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Correlation Between Psychological and Contextual Characteristics Affecting Chemistry Achievement in Senior Secondary Science Education in Sri Lanka

[1]B. Siri Sumedha Thero*, ; [2]K.S.H.M.V.W.W. Senevirathne
[1] Piriven Education Branch, Ministry of Education, Isurupaya, Baththaramulla, Sri Lanka.
[2] Department of Education, Faculty of Arts, University of Peradeniya, Peradeniya, Sri Lanka.
Corresponding Author*

Abstract:- This quantitative study explores the correlation between psychological and contextual characteristics and student achievement in chemistry within senior secondary schools in Sri Lanka. The research addresses the persistent low performance in chemistry, a critical subject within the science curriculum, by examining various influencing factors. The study utilized a cluster random sampling method, selecting 302 students and 114 teachers from the Kegalle Education Zone. A pilot test was conducted to refine the instruments, followed by confirmatory factor analysis and exploratory data analysis to ensure reliability and validity. The psychological factors investigated include teachers' teaching styles, students' perceptions of chemistry, subject satisfaction, and attitudes toward chemistry. Contextual factors encompass school type and gender. Data collection involved standardized instruments and a structured chemistry examination, with analysis performed using SPSS and Amos software. The findings reveal significant positive correlations between students' perceptions, satisfaction, attitudes towards chemistry, and their academic achievement. Additionally, the study highlights differences in achievement based on school type and gender, emphasizing the importance of tailored educational strategies. The results underscore the necessity for targeted interventions and policy reforms to enhance chemistry education in Sri Lanka. These insights aim to inform educators and policymakers, fostering improved educational outcomes in the region.

Keywords:- *Student Achievement, Chemistry Education, Psychological Factors, Contextual Characteristics, Sri Lankan Secondary Schools*

I. INTRODUCTION

A. Background and Significance of the Study

The educational landscape of Sri Lanka has undergone significant changes over the past few decades, yet challenges persist, particularly in the science education sector. Reports from the Sri Lanka Examinations Department indicate that students consistently obtain minimum marks in science subjects, with chemistry being the least performing among biology and physics. This study aims to address this issue by exploring the correlation between psychological and contextual characteristics and student achievement in chemistry in senior secondary schools in Sri Lanka.

B. Statement of the Problem

Despite numerous efforts to improve science education, chemistry achievement remains low. The problem is compounded by a lack of localized research exploring the factors influencing student performance in chemistry. This study seeks to fill this gap by examining both psychological and contextual factors that may affect student achievement.

C. Purpose of the Study

The primary purpose of this study is to identify and analyze the psychological and contextual characteristics that influence chemistry achievement among senior secondary school students in Sri Lanka. By understanding these factors, educators and policymakers can develop targeted strategies to enhance student performance in chemistry.

D. Research Questions

1. What is the relationship between teachers' chemistry teaching style and student achievement in chemistry?
2. How do students' perceptions of chemistry concepts relate to their achievement in chemistry?
3.What is the impact of subject satisfaction and attitude towards chemistry on student performance?
4. How do contextual characteristics such as school type and gender affect chemistry achievement?

E. Definition of Key Terms

- Chemistry Achievement: The level of proficiency demonstrated by students in chemistry, measured through standardized tests.
- Psychological Factors: Internal factors such as teaching style, perception, satisfaction, and attitude.
- Contextual Characteristics: External factors such as school type and gender.

F. Overview of the Research Design

This quantitative study employs a correlational research design to explore the relationships between the identified variables. Data were collected from a sample of students and teachers in the Kegalle Education Zone and analyzed using SPSS and Amos software.

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G. Hypotheses for the Research

Based on the research objectives and literature review, the following hypotheses are formulated:

➢ *Hypothesis 1: Teaching Style*
- H1: There is a positive correlation between teachers' teaching styles and students' achievement in chemistry.
- H0: There is no significant correlation between teachers' teaching styles and students' achievement in chemistry.

➢ *Hypothesis 2: Student Perception*
- H1: Students' perceptions of chemistry as a subject are positively correlated with their achievement in chemistry.
- H0: Students' perceptions of chemistry as a subject are not significantly correlated with their achievement in chemistry.

➢ *Hypothesis 3: Subject Satisfaction*
- H1: Students' satisfaction with chemistry as a subject is positively correlated with their achievement in chemistry.
- H0: Students' satisfaction with chemistry as a subject is not significantly correlated with their achievement in chemistry.

➢ *Hypothesis 4: Attitude towards Chemistry*
- H1: There is a positive correlation between students' attitudes towards chemistry and their achievement in chemistry.
- H0: There is no significant correlation between students' attitudes towards chemistry and their achievement in chemistry.

➢ *Hypothesis 5: School Type*
- H1: There is a significant difference in chemistry achievement between students from urban schools and those from rural schools.
- H0: There is no significant difference in chemistry achievement between students from urban schools and those from rural schools.

➢ *Hypothesis 6: Gender*
- H1: There is a significant difference in chemistry achievement between male and female students.
- H0: There is no significant difference in chemistry achievement between male and female students.

II. LITERATURE REVIEW

Previous research has identified various factors that influence student achievement in science subjects, particularly in chemistry. For instance, a study by Bennett (2019) highlighted that students' performance in chemistry is significantly influenced by the quality of teaching and the resources available in schools. Similarly, Jones and Hargreaves (2018) emphasized the importance of effective teaching strategies and how they impact students' understanding and interest in chemistry. Several psychological factors play a crucial role in determining students' achievement in chemistry. According to Deci and Ryan (2000), intrinsic motivation, which includes students' interest and enjoyment in the subject, significantly enhances learning outcomes. Teachers' teaching styles also impact student achievement. For example, constructivist teaching methods that encourage active student participation have been shown to improve understanding and retention of chemistry concepts (Bransford, Brown, & Cocking, 2000). Students' perceptions of chemistry also affect their performance. Research by Osborne, Simon, and Collins (2003) indicates that students who perceive chemistry as relevant and useful are more likely to excel in the subject. Additionally, students' satisfaction with the subject and their overall attitude towards chemistry can influence their achievement. A positive attitude toward chemistry has been linked to higher levels of engagement and better academic performance (Glynn, Brickman, Armstrong, & Taasoobshirazi, 2011). Contextual factors such as school type and gender also significantly influence student achievement in chemistry. According to Lee and Burkam (2003), students from urban schools often have access to better resources and more qualified teachers compared to those from rural schools, leading to better academic performance. Gender differences in science achievement have also been widely studied. Research by Hyde and Linn (2006) suggests that while gender differences in mathematics and science achievement have decreased over time, they still exist, with boys often outperforming girls in certain contexts.

While international studies provide valuable insights into factors affecting chemistry achievement, there is a noticeable gap in research specifically focused on Sri Lanka. Most studies have been conducted in Western contexts, and there is limited research addressing the unique educational and cultural dynamics in Sri Lanka. This study aims to fill this gap by providing localized data and analysis.

