement, and student self-efficacy with science achievement. For this purpose, this study aimed to prove several hypotheses;

i. Attitudes toward science mediates the relationship between perceptions of the science classroom environment and science achievement among Form 2 students.
ii. Attitudes toward science mediates the relationship between family involvement and science achievement Form 2 students.
iii. Attitudes toward science mediates the relationship between students' science self-efficacy and science achievement Form 2 students.

MATERIAL AND METHODS

Methods

The research methodology employed in this study was quantitative non-experimental research, which entails a systematic empirical inquiry in which the researcher lacks the ability to manipulate or control the independent variables due to their prior occurrence [42]. For this study, a survey research design was employed, and questionnaires were used to collect the necessary data. Survey research was employed to survey the thoughts, feelings, and behaviors of specific groups of individuals [42]. Researchers can examine the attitudes, beliefs, perceptions, and behaviors of targeted samples through the use of questionnaires. Questionnaires offer advantages, including the ability to provide a comprehensive view from a larger population with a smaller sampling-range error, the option of being mailed, cost-effectiveness, wider reach, and the capacity to cover extensive geographic areas [43].

Form 2 Sabahan students were taken as population in this study. The population chosen were assumed to belong in an environment with the same rules, regardless of their schools, and that individuals around them affected them differently. This adhered to the second assumption of the positivist approach. The students answered the questionnaires based on their experiences within the science classroom, their self-efficacy, and their family involvement. This adhered to the third assumption, where the researcher relied fully on the students to make their own decisions and interpret their own experiences. The researcher acted as a neutral observer, in accordance with the positivist research theory. Google Forms links were employed to collect data over a period of three weeks. This was set up to avoid fatigue when answering questionnaires. Teachers were also appointed to help with data collection for science Achievement Test, in order to simulate a written examination test where students were not allowed to refer to textbooks when answering science questions.

This study was guided by two main theories: Bandura's Social Cognitive Theory and the Theory of Educational Productivity. In the Social Cognitive Theory, it was believed that humans had developed a strong ability to learn through direct experiences by observing people's actions and their outcomes [44]. On the other hand, the Theory of Educational Productivity was an empirical test that examined how different factors contribute to effectiveness of production. In this study, production referred to achievement in science. Additionally, the study considered the effect that perceptions of science classroom environment, family involvement, and science self-efficacy had on students' social cognitive development, which then would influence their science achievement.

Instrument

The questionnaires involved in this study were the What is Happening In this Class? (WIHIC) to measure students' perceptions of the science classroom environment, the Sources of science Self-Efficacy (SSES) to measure students' self-efficacy in science subject, the Family Involvement Questionnaire-High School Version (FIQ-HS) to measure family involvement or parental support, and the Test of science-Related Attitudes (TOSRA) to measure attitudes toward science. science achievement was measured using science Achievement Test instrument, which was built based on the Malaysian science syllabus for Form 2. These questionnaires were adapted and modified to fit the Malaysian

educational context.

WIHIC contained the following aspects; Teacher Support, Cooperation, Equity, and Task Orientation [45]. FIQ-HS involved the aspects School-Based Involvement, and Home-School Conferencing [46]. SSES was modified from the instrument called Sources of Mathematics Self-Efficacy [47]. This questionnaire explored four aspects which were Performance Accomplishments, Vicarious Information, Verbal Persuasion, and Emotional Arousal. Lastly, TOSRA were represented with three aspects, which were the Social Implications of science, Adoption of Scientific Attitudes, and Enjoyment of science Lessons, which view upon students' enjoyment of science learning lessons [48].

Procedures

Permission was obtained from relevant authorities and schools before the study was conducted. In order to conduct any research involving students, permission must be granted by the Malaysian Ministry of Education. Afterwards, further permission must be applied from Sabah's Department of Education. Principals of chosen schools then were contacted before proceeding with any data collection. Teachers who were selected by the principals to assist in data collection were briefed by the researchers. The teachers then explained to students that the instruments were not for grading purposes, and stressed to students of their anonymity.

The questionnaires were sent out to teachers via Google Form who later carried out data collection with their students. After three weeks, the data was downloaded from Google form in the Excel form, and streamlined before analysis was conducted. Participants who did not complete either the questionnaires or science achievement test were removed from the final analyzed data set. Before PLS-SEM was applied, the reliability and validity were established. This was done through the SmartPLS 4. The reliability of the instruments was determined through composite reliability, where all constructs yielded reliability value of 0.70 or more.

Table 1. Reliability and Validity

Variables	N	Cronbach's Alpha	Composite Reliability (rho_c)	AVE
Test of science-Related Attitudes	12	.911	.924	.178
What Is Happening In this Class?	28	.883	.919	.679
Family Involvement Questionnaire – High School	22	.836	.903	.757
Sources of science Self-Efficacy	9	.658	.768	.175

Afterwards, the convergent validity were tested by examining the Average Variance Extracted (AVE). From the analysis, SSES recorded the lowest reliability, but was still within acceptable range for both Cronbach's Alpha and composite reliability. The rest of the questionnaires scored more than .90, which was still very acceptable. For convergent validity, it was established through outer loadings, indicator reliability and AVE. Hair et al. [49] had ruled that outer loadings should be more than 0.70, indicator reliability more than 0.50, and AVE more than 0.50 to be acceptable. Note here in Table 1 that Test of science-Related Attitudes and Sources of science Self-Efficacy yielded values less than 0.50. However, the instruments' validity was established through the composite reliability of

more than 0.70 [50]. Then, discriminant validity was determined through cross-loadings analysis, Fornell-Larcker Criterion, and HTMT Ratio.

Table 2. Tolerance and VIF Values

Set	Constructs	Tolerance	VIT
1	WIHIC	0.690	1.450
	FIQ-HS	0.649	1.540
	SSES	0.855	1.170
2	SIS	0.338	2.955
	ASA	1.339	1.747
	ESL	0.401	2.491
3	WIHIC	2.611	2.383
	FIQ-HS	0.649	1.541
	SSES	0.816	1.225
	SIS	0.338	2.955
	ASA	1.339	1.747
	ESL	0.401	2.491

Table 2 showed the VIF result from SmartPLS 4. It showed that none of the constructs yield tolerance values of less than 0.2 and VIF values of less than 5. This meant that the constructs had no collinearity problems.