This study is grounded in educational psychology and sociology theories. Educational psychology theories, such as those proposed by Vygotsky (1978), emphasize the role of social interaction and cultural context in learning. Sociology theories, such as those by Bourdieu (1986), explore how external factors like socioeconomic status and school environment impact educational outcomes. These theoretical perspectives provide a comprehensive framework for understanding how psychological and contextual factors interact to influence student achievement in chemistry.

III. METHODOLOGY

➢ *Research Design*

A quantitative research design was chosen to examine the correlation between psychological and contextual characteristics and student achievement in chemistry. This design is appropriate for identifying relationships between variables and providing statistical evidence to support the study's hypotheses (Creswell, 2014).

➢ *Population and Sample Selection*

The study was conducted in the Kegalle Education Zone, involving a total of 302 students and 114 teachers from 13 schools. The sample size was determined using the Morgan table, which provides a method for determining

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sample size for a given population size to ensure representativeness (Krejcie & Morgan, 1970).

➢ *Data Collection Instruments and Procedures*

Data collection involved four standardized instruments related to psychological factors: teachers' teaching style, students' perception of chemistry concepts, subject satisfaction, and attitudes toward chemistry. These instruments were adapted and validated for the Sri Lankan context. Additionally, a structured chemistry examination paper was administered to measure student achievement.

The instruments were initially developed in English and then translated into Sinhala to ensure cultural relevance and comprehension. A pilot study was conducted with 10% of the sample to test the instrument's validity and reliability. The KMO Bartlet test and Cronbach's alpha were used to assess validity and reliability, respectively, ensuring the instruments met acceptable standards (Field, 2013).

➢ *Validity and Reliability of Instruments*

Validity was ensured through expert reviews and pilot testing. The KMO Bartlet test confirmed the sample adequacy, while the Cronbach's alpha values indicated the high reliability of the instruments. Confirmatory factor analysis was performed to further validate the instruments' structure and consistency.

➢ *Data Analysis Techniques*

Data were analyzed using SPSS and Amos software. Before analysis, the data were cleaned by checking for normality, multicollinearity, linearity, and homoscedasticity. Missing values were removed, and outliers were addressed. Pearson and Spearman correlation analyses were performed to identify relationships between psychological factors, contextual characteristics, and student achievement. Structural equation modeling (SEM) was used to represent the relationships between all independent and dependent variables.

The validity and reliability of the study instruments were also measured with care. Tables 1.1 and 1.2 make it abundantly evident that every piece of research equipment was finished to the highest standard.

Table 1. Cost-Effectiveness Comparison between Pilot and Main Studies

Scale	Pilot test			Real test		
	Items	**Cronbach's Alpha**	**Cronbach's Alpha Based on Standardized Item**	**Items**	**Cronbach's Alpha**	**Cronbach's Alpha Based on Standardized Item**
SSQ	42	0.954	0.957	42	0.957	0.959
SPQ	35	0.779	0.809	35	0.826	0.838
SAQ	30	0.764	0.794	30	0.793	0.806
TSQ	40	0.946	0.948	40	0.922	0.930

(SSQ -Student satisfaction, SPQ-Student perception, SAQ-Student attitude, TSQ -Teaching style)

Table 2 Identifies the Validity of Each Research Instrument

Variable	No of item	Kmo value	Bartlert significant
SSQ	42	0.908	0.000
SPQ	35	0.771	0.000
SAQ	30	0.750	0.000
TSQ	40	0.905	0.000

(SSQ -Student satisfaction, SPQ-Student perception, SAQ-Student attitude, TSQ -Teaching style)

IV. DATA ANALYSIS & RESULTS

Before data analysis, an exploratory data analysis (EDA) was conducted to validate the collected data. First, missing values and outliers were removed. Then multicollinearity, linearity, and homoscedasticity tests were performed. In addition, normality tests were also performed for all research instruments to examine the nature of normal distributions in the data. SPSS version 25 and AMOS Graphics version 25 software packages were used for these data analyses. Multiple analytic techniques, including multiple regression and factor analysis, were used to identify relationships between independent variables and student achievement. Structural equation modeling was used to develop and test theoretical models, exploring the direct and indirect effects of the identified factors on student performance.

Conducted a confirmatory factor analysis (CFA) specifically for all research instruments. The measurement model related to it is shown in the following diagrams 1..

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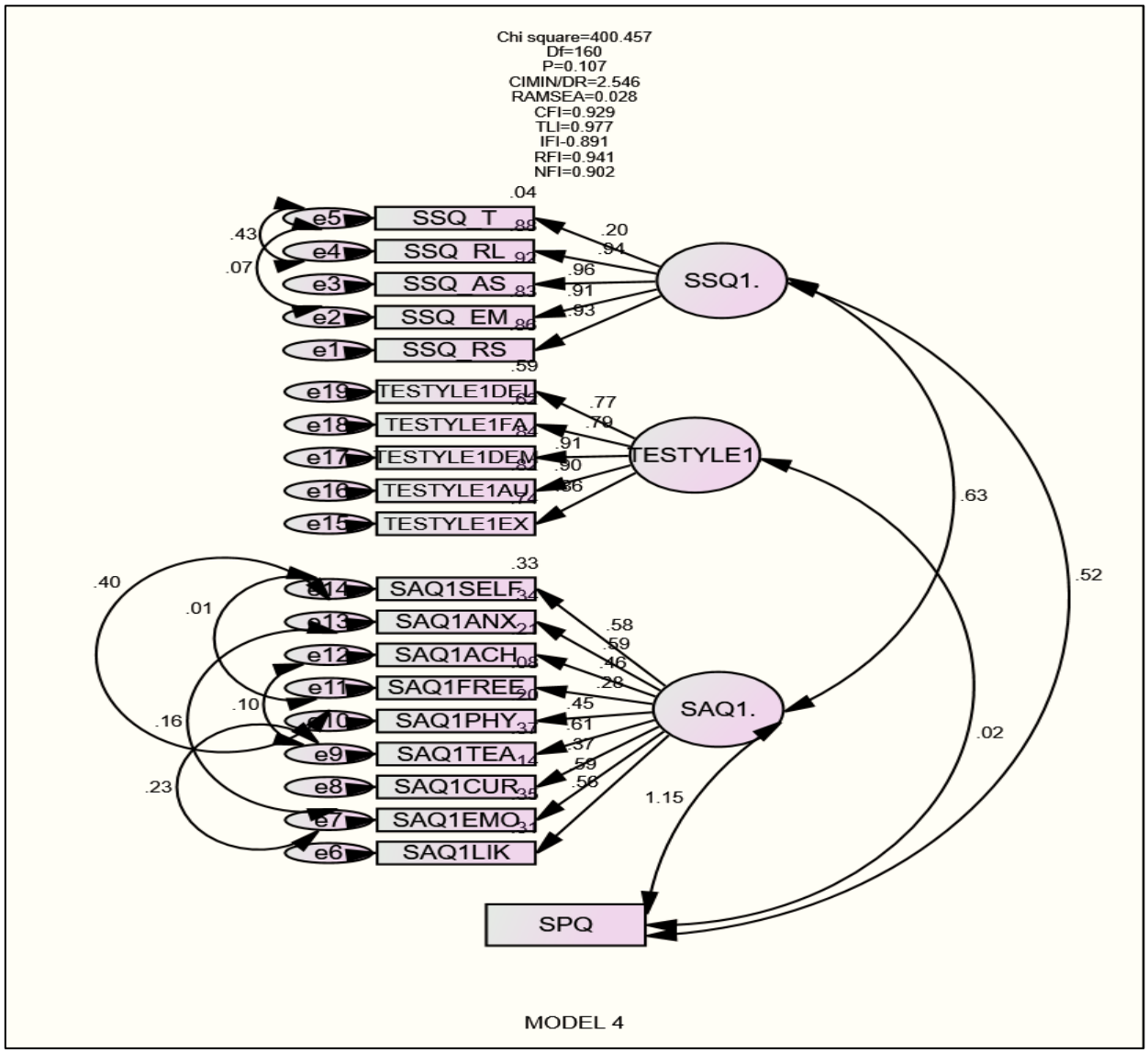

Fig 1 Initial measurement model related to the research instruments designed to measure all the psychological variables relevant to the research.

Compute variables were created by combining the questionnaire items of the research instruments. Accordingly, the accuracy of the initial measurement model of all psychological variables was tested. The measurement scales obtained for the test carried out are clearly mentioned in Table No. 3

Table 3 Model Fit Indicators of the Measurement Model

Category	The Goodness of the Fit Index	Observed Value	Threshold	Decision
Absolute fit Indicates	P	0.107	>0.05	Satisfied
	CMIN/DF	2.546	< 3 good	Satisfied
	GFI	0.979	>0.9 good > 0.8 Acceptable	Satisfied
	RMESA	0.028	< 0.1	Satisfied
	RMR	0.014	< 0.1	Satisfied
	Hoelter's CN (.05)	372	>200	Satisfied
Incremental fit indices	TLI	0.977	>0.9	Satisfied
	CFI	0.929	>09	Satisfied
	RFI	0.941	>0.9	Satisfied
	NIF	0.902	>0.9	Satisfied
Parsimony fit indices	PRATIO	0.862	>0.8	Satisfied
	PNFI	0.829	>0.8	Satisfied
	PCFI	0.850	>0.8	Satisfied

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According to table number 3 CMIN/DF value shows a value of 2.546 (CMIN/DF=2.546). The value of GFI (goodness of fit index) is high at 0.979 (GFI=0.979). The RMESA value is at a level of 0.028, and the requirement of being less than the level of 0.1 that should be in an appropriate measurement model is fulfilled (RMESA = 0.028). The RMR value is also at a level of 0.014 (RMR=0.014). So Hoelter's CN value is 372 and the need to be above 200 is fulfilled. Accordingly, the prepared research equipment could be identified as the optimal level and quality equipment. Also, the absolute fit indicates that the research equipment should have been completed. In addition, TLI, CFI, RFI, and NIF values took the optimal value levels of 0.977, 0.929, 0.941, and 0.902, respectively (TLI = 0.977, CFI = 0.929, RFI = 0.941, and NFI = 0.902). Also, the values of PRATIO, PNFI, and PCFI all took a high value close to the level of 0.8 (PRATIO = 0.862, PNFI = 0.829, PCFI = 0.850). Accordingly, it will be clear that the data related to the current study also confirms that the measurement model related to the instruments is at an acceptable and optimal level even if used to measure all the variables of the research. Meanwhile, the following tests were also carried out to further confirm that the research instrument is a valid research instrument

A. Validation of the Measurement Model

The results of the convergent validity test carried out to evaluate the validity of the measurement model are clearly shown in Table 4

Table No. 4. Convergent validity measures

Construct	No of Items	Standardized factor loading (>0.7)	Average variance exacted (AVE) (>0.6)	Composite Reliability (CR) (>0.7)
SSQ1	5	0.734 - 0.910	0.726	0.929
SAQ1	9	0.784 - 0.910	0.710	0.924
TESTYLE	5	0.843 – 0.892	0.763	0.928

(SSQ1 -Student satisfaction, SAQ1-Student attitude, TESTYLE -Teaching style)

According to Table No. 4 above, it is clear that the convergent validity for each construct is at an optimal level due to the minimum values of the standardized factor loadings related to all the constructs. Accordingly, the minimum values for SSQ1, SAQ1, and TESTYLE were found to be 0.734, 0.784, and 0.843, respectively (SSQ1=0.734, SAQ1=0.784, TESTYLE=0.843), so the AVE values were 0.726, 0710, and 0763, respectively (SSQ1=0.726, SAQ1=0.710). , and CR values were 0.929, 0.924, and 0.928 (SSQ1=0.929, SAQ1=0.924, TESTYLE=0.928), respectively. Heya Atal points out that the AVE value should be higher than the correlation value, and it will be clear that this requirement has also been fulfilled here.

Table No. 5. Interconstruct correlation and Squreroot of AVE

	SSQ1	SAQ1	TESTYLE1
SSQ1	**0.873**		
SAQ1	0.249	**0.852**	
TESTYLE1	0.517	0.388	**0.843**

(SSQ1 -Student satisfaction, SAQ1-Student attitude, TESTYLE -Teaching style)

Heir Atal points out that the square root of these values should be greater than the value As shown in Table No. 5 above, it will be seen that the values of the instruments (square root of AVE) used in the research are high. Also, all AVE values are higher than inter-construct correlation values. Thus, the confirmatory factor analysis (CFA) conducted for the measurement instruments related to the current research enabled us to confirm that the research instruments are of acceptable quality and acceptability. The data analysis tasks were performed on the main study to find answers to the research questions, respectively.

B. Bivariate Data Analysis

Hypothesis testing is specifically done in quantitative research. In it, hypotheses are formed based on the currently accepted theories in the world and the research currently conducted in the world. Accordingly, hypothesis tests are conducted to find answers to research questions. Specifically, quantitative research is conducted under a deductive approach. In it, hypothesis tests are conducted based on identifying research-related variables and the relationships between them. In this research, based on the information identified through the literature review, hypotheses were formed to measure the relationship between the identified variables, and then the data analysis work was carried out for the following tests.

C. Relationship Between Contextual Characteristics And Students' Achievement Scores

I found out from the research literature that when there are two groups of nominal and categorical data, it is appropriate to perform a Chi-square to find the relationship between the two variables. Also, such data sets are nonparametric data. In conducting a type test, the Expected count value of each cell should not be less than five. In such cases, Pearson Chi-Square cannot be used. However, Heya Atal points out that Fisher's Exact test should be done in such a case. If it is inactive, the Monte Carlo in Exact should be implemented and the Confidence level should be maintained at 95%. After that, Fisher's Exact test should be done and confirmed as significant ($p > 0.05$). In that case, is there a relationship by the Pearson Chi-Square value? Should be

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looked into. For that, if there is a relationship that should be in the range of (0 - 1), the strength of the relationship can be identified by Cramer's value (George & Mallery, 2006). As indicated by Cohen (1988), the effect size should be in the range of (W=.10 Small, W=.30 Medium and W=.5 Large).