Data Analysis

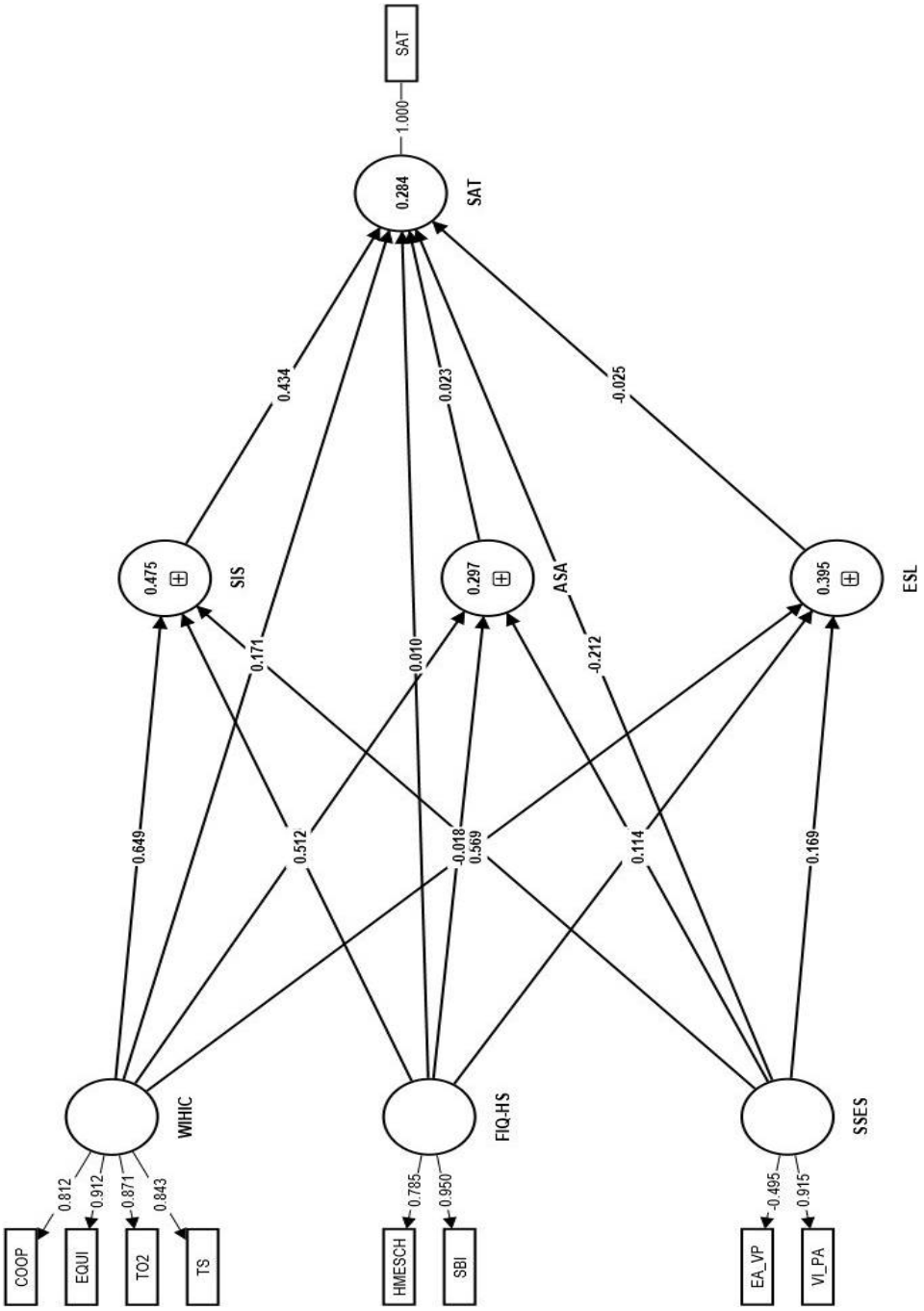
The technical data analysis uses the Rasch model and is assisted by Winsteps 3.73 software developed. Parameters used to determine the accuracy or suitability of respondents and items, include means-square outfit value, z-standard outfit, and measurre correlation points. The level of difficulty of the item (item measure) can be known from the logit value of each item. Reliability testing uses cronbach alpha formula in Table 1

RESULTS AND DISCUSSION

Developing and Validating

After ensuring the reliability and validity were established, analysis of structural model was conducted. For the first step, collinearity assessment was conducted to examine each set of predictor constructs distinctly for each subpart of the structural model. According to Hair et al [49], a predictor construct would have critical levels of collinearity if it has tolerance values below 0.20 and Variance Inflation Factor above 5.0. Specifically, WIHIC, FIQ-HS, SSES, SIS, ASA, and ESL as predictors of SAT.

The measurement model captured the relationships between latent variables and their corresponding measures, with the indicators representing a sample of all possible items within the construct's conceptual domain [49]. The path coefficients between WIHIC, FIQHS, SSES, and the three dimensions of attitudes toward science (SIS, ASA, and ESL) with science achievement are illustrated in Figure 2.