- *The Relationship Between School Type and Student Achievement in Terms of curriculum implementation*

There are four types of schools operating in Sri Lanka (1 AB, 1 C, Type 2, and Type 3) depending on the nature of the curriculum. Among them, the variables were identified by involving all schools as well as other schools except Type 3 schools. In addition, the achievement test scores given to the students were divided into five categorical data groups (0-24, 20-39, 40-59, 60-74, 75-100). Identified into categorical data. Also, all data are identified as non-parametric data. School type was treated as the independent variable and student achievement score as the dependent variable. Based on that, the following hypotheses are formulated to investigate the relationship between the two variables. In forming the hypothesis, data analysis was done by taking H1 as the absolute hypothesis and H0 as the alternative hypothesis.

A chi-square test was conducted following the research literature to identify what this relationship looked like. The results can be presented in Table 1.6 below. Accordingly, the maximum score range of 1AB schools is in the range of 60-74. It is a percentage of 31.7%. The minimum score range is 25 - 39 which is 6.3%. A high-value range of 1C schools indicates a level of 0–24. It is 41.9% as a percentage. The lowest value range is between 75-100 and is expressed as a percentage of 10.0%. The upper range of Type 2 schools is 0-24 with a percentage of 31.1%. The minimum score is in the range of 75-100. It is a small percentage of 2.1%. The maximum value percentage of Piriven Vidyalayas is 32.1%. Accordingly, its range is the 40-59 range. The minimum value range is in the range of 25 to 39. It is 14.7% as a percentage.

Table 6 Correlation between the Type of School Where the Curriculum is Implemented and Student Achievement in Chemistry

			ST_MARKS				
			"0-24"	"25-39"	"40-59"	"60-74"	"75-100"
SCTYPE_1	"1AB"	Count(**n=18**)	18	12	49	60	50
		Expected Count	32.5	16.3	51.9	52.6	35.7
		% within SCTYPE_1	9.5%	6.3%	25.9%	31.7%	26.5%
	"1C"	Count(**n=31**)	13	4	9	5	0
		Expected Count	5.3	2.7	8.5	8.6	5.9
		% within SCTYPE_1	41.9%	12.9%	29.0%	16.1%	0.0%
	"TYPE2"	Count(**n=48**)	15	5	14	13	1
		Expected Count	8.3	4.1	13.2	13.4	9.1
		% within SCTYPE_1	31.3%	10.4%	29.2%	27.1%	2.1%
	"VIDYAYATHANA"	Count(**n=34**)	6	5	11	6	6
		Expected Count	5.9	2.9	9.3	9.5	6.4
		% within SCTYPE_1	17.6%	14.7%	32.4%	17.6%	17.6%

χ 2 = 49.610[a], df = 12, Fisher's exact test = 52.528, P-value = .000, CV= .234, a. 3 cells (15.0%) have expected count less than 5. The minimum expected count is 2.67.

According to Table No. 6, only three of the cells with percentage values are below the expected count of five. Likewise, the rule of thumb indicates a level of 15%. According to Heya Atal, the rule of thumb requirement of less than 20% is fulfilled. Under those circumstances, the requirements to carry out a type test were fulfilled. Also, the Chi value is 49.610 (χ 2 = 49.610), and the P value is significant at 0.000 (P = 0.000), and it is clear from the data analysis information that all the other requirements are at an optimal level. The null hypothesis was rejected and the alternative hypothesis was accepted. Accordingly, it was revealed that there is a relationship between school type and student achievement depending on how the curriculum is implemented. Also, according to the results of Fisher's exact test, Cramer's v value also showed that there is a strength of relationship of 0.234. It is a relationship with a small level of influence according to Cohen's effect range (W = 0.234). Accordingly, it was confirmed that "**there is a relationship between the type of school where the curriculum is implemented and student achievement.**".

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➢ *The Relationship Between School Type and Student Achievement by School Location*

Based on the nature of the data collected, it was decided to conduct a chi-square test to investigate the relationship between the independent variable of school type and student achievement based on the location of the school. Accordingly, the results obtained are shown in Table No. 1.8 below. Examining the information in the table, it appears that the majority of urban school students have obtained the range of 60-74 points. It is 35.15% as a percentage. The least number of people scored in the range of 25-39. Its percentage is 5.2%. 33.8% of semi-urban students are in the range of 40-59 marks. The majority of students in rural areas scored 27.8%. The score range is 60-74. The lowest value is 2.7%. Its score ranges from 74-100.

Table 7 Relationship between School Type and Chemistry Student Achievement by School Location

			ST_MARKS				
			"0-24"	"25-39"	"40-59"	"60-74"	"75-100"
SCTYPE1_2	URBAN SCHOOLS	Count(**n=191**)	18	10	44	67	52
		Expected Count	32.9	16.4	52.5	53.1	36.0
		% within SCTYPE1_2	9.4%	5.2%	23.0%	35.1%	27.2%
	SEMI URBAN SCHOOLS	Count(**n=74**)	22	12	25	11	4
		Expected Count	12.7	6.4	20.3	20.6	14.0
		% within SCTYPE1_2	29.7%	16.2%	33.8%	14.9%	5.4%
	RURAL SCHOOLS	Count(**n=37**)	12	4	14	6	1
		Expected Count	6.4	3.2	10.2	10.3	7.0
		% within SCTYPE1_2	32.4%	10.8%	37.8%	16.2%	2.7%

χ 2 = 59.204[a], df = 8, Fisher's exact test = 61.265, P-value = 0.000, CV(Cramer's V) =0.313, 1 cell (6.7%) have expected count less than 5. The minimum expected count is 3.19.

According to Table No. 7, only one of the cells with percentage values is below the expected count of five. Also, Rule of thumb indicates a level of 6.7%. According to Haya Atal, the rule of thumb value of less than 20% is fulfilled, and under the same conditions, the requirements of performing a type test are fulfilled. Also, the Chi value is 59.204a (χ 2 = 59.204a), and the P value is seen as significant at 0.000. It seems clear from the data analysis information that all other requirements are also optimal. The null hypothesis is rejected and the alternative hypothesis is accepted. Accordingly, it was discovered that there is a relationship between school type and student achievement depending on the area where the school is located. Also, according to the results of Fisher's exact test, Cramer's v value shows that there is a strength of relationship of 0.313. It is a relationship with a medium level of influence according to Cohen's range of influence (W = 0.313). Accordingly, **there is a relationship between school type and student achievement depending on the area where the school is located**.

➢ *Relationship Between School Type and Student Achievement by School Affiliation*

According to table number 8, it appears that the range of scores obtained by a high percentage of national schools is the range of 40-59. It will be 31.7% as a percentage. The minimum value range is 25-39. A minimum of 10.9% was taken. The highest percentage of marks obtained in provincial schools is in the range of 60-74. It is 51.2% as a percentage. Piriven colleges have the highest pass percentage of 33.9%. Its range is 60-74. The minimum percentage response range is 25-39. Its percentage is 3.4%.