Note:
COOP=Cooperation, EQUI=Equity, TO=Task Orientation, TS=Teacher Support, HMESCH=Home-School Conferencing, SBI=School-Based Involvement, EA_VP= Emotional Arousal and Verbal Persuasion, VI_PA= Vicarious Information and Performance Accomplishments, WIHIC=Perceptions of science Classroom Environment, FIQ-HS=Family Involvement, SSES=Sources of science Self-Efficacy, SIS=Social Implication of science, ASA=Adoption of Scientific Attitudes, ESL=Enjoyment of science Lessons, SAT=science Achievement

Figure 2. Path Coefficients Result

For this study, coefficients of determination (R2) and effect sizes were reported. For R^2, Cohen (1988) suggested that if it falls within the range of 0.02 – 0.12, it would have a small effect, medium effect in the range of 0.13 – 0.25, and large effect in the range of 0.26 and above. From Figure 2, the R^2 value for SAT is .284, which means 28.4% variance is explained by WIHIC, FIQ and SSES, and attitudes towards science's SIS, ESL and ASA, which is large according to Cohen (1988). WIHIC (β = .171), FIQ-HS (β = .010), and SSES (β = -0.212) all had positive effect on SAT but none of them were significant. It was also found that SIS (β = .434), ASA (β = .023) affect SAT positively, while ESL (β = -0.025) affect SAT negatively, however, only SIS yielded significant result. WIHIC, FIQ and SSES explained SIS by 48.8%, ASA by 56.7%, and ESL by 54.7%.

Table 3. Relationships in the Structural Model's Direct Effects

Correlation	β	σ_M	t-value	f^2	Significance
WIHIC -> SAT	0.171	0.099	1.723	.017	No
FIQ-HS -> SAT	0.010	0.095	0.101	.000	No
SSES -> SAT	-0.212	0.120	1.771	.051	No
SIS -> SAT	0.434	0.110	3.937	.066	Yes
ASA -> SAT	0.023	0.099	0.230	.000	No
ESL -> SAT	-0.025	0.105	0.237	.000	No

Table 3 also presented the effect sizes for all combinations of endogenous and exogenous constructs. [51] categorized effect sizes of more than .02 as small, more than .15 as medium, and more than .35 as large. In Table 3, almost all of the f^2 values were small, and none of the exogenous variables had any effect on SAT with effect sizes ranging from .000 in .066.

Table 4. Mediating Effects of Attitudes towards science on the Relationship between Perceptions of science Classroom Environment and science Achievement

Correlation	β	SD	*t*-value	CI	Findings
WIHIC -> SIS -> SAT	0.282	0.077	3.671	LL: 0.132 UL: 0.434	Supported
WIHIC -> ASA -> SAT	0.012	0.052	0.226	LL: -0.090 UL: 0.114	Not supported
WIHIC -> ESL -> SAT	-0.014	0.060	0.235	LL: -0.128 UL: 0.108	Not supported

Going into mediating effect, the standard beta, standard deviation, t-value, confidence intervals and findings were discussed. In Table 4, the indirect effect for WIHIC to SAT through SIS yielded β = 0.282 which was significant with t-value = 3.671. The confidence interval (LL = 0.132, UL = 0.434) did not include the value 0. Thus, Social Implications of science significantly mediated the perceptions of science classroom environment and science achievement among Form 2 students. Meanwhile, the indirect effect for WIHIC to SAT through ASA (β = 0.012, t-value = 0.226, with the confidence interval: LL = -0.090, UL = 0.114), and ESL (β = -0.014, t-value = 0.060, confidence interval: LL = -0.128, UL = 0.108) involved the value of zero, thus there was no mediating effect.

Table 5. Mediating Effects of Attitudes towards science on the Relationship between Family Involvement and science Achievement

Correlation	β	SD	*t*-value	CI	Findings
FIQ-HS -> SIS -> SAT	-0.008	0.034	0.228	LL: -0.078 UL: 0.065	Not supported
FIQ-HS -> ASA -> SAT	0.000	0.010	0.041	LL: -0.019 UL: 0.025	Not supported
FIQ-HS -> ESL -> SAT	0.000	0.007	0.059	LL: -0.014 UL: 0.017	Not supported

The bootstrapping analysis in Table 5 showed that the indirect effect for family involvement to science achievement through SIS (β = -0.008, t-value = 0.228, confidence interval: LL = -0.078, UL = 0.065), ASA (β = 0.000, t-value = 0.041, confidence interval: LL = -0.019, UL = 0.025), and ESL (β = 0.000, t-value = 0.059, confidence interval: LL = -0.014, UL = 0.017). The confidence intervals for SIS, ASA and ESL included the value of zero, thus there was no mediating effect for all aspects of attitudes towards science.