Table 8 Correlation between School Type and Chemistry Student Achievement by School Institution

			ST_MARKS				
			"0-24"	"25-39"	"40-59"	"60-74"	"75-100"
SCTYPE1_3	NATIONAL	Count(**n=202**)	34	22	43	64	39
		Expected Count	34.8	17.4	56.5	55.5	38.1
		% within SCTYPE_3	16.8%	10.9%	21.3%	31.7%	19.3%
	PROVINCIAL	Count(**n=41**)	5	2	4	21	9
		Expected Count	7.1	3.5	11.3	11.4	7.7
		% within SCTYPE_3	12.2%	4.9%	9.8%	51.2%	22.0%

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUL1837

	PIRIVEN VIDYAYATHANA	Count(**n=59**)	13	2	15	20	9
		Expected Count	10.2	5.1	16.2	16.4	11.1
		% within SCTYPE_3	22.0%	3.4%	25.4%	33.9%	15.3%

χ 2 = 23.830[a], df = 8, Fisher's exact test = 23.009, P-value = .003[c], CV(Cramer's V) =.199, 1 cell (6.7%) have an expected count less than 5. The minimum expected count is 3.53

According to table number 8 above, only one of the cells with percentage values is less than five expected counts. Also, the Rule of Thumb indicates a level of 6.7%. According to Heya Atal, the Rule of Thumb requirement of less than 20% is fulfilled. Under those circumstances, the requirements for a type test have been fulfilled. Likewise, the Chi value is 23.830a (χ 2 = 23.830a), and the P value is seen as significant at 0.003 (P = 0.003). It is clear from the data analysis information that all other requirements are also optimal. The null hypothesis is rejected and the alternative hypothesis is accepted. Accordingly, it was discovered that there is a relationship between school type and student achievement depending on the area where the school is located. Also, according to the results of Fisher's exact test, Cramer's v value shows that there is a strength of relationship of 0.199. It is a relationship with a small level of influence according to the range of Cohen's effect (W = 0.199). Accordingly, **there is a relationship between the type of school and student performance depending on the institution to which the school belongs**.

- *The Relationship Between Assertiveness and Student Achievement*

According to table number 9, the range of scores obtained by most girls is 40-59. It is 31% as a percentage. The minimum score percentage is 10%, and its range is 25-39. The maximum score range of 75-100 marks is 19%. The range of marks obtained by most of the boys is 60-74, and it is 51% as a percentage. The minimum percentage of marks 4g9 has been obtained for the range of 25 - 29. Also, 22 marks were scored in the maximum range of 75-100.

Table No. 9 Relationship between Student Attitude and Student Achievement in Chemistry

			ST_MARKS				
			"0-24"	"25-39"	"40-59"	"60-74"	"75-100"
ST_GRND	FEMAIL	Count(**n=202**)	34	22	64	43	39
		Expected Count	34.8	17.4	55.5	56.2	38.1
		% within ST_GEND	16.8%	10.9%	31.7%	21.3%	19.3%
	MAIL	Count(**n=41**)	5	2	4	21	9
		Expected Count	7.1	3.5	11.3	11.4	7.7
		% within ST_GEND	12.2%	4.9%	9.8%	51.2%	22.0%

χ 2 = 20.470[a], df = 4, Fisher's exact test = 20.012, P-value = 0.000, CV(Cramer's V) =0.260, a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.26.

According to Table No. 9, none of the cells with percentage values are below the Expected count of five. Also, the Rule of Thumb indicates a level of 0.0 %. According to Heya Atal, the Rule of Thumb value of less than 20% fulfills the requirement. Under those circumstances, the requirements for a type test have been fulfilled. Likewise, the Chi value is 20.470a (χ 2 = 20.470a) and the P value is significant at 0.000 (P=0.000). It was clear from the data analysis information that all other requirements are also optimal. Accordingly, the null hypothesis is rejected and the alternative hypothesis is accepted. Accordingly, it has been revealed that there is a relationship between school type and student achievement depending on the area where the school is located. Also, according to the results of Fisher's exact test, Cramer's v value also shows that there is a strength of relationship of 0.260. It is a relationship with a small level of influence according to the range of Cohen's effect (W = 0.260). Accordingly, it was confirmed that "there is a relationship between the type of school and student achievement according to the gender of the students". Also, according to the above-analyzed information, it is clear that the achievement level of boys is higher than the achievement level of girls.

D. Multivariate Correlation Between Psychological Factors And Contextual Characteristics

Among the psychological factors, student achievement and concept perception were taken as dependent variables and other variables as independent variables and two tailed bivariate correlation was used to identify the correlation between variables based on Pearson's correlation coefficient. Also, since the data collected on contextual characteristics were non-parametric data as explained in the first chapter, Spearman's correlation coefficient was investigated. In this study, all variables related to psychological factors were converted into (compute variables).

Accordingly, all those variables became scale variables. In addition, the two variables of student achievement and concept perception were made as dependent variables. Those two variables were also (Scale variables). According to Haya Atal, when there is a scale variable, it is possible to use statistical methods called Correlation and Regression to find

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the correlation between them. Here, a search for the relationship between two variables or bivariate correlation (Bivariate correlation) is investigated in the study.

Taking more than two variables and looking for the effect between them (Multivariate regression) is analyzed by the univariate statistical method. Accordingly, in this study, the data analysis work is done by using both methods. This answers the third and fourth research questions. In that, first, the bivariate correlation between the variables of students' chemistry student achievement, chemistry concept perception, subject satisfaction, attitude towards chemistry subject, and teachers' teaching style was investigated. In this case, Pearson's correlation coefficient can be used to check the correlation (Meyers, Gamut, & Guarino, 2006). Accordingly, the two variables of student achievement and concept perception were used as dependent variables, and the rest of the variables were selected as independent variables. Initial assumptions were made to ensure that the assumptions of normality and linearity were not violated. Since bivariate correlations required null hypothesis testing, Bonferroni-adjusted α values of 0.01(0.05/5) were used.

First, the conceptual model of the study presents the information of Bivariate Correlation to find out the correlation between the variables presented. Here (r-value) indicates the strength of the relationship and (p-value) indicates the statistical significance of the relationship. Here, the scale of interpretation of the correlation coefficient introduced by Guildford (1977) is used. According to him, if there is a correlation coefficient (+/-) in the range of 0 to 0.2, it is insignificant even if there is a relationship. A range of 0.2 to 0.4 indicates a low correlation. A range of 0.4 to 0.7 indicates moderate correlation and 0.7 to 0.9 indicates high correlation. Likewise, 0.9 to 1 also indicates a very high correlation (Guilford, 1977). Table 10 presents the correlation of variables according to the conceptual model of this study. Thus, it appears that all independent variables (X1,X2,X3) and dependent variables (Y1,Y2) show a significant level of positive correlation.