Table 6. Analysis of Attitudes towards science as Mediator Between science Self-Efficacy and science Achievement

Relationship	β	SD	*t*-value	CI	Findings
SSES -> SIS -> SAT	0.058	0.039	1.508	LL: -0.049 UL: 0.126	Not supported
SSES -> ASA -> SAT	0.003	0.015	0.176	LL: -0.033 UL: 0.030	Not supported
SSES -> ESL -> SAT	-0.004	0.020	0.215	LL: -0.043 UL: 0.038	Not supported

In Table 6, the bootstrapping analysis reported the indirect effect for SSES to SAT through SIS (β = 0.058, t-value = 1.508, confidence interval: LL = -0.049, UL = 0.126), ASA (β = 0.003, t-value = 0.176, confidence interval: LL = -0.033, UL = 0.030), and ESL (β = -0.004, t-value = 0.215, confidence interval: LL = -0.043, UL = 0.038). The confidence intervals for SIS, ASA and ESL involved the value of zero, thus there was no mediating effect for all relationships.

DISCUSSION

Science educators gauge students' comprehension of science topics through evaluating science achievement. Over the years, numerous factors have been explored concerning academic achievement in an attempt to enhance students' performance. It is essential to acknowledge this context when interpreting the results of this study, which primarily concentrated on science achievement. Among the extensively studied factors influencing science achievement, attitudes towards science stand out. Many research found that positive attitudes towards science were usually followed with good academic performance [13]; [11]. Nonetheless, more research on the indirect effect of attitudes towards science to science achievement should be done as attitudes could be influenced from other factors important in influencing science achievement.

The result from the data shown one of the components of attitudes towards science

could mediate the connection linking between perceptions of science learning environment and science achievement. The aspect of attitudes towards science which was Social Implication of Science moderated the perceptions of science classroom environment to science achievement. Meanwhile, the Adoption of Scientific Attitudes and Enjoyment of Science Lessons did not mediate the relationship between perceptions of science classroom environment and science achievement. This finding is consistent with Mokshein, who found that Social Implications of Science contributed significantly on science achievement. Students seems to learn better in a science classroom where they understand the benefits science offered to society. This understanding can be fostered during the process of learning and communications among students and teachers. This was supported in a study done by [52], who found that a classroom that utilized constructivist learning style could increase students' science achievement. This study's finding was also in line with Tosto et al. [53], who found that intrapersonal factors like interest, mediated the connection between perceived classroom environment and maths performance. Interest could be seen as attitudes towards science, as attitude was closely related to the forming of behaviour.

Based on the findings, there was no significant mediating effect of attitudes towards science between family involvement and science achievement. Social Implications of Science yielded a weak negative mediating effect on the relationship between family involvement and science achievement. However, the effect of Social Implications of Science as mediator was not a significant one. The findings of this study contradicted several studies which found that students' developed better attitudes towards science if their family were involved in their academic lives [29]; [31]; [54]. In fact, parents with low involvement did not encourage their children to go for private lessons or study regularly. This would translate to students facing difficulties to have meaningful academic progress [54]. However, this finding suggested that good attitudes towards science may be unnecessary for family involvement to influence science achievement, or that family involvement might not be an important factor to ensure students' success in science. This meant that students could have positive attitudes towards science and do well in the subject, despite low involvement from their family. However, further study would be needed.

The findings showed all aspects of attitudes towards science did not mediate the association between science self-efficacy and science achievement. However, some context from previous studies could still be referred to understand the result of this research. Roebianto found that although attitudes toward science positively affect science achievement, self-efficacy could still have a negative effect. This could explain the negative relationship between science self-efficacy and science achievement mediated by Enjoyment of Science Lessons. Students might really enjoy science lessons, but this enthusiasm could make them think they are more skilled and knowledgeable in science than they actually are. Roebianto also discussed that an enjoyable science lessons did not affect students' performance in science academic. Therefore, it was more important to focus on students' mastery of the subject rather than just their enjoyment of the lessons in class. This is also supported by a study done by Zhang et al. [55], where it was found that when students focus on subject mastery instead of performance, their academic engagement were affected positively.

Another possible explanation for this finding was the nature of science examinations in Malaysia, specifically, the KSSM format of science standardized exam papers. The

science exam format underwent improvements to ensure fairness for students with varying abilities. Departing from the conventional reliance on multiple-choice and close-ended questions, the revised format included fewer multiple-choice questions. Instead, it incorporated a mix of close-ended and open-ended questions with a contextual focus and simpler close-ended questions. The new approach reduced the emphasis on memorization and prioritized higher-order thinking, requiring students to explain natural phenomena using acquired science facts. Questions were designed to tap into students' real-life situations, contributing to their improved overall performance in science. Evaluation that took from students' experience could help in improving their science academic performance. This was supported by a study done by Nurul et al. [56], where it was found that implementing contextual teaching and learning model can increase students' learning achievement in Science learning.

Furthermore, there is an increased emphasis on formative assessments rather than relying solely on written evaluations in final examinations to ensure strong academic performance. Teachers face ongoing pressure to facilitate the success of all students, and they are expected to create interventions to help struggling students. Moreover, the varying levels of effort exerted by students could influence their achievements. This, coupled with extra classes and support from science teachers, could be the cause of diminished impact from attitudes towards science. Schneider et al. [57] had discussed that positive science achievement results could be expected from a principled design system that involved engaging curriculum with high-quality professional learning and formative assessments designed to stimulate knowledge. Consequently, students' attitudes towards science may have had a diminished impact on their science performance, given the extensive provision of extra classes and support aimed at excelling in examinations.

CONCLUSION

The findings suggest that certain aspects of attitudes towards science play a mediating role between perceptions of science classroom environment, family involvement, and science self-efficacy with science achievement among Malaysian students. This phenomenon may be linked to the predominant use of written examinations in the Malaysian evaluation format and the substantial support offered by teachers to enhance the performance of students across all proficiency levels. Additionally, the KSSM format examinations offer chances for less proficient students to succeed by incorporating questions related to subjects in which they may excel. However, our findings do not conclusively establish whether these factors have enhanced science teaching accessibility or if science examinations effectively assess the diverse abilities of students. Therefore, further in-depth research is warranted to investigate these matters comprehensively.

The results of this study suggest that science achievement can be improved despite students' attitudes towards science. It is important for teachers to provide students with effective learning opportunities and not rely solely on their attitudes to help them excel in science. It is inadequate to rely solely on standardized examinations for assessing academic achievement, revealing a potential weakness in educators' evaluation of students' science performance. This underscores the importance for Malaysian educators to investigate effective pedagogical approaches to enhance meaningful science learning. While students' attitudes toward science remain crucial, teachers can contribute to their success by

implementing improved evaluation methods, engaging class activities, and effective teaching techniques. Ultimately, the manner in which students acquire and apply knowledge serves as a more reliable indicator of academic achievement than their attitudes toward the subject.

Several recommendations for future research can be made based on the findings of this study. Firstly, the first one was to conduct a longitudinal study to see how attitudes towards science as mediator and even its effect on science achievement could change over the years. Secondly, quantitative research could be complemented with qualitative investigations to explore the experiences and perceptions of students in-depth. Thirdly, future research could focus on differential impact on diverse students' groups, where attitudes towards science may vary among different student groups, in terms of gender, socio-economic background, and cultural diversity. Lastly, further research can be conducted to compare the KSSM exam format to the previous KBSM format to determine whether there are significant differences in student achievement and what this might mean for their future success. By addressing these areas of research, we can gain a more comprehensive understanding of the factors that contribute to students' science achievement in Malaysia, and develop more effective strategies to improve science education in the country

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