Table No. 10 Correlation of Psychological Variables According to Conceptual Framework

			Mean	SD	Y1	Y2	X1	X2	X3
Y1	ST_MARKS		52.41	23.560	1				
Y2	SPQ		2.44	0.385	0.009	1			
X1	SSQ		2.16	0.643	0.044	0.562**	1		
X2	SAQ		2.47	0.430	0.048	0.759**	0.448**	1	
X3	TESQ		1.97	0.360	0.133*	0.018	0.111*	0.108*	1

. Correlation is significant at the 0.01 level (2-tailed). **SD=Standard Deviation **N**=302/111 * P<0.05
(ST_MARKS- Student Marks, SSQ -Student satisfaction, SPQ-Student perception, SAQ-Student attitude, TESQ -Teaching style)

According to Table 10, the relationship between concept perception and student achievement (r=0.009, p=0.009), the relationship between subject satisfaction and student achievement (r=0.044, p=0.050), the relationship between chemistry subject satisfaction and concept perception (r =0.562, p=0.000), the relationship between students' attitude towards chemistry subject and student achievement (r=0.048,p=0.010), relationship between students' attitude towards chemistry subject and concept perception (r=0.759, p=0.000), The relationship between students' attitude towards chemistry subject and subject satisfaction (r=0.448, p=0.000), teachers' teaching style between student achievement and (r=0.133, P=0.006) between teaching style and concept perception (r=0.018, p =0.003), between teaching style and subject satisfaction (r=0.111, p=0.007), it is seen that there is a relationship between teachers' teaching style and students' attitude towards the subject (r=0.108, p=0.009).

From the above-analyzed information, it is clear that there is a weak (r<0.2) or low (r<0.4) positive correlation between all the independent variables. Accordingly, it appears that there is no risk of multicollinearity between the variables. That is, each variable is nearly independent or at least marginally correlated with one another.

After examining the correlation between the psychological variables in the above manner, Spieman's bivariate correlation was investigated according to Hey et al. The results are shown in Table 11.

Table No. 11 Correlation between Contextual Characteristics According to the Conceptual Framework

		Y1	X1	X2	X3	X4
Y1	ST_MARKS	1				
X1	SCTYPE_1	0.312**	1			
X2	SCTYPE_2	0.426**	0.394**	1		
X3	SCTYPE_3	0.072	0.040	0.128*	1	
X4	STGEND	0.208**	0.494**	0.244**	0.026	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

(ST_MARKS- Student Marks, SCTYPE_1-School type 1, SCTYPE_2-School type 2, SCTYPE_3-School type 3, STGEND - Gender)

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There, contextual characteristics were taken as the independent variable and student achievement as the dependent variable. Accordingly, according to Table No. 12, it was clear that there is a positive correlation between the type of school and student achievement according to the nature of the curriculum (r =0.312, P=0.000). According to the jurisdiction of the school, there is a positive correlation between the type of school and student achievement (r = 0.426, P=0.000) and there is a positive correlation between the jurisdiction of the school and the nature of the curriculum implementation (r = 0.394, P=0.000). Also, according to the institution to which the school belongs, a weak positive correlation was shown under both the variables of school type, student achievement, and the nature of curriculum implementation. Also, there was a positive correlation between school type according to the school institution and school type according to the school jurisdiction (r=0.128, P=0.027). There is a significant relationship between the level of leadership and student achievement (r = 0.208, P=0.000) and between the level of leadership and the type of school according to the nature of the curriculum implementation (r = 0.494, P=0.000) and the level of leadership and the jurisdiction of the school (r = 0.244), P=0.000) a positive correlation was also found. However, school type showed a marginally positive correlation (r = 0.026, P=0.000) for ownership and school affiliation.

V. DISCUSSION OF THE RESULTS

The analysis of the data reveals several significant findings that shed light on the correlation between psychological and contextual characteristics and student achievement in chemistry among senior secondary school students in Sri Lanka.

- *Teaching Style*

The hypothesis testing showed a positive correlation between teachers' teaching styles and students' achievement in chemistry (H1). The findings indicate that students taught by teachers who employ interactive and engaging teaching methods tend to perform better in chemistry. This aligns with previous studies suggesting that constructivist teaching methods, which involve active student participation, improve understanding and retention of chemistry concepts.

- *Student Perception*

The results demonstrated a significant positive correlation between students' perceptions of chemistry and their achievement (H2). Students who perceive chemistry as relevant and useful are more likely to excel. This highlights the importance of making chemistry concepts relatable to students' everyday lives to enhance their interest and engagement in the subject.

- *Subject Satisfaction*

The data indicated that students' satisfaction with chemistry as a subject is positively correlated with their achievement (H3). Students who are satisfied with their chemistry courses tend to have higher academic performance. This finding underscores the need for educational strategies that increase student satisfaction, such as providing more hands-on laboratory experiences and real-world applications of chemistry.

- *Attitude towards Chemistry*

The study found a positive correlation between students' attitudes towards chemistry and their achievement (H4). A positive attitude towards chemistry is linked to higher levels of engagement and better academic performance. Educators should focus on fostering a positive attitude by creating a supportive learning environment and providing encouragement and motivation.

- *School Type*

The analysis revealed significant differences in chemistry achievement between students from urban and rural schools (H5). Students from urban schools generally perform better, likely due to better resources and more qualified teachers. This suggests that addressing resource disparities between urban and rural schools could help improve chemistry achievement in rural areas.

- *Gender Differences*

The findings showed a significant difference in chemistry achievement between male and female students (H6), with male students generally outperforming female students. This gender disparity calls for targeted interventions to support female students in chemistry, such as mentorship programs and initiatives to boost confidence and interest in the subject.

Overall, the study provides valuable insights into the factors influencing student achievement in chemistry. The results emphasize the need for a multifaceted approach to improving chemistry education, including enhancing teaching styles, making chemistry more relevant and engaging for students, increasing subject satisfaction, fostering positive attitudes, addressing resource disparities, and supporting female students. These findings can guide educators and policymakers in developing effective strategies to enhance chemistry education and student performance in Sri Lanka.

VI. CONCLUSION

This research aimed to investigate the correlation between psychological and contextual characteristics and student achievement in chemistry among senior secondary school students in Sri Lanka. The study's findings underscore the complexity of factors influencing academic performance in chemistry, providing valuable insights for educators and policymakers.

A. Key Findings:

- Teaching Style: A positive correlation was found between interactive, engaging teaching methods and higher student achievement in chemistry. This highlights the importance of adopting constructivist teaching practices to enhance student understanding and retention of chemistry concepts.

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- Student Perception and Satisfaction: Students who perceive chemistry as relevant and are satisfied with their chemistry courses tend to perform better academically. This indicates the need for educators to make chemistry more relatable and to create more satisfying learning experiences through practical applications and hands-on laboratory work.
- Attitude towards Chemistry: A positive attitude towards chemistry correlates with higher academic performance. Encouraging a positive mindset towards chemistry through supportive learning environments and motivational strategies can significantly impact student success.
- School Type and Gender Differences: The study revealed disparities in achievement based on school type and gender, with urban schools and male students generally performing better. Addressing resource gaps between urban and rural schools and implementing targeted support for female students are essential steps towards equitable education.

B. Implications for Practice:

- Teacher Training and Development: Professional development programs for teachers should emphasize interactive and student-centered teaching methods.
- Curriculum Design: The chemistry curriculum should incorporate real-world applications and practical experiences to enhance student engagement and satisfaction.
- Gender-Specific Interventions: Initiatives to support female students in chemistry, such as mentorship programs and confidence-building activities, should be implemented.
- Resource Allocation: Policies should focus on providing equitable resources and qualified teachers to rural schools to bridge the achievement gap between urban and rural students.

C. Future Research:

Further studies should explore the longitudinal effects of these psychological and contextual factors on student achievement in chemistry and other science subjects. Additionally, qualitative research could provide deeper insights into students' and teachers' experiences and perceptions, complementing the quantitative findings of this study.

In conclusion, this research highlights the multifaceted nature of factors influencing student achievement in chemistry. By addressing these psychological and contextual characteristics through targeted interventions and policy reforms, educational outcomes in chemistry can be significantly improved, contributing to the overall development of science education in Sri Lanka.

RECOMMENDATIONS

The following recommendations can be made based on the results obtained in investigating the relationship between concept perception and student achievement with contextual characteristics.

- Implementation of Standardized Curriculum – Education authorities should ensure consistent and effective implementation of chemistry curricula across all schools. This is achieved through regular monitoring and evaluation processes to maintain quality and consistency with teacher training programs, curriculum guidelines, and educational goals.
- Equitable Resource Allocation – Efforts should be made to address disparities in resource allocation between schools, particularly in disadvantaged areas. This could include increasing funding for schools in underserved districts, providing additional support for teachers, and improving access to educational materials and facilities to create better-quality lab facilities for all students.
- Professional Development for Teachers - Teachers should receive ongoing professional development opportunities to improve their teaching skills and keep them abreast of best practices in chemistry education. This may include workshops, mentoring programs, and access to resources and tools that support effective teaching strategies.
- Community involvement and support – collaboration between schools, local communities, and relevant stakeholders can further support chemistry education initiatives. Engaging parents, community organizations, and industry partners can provide additional resources, instructional opportunities, and real-world applications of chemistry concepts, expanding opportunities for students to gain hands-on learning experiences.
- Research and Evaluation – Continued research on factors affecting chemistry student achievement, including curriculum implementation, geographic location, and institutional governance, is essential. This research can inform evidence-based policies and interventions aimed at improving educational outcomes for all students.
- Tailored support to low-performing schools – Education authorities should consistently identify schools with low chemistry student achievement and provide appropriate support to meet their specific needs. This support may include targeted interventions such as supplemental funding, professional development opportunities for teachers, access to instructional resources, and academic support programs for students. By addressing the unique challenges faced by underperforming schools, it appears that authorities should help improve student achievement and close the gap between schools with different levels of performance.
- Promoting effective curriculum implementation – Schools and education authorities should prioritize effective curriculum implementation across all types of schools and governing bodies. Provide adequate training and support for teachers, ensure access to quality instructional materials, and implement strategies to actively engage students in learning chemistry concepts.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUL1837

- Tailored approaches for different school types – Recognizing the positive relationship between school type and chemistry concept perceptions, authorities considered tailoring support and resources based on the specific needs of different types of schools. Targeted funding, professional development opportunities, or specialized programs can be used to improve curriculum implementation in schools that have the greatest impact on students' understanding of chemistry concepts.
- Addressing gender disparities - Educational authorities should be concerned about gender differences in chemistry concept perception and work to address the existing disparities. This may include implementing strategies to promote gender equality in science education. The following recommendations can be made based on the results obtained in investigating the relationship between psychological factors and contextual characteristics affecting student achievement.
- Improving Teaching Practices- Chemistry teachers should further develop and improve their teaching practices to instill a deeper understanding and appreciation of chemistry concepts among students. This can include interactive and hands-on activities, providing explanations in an easy-to-understand manner, and creating collaborative learning environments that encourage student participation.
- Promotion of Positive Attitudes- Efforts should be made to promote positive attitudes towards chemistry among students. Teachers should show students the relevance of chemistry to everyday life. Its importance can be highlighted in various fields. Students can be allowed to explore their interests and skills in the subject.
- Addressing student satisfaction – Schools and educators should regularly assess student satisfaction with the chemistry learning experience. Steps should be taken to address any areas of student concern. This can be improved by obtaining feedback from students, implementing changes in curriculum or teaching methods based on student preferences, and providing additional support or resources as needed to increase student satisfaction.
- Professional development for teachers - Chemistry teachers should have access to continuing professional development opportunities to enhance their teaching skills and effectiveness. This may include workshops, seminars, and training programs focused on innovative teaching strategies, classroom management techniques, and methods of creating an effective learning environment. In particular, teachers should be oriented toward school-based professional teacher development programs
- Collaborative Learning Communities – Encouraging collaboration among chemistry teachers and creating opportunities for them to share best practices, resources, and ideas can further support the development of effective teaching practices and improve student outcomes in chemistry. This can be facilitated through professional learning communities, peer mentoring programs, and collaborative lesson-planning initiatives.
- Positive Correlation - The small positive correlation between chemistry concept perception, chemistry subject satisfaction, attitude towards chemistry subject, and teachers' teaching style indicates that there is some relationship between these variables. It shows that when students understand their chemistry concepts more clearly, are more satisfied with the subject, and have a positive attitude toward it, they tend to view their teachers' teaching style more positively.
- Mutually reinforcing relationship: This correlation suggests that when students understand chemistry concepts more clearly, they become more satisfied with the subject and tend to develop a more positive attitude. Conversely, a high satisfaction and positive attitude towards the subject will lead to a deeper understanding and appreciation of chemistry concepts.
- Effect of Teaching Style- Teachers' teaching style has been found to affect students' conceptual understanding, subject satisfaction, and attitudes towards the subject of chemistry. It shows that the use of effective teaching styles can lead to a more positive learning experience in terms of students' understanding, satisfaction, and attitudes towards chemistry.
- School Type and Curriculum Implementation- The positive correlation between school type based on curriculum implementation and student achievement suggests that curriculum implementation in different types of schools affects students' academic performance in chemistry. Schools that implement the curriculum effectively provide clearer instruction, better resources, and more engaging learning experiences that lead to higher student achievement.
- School Location- The positive correlation between school location and school type based on student achievement indicates that a school's geographic location plays some role in determining student chemistry achievement. Factors such as access to resources, quality of teaching staff, and local socioeconomic conditions may contribute to differences in student achievement across schools in different areas.
- School governing body- The positive correlation between school governing body and school type based on student achievement suggests that a school's governance structure affects students' academic performance in chemistry. Different governing bodies may have different policies, priorities, and resources allocated to education, which can influence the quality of teaching, curriculum implementation, and overall student support.
- Low level of positive correlation- The low level of positive correlation between school type based on the governing body of the school and school type based on the area in which the school is located indicates that there may be some relationship between these variables, but it is not particularly strong. This suggests that the governance structure of a school has little influence on its geographical location.

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Applying findings from chemistry education research to STEM (Science, Technology, Engineering, and Mathematics) education involves integrating similar strategies across multiple disciplines to promote holistic and interdisciplinary learning experiences. Accordingly, how these findings can be applied to STEM education can be shown as follows.

- Provide extensive training and professional development opportunities for STEM educators, focusing on integrating effective instructional strategies, inquiry-based learning approaches, and real-world applications across science, technology, engineering, and mathematics disciplines.
- Integrated STEM curricula that emphasize connections between science, technology, engineering, and math concepts can be developed. These may include projects, problem-solving tasks, and hands-on activities that encourage students to apply knowledge and skills from multiple disciplines to solve complex problems.
- Foster inquiry-based learning environments in which students are actively engaged in investigating scientific phenomena, designing solutions to engineering challenges, and applying mathematical concepts to real-world problems. Likewise, curiosity, critical thinking, and experimentation should be encouraged through STEM subjects.
- Implement initiatives to promote gender equity and diversity in STEM education by encouraging equal participation and achievement among all students.
- Expose students to a wide range of STEM career opportunities and pathways through career awareness sessions, industry partnerships, and experiential learning opportunities. The relevance of STEM subjects in addressing global challenges and making meaningful contributions to society is highlighted.
- Integrate technology tools and digital resources into STEM instruction to enhance learning experiences and facilitate hands-on exploration. Opportunities to use simulation, virtual lab, coding platforms, and multimedia resources to engage students across STEM disciplines and promote technical literacy. Should be given.
- It is important to use project-based learning approaches where students collaborate on authentic STEM projects, such as designing experiments, building prototypes, or developing solutions to real-world problems. Encouraging creativity, teamwork and innovation can be achieved by using the concepts of science, technology, engineering, and mathematics.
- Possible partnerships with industry, organizations, research institutions, and community stakeholders to provide students with opportunities for authentic experiences outside the classroom. Internships, mentorship programs, and hands-on learning opportunities should be offered that connect classroom learning to real-world contexts. By applying these strategies based on findings from chemistry education research to STEM education, schools can create dynamic learning environments that inspire curiosity, foster critical thinking, and prepare students for success in STEM fields and beyond. Integrated education will empower students to make meaningful connections between different disciplines, develop essential skills for the future workforce, and become lifelong learners and innovators. Certainly, it is possible to make the following recommendations that can be applied to findings from chemistry education research to STEM education.
- It is possible to design cross curricular projects that integrate chemistry concepts with other STEM subjects. For example, students explore environmental science by studying the effects of pollutants on water quality, conducting experiments to test cleanup methods, and analyzing data using mathematical models.
- Provide opportunities for experiments and maker activities that allow students to explore scientific principles, engineering design processes, and mathematical concepts in a practical context. Activities can include building circuits, designing and testing prototypes, or conducting chemistry experiments using household materials.
- Students can be involved in STEM competitions and challenges to improve knowledge and skills across multiple disciplines. Participating in events such as science fairs, robotics competitions, or mathematical modeling challenges can deepen their understanding of given subjects and motivate students to develop teamwork and problem-solving skills.
- Establish STEM Clubs and extracurricular programs where students can pursue their interests in science, technology, engineering, and math outside of regular classroom instruction. Opportunities for community members to engage in hands-on projects, guest speaker sessions, field trips, and STEM-related community service activities are possible.

SUGGESTIONS FOR FUTURE RESEARCH

➢ *Longitudinal Studies:*

Longitudinal studies can be conducted to examine causal relationships between independent variables and student achievement over time. This will confirm the direction of the relationships and provide insight into how changes in variables affect academic performance.

➢ *Mediation Analysis:*

Investigation of potential mediating mechanisms underlying the relationships between independent variables and student achievement. For example, it could be explored whether the effect of teachers' teaching style on student achievement is mediated by students' attitudes toward the subject.

➢ *Moderation Analysis:*

Can further examine moderator variables that may influence the strength or direction of the observed relationships. For example, does the relationship between subject satisfaction and student achievement vary based on students' prior knowledge or socio-economic background? is being investigated.

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➢ *Comparative Study:*

Can compare the effects of different teaching styles, instructional methods, or educational interventions on student achievement in high school chemistry. This may include comparing traditional lecture-based teaching with more interactive or inquiry-based approaches.

➢ *Qualitative Research:*

Research can be conducted by combining quantitative findings with qualitative research methods to gain a deeper understanding of students' perceptions, attitudes, and experiences in chemistry education. Qualitative data can provide rich contextual information, helping to understand the nuances of student-teacher interactions.

➢ *Cross-Cultural Studies:*

Cross-Cultural Studies Can Explore Potential Cultural Differences in the Relationships Between Independent Variables and Student Achievement. Do these relationships hold true across different cultural contexts? Or are there differences in the importance of certain variables? can be investigated.

➢ *Teacher Training Interventions:*

Organizations can design and implement interventions aimed at improving the pedagogical skills and teaching effectiveness of teachers in science education. The impact of these interventions on student achievement and other relevant outcomes can be evaluated.

➢ *Technology Integration:*

The role of technology in improving chemistry learning and student achievement can be investigated. Accordingly, the effects of integrating educational technologies on student achievement can be explored.

➢ *Inclusive Education:*

The impact of inclusive education teaching practices on chemistry student achievement, particularly for students with diverse learning needs or backgrounds, can be examined. There is also potential to investigate strategies for promoting equity and inclusion in the chemistry classroom.

➢ *Meta-Analysis:*

Conducting meta-analyses to synthesize findings from existing studies and provide a comprehensive overview of the relationships between independent variables and student achievement in chemistry education. Patterns, trends, and moderator variables are identified across studies. Using the above suggestions for future research, scholars can further their understanding of the factors influencing chemistry students' achievement and inform the development of effective educational interventions and practices. Due to the finding that attitude towards the subject acts as a mediating variable, the following suggestions are made for future research.

- Contextual factors that may moderate the mediating effect of attitude on the subject can be investigated. It is possible to explore whether the strength or direction of this intervention varies based on factors such as students' prior knowledge, cultural background, or classroom environment.
- The role of teachers' practices and instructional approaches in shaping students' attitudes toward chemistry can be explored. It examines how teachers can foster positive attitudes and intrinsic motivation toward the subject through engaging and supportive teaching methods.
- The influence of peer interactions and social dynamics in the classroom on students' attitudes toward chemistry can be examined. Investigations are directed at how peer and group dynamics contribute to attitude formation and academic outcomes.
- The role of parental involvement and family support in shaping students' attitudes towards science subjects such as chemistry can be investigated. Exploring how parents' attitudes, expectations, and involvement in children's education influence attitude formation and academic achievement.
- A comparison of the mediating role of attitude towards the subject can be made across different subjects in non-professional areas. Do Attitudinal Mediating Mechanisms Vary by the Nature of the Subject Matter and the Instructional Context? should be investigated.
- Evaluation can be used to develop interventions aimed at improving students' attitudes towards chemistry. Explore the effectiveness of strategies such as inquiry-based learning, real-world applications, and hands-on activities in promoting positive attitudes and engagement.

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