



RELATIONSHIP BETWEEN SELF-EFFICACY IN CHEMISTRY AND CHEMISTRY ACHIEVEMENT AMONG SECONDARY SCHOOL STUDENTS IN KERALA: A QUANTITATIVE ANALYSIS

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Abstract

This study aimed to investigate the extent of self-efficacy and achievement in Chemistry among secondary school students and explore whether significant differences exist based on gender, locale, and type of school management. A survey methodology was employed, and a representative sample of 324 students from Kannur district, Kerala, was selected using stratified random sampling. The study utilized the Self-efficacy scale in Chemistry and an Achievement test in Chemistry as the tools for data collection. results of the study indicated a positive relationship between achievement and self-efficacy in Chemistry. This relationship was stronger among females, urban students, and students from government-managed schools. This study provides insights into the self-efficacy and achievement levels of secondary school students in Chemistry. The findings emphasize the importance of considering gender, locale, and type of school management when addressing self-efficacy and achievement in Chemistry education. The results of the study will contribute to educational practices and interventions aimed at promoting student success in Chemistry

Key terms: Self-efficacy, Achievement, Chemistry, Secondary school students



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Introduction

The present study is aims to investigate the relationship between self-efficacy in chemistry and chemistry achievement among 9th-grade students in Kerala. Self-efficacy refers to an individual's belief in their ability to perform a specific task or achieve a particular goal. In the context of this study, self-efficacy refers to students' beliefs in their ability to succeed in chemistry-related tasks and assessments.

Chemistry is a fundamental subject in science education, providing the foundation for understanding various natural phenomena and technological advancements. It is essential for

students to develop a strong conceptual understanding of chemistry during their early years of education. However, studies have shown that students often struggle with chemistry, leading to poor achievement and a lack of interest in the subject. Understanding the factors that influence chemistry achievement is crucial for designing effective educational interventions and improving learning outcomes.

Self-efficacy has been identified as a significant predictor of academic achievement across various subjects. Students with high self-efficacy beliefs tend to be more motivated, persevere in the face of challenges, and adopt effective learning strategies. Conversely, students with low self-efficacy beliefs may experience decreased motivation, self-doubt, and a higher likelihood of giving up when faced with difficulties. Therefore, investigating the relationship between self-efficacy and chemistry achievement can provide valuable insights into students' academic performance and inform the development of targeted interventions to enhance their learning experiences.

This study is grounded in Bandura's social cognitive theory, which highlights the dynamic interplay between individual characteristics, environmental factors, and behavior. (Bandura, 1986). According to this theory, self-efficacy beliefs play a crucial role in shaping individuals' thoughts, feelings, and actions. Self-efficacy is influenced by four main sources: mastery experiences (previous successes and failures), vicarious experiences (observing others' performances), social persuasion (verbal encouragement or discouragement), and physiological and emotional states (Bandura, 1997).

In the context of chemistry learning, self-efficacy is expected to influence students' engagement, effort, and persistence, ultimately impacting their achievement. Students with higher self-efficacy beliefs in chemistry are more likely to approach learning tasks with confidence, set higher goals, and invest effort in understanding complex concepts (Sengupta & Mandal, 2012). Conversely, students with lower self-efficacy beliefs may avoid challenging tasks, experience heightened anxiety, and exhibit reduced motivation, which can hinder their chemistry achievement.

Multon, Brown and Lent (1991) conducted meta-analytic investigation examined the relationship between self-efficacy beliefs and academic outcomes. The analysis synthesized findings from 115 independent samples obtained from 105 studies. Results indicated a moderate positive correlation between self-efficacy beliefs and academic performance, with an average effect size of $r = .38$. The relationship between self-efficacy and academic outcomes was stronger for performance than for choice of academic tasks or persistence in academic

pursuits. Moderator analyses revealed that the magnitude of the self-efficacy–performance relationship was influenced by the measurement of self-efficacy, age level of the participants, and type of academic performance measure. Implications for theory, research, and practice are discussed.

Pajares (2002) conducted an overview of social cognitive theory and of self-efficacy. This overview of social cognitive theory and self-efficacy examines the theoretical constructs and empirical evidence supporting the role of self-efficacy in various domains, including academic achievement. The article discusses Bandura's social cognitive theory, which highlights the importance of self-efficacy beliefs in shaping individuals' thoughts, feelings, and actions. The review emphasizes the reciprocal interactions between personal factors, environmental influences, and behavior, and highlights the significance of self-efficacy as a motivational factor that impacts performance and learning outcomes.

Zimmerman (2000) conducted a study on self-efficacy: An essential motive to learn. This article explores the concept of self-efficacy as an essential motive to learn. Drawing from Bandura's social cognitive theory, the study highlights the significance of self-efficacy beliefs in motivating academic achievement and fostering effective learning strategies. The review discusses the role of self-efficacy in goal setting, effort expenditure, and perseverance in the face of challenges. The article provides empirical evidence and theoretical insights into the impact of self-efficacy on learning outcomes, suggesting that enhancing self-efficacy can lead to improved academic performance and increased motivation to learn.

By examining the relationship between self-efficacy and chemistry achievement among 9th-grade students in Kerala, this study aims to provide empirical evidence regarding the importance of self-efficacy in predicting academic success in chemistry. The findings may provide insight to educators, policymakers, and curriculum designers about the significance of nurturing students' self-efficacy beliefs and designing instructional strategies that enhance self-efficacy and promote positive learning experiences in chemistry education.

Objectives of the Study

1. To find the extent of self-efficacy in Chemistry and Achievement in Chemistry among secondary school students
2. To find out whether there exists any significant difference in self-efficacy in Chemistry and Achievement in Chemistry among secondary school students based on Gender, Locale and Type of Management
3. To find whether there exist significant relationship between self-efficacy in Chemistry and Achievement in Chemistry among secondary school students for total sample and based on relevant sub sample.

Methodology in Brief

The chosen research methodology involved the utilization of a survey method as the design of the study

Sample used for the study

A representative sample of 324 secondary school students from Kannur district in Kerala was selected for the study. The sample selection was conducted using a stratified random sampling approach, ensuring adequate representation of factors such as gender, locale, and type of school management.

Tools

The tools used for the study are

1. Self-efficacy scale in Chemistry
2. Achievement test in Chemistry

Statistical Techniques

Statistical techniques used in the study are,

- Descriptive Analysis
- Percentile Analysis
- Independent sample t-test
- Pearsons product moment coefficient of correlation

Results and Discussion

Descriptive statistics for the variable achievement in Chemistry and Self-efficacy in Chemistry are presented in table 1

Table 1 *Descriptive statistics for the variable achievement in Chemistry and Self-efficacy in Chemistry*

Statistics	Achievement in Chemistry	Self-efficacy in Chemistry
N	324	324
Mean	35.12	81.34
Median	38.00	81.00
Mode	42	81
Std. Deviation	12.728	11.709
Skewness	-.425	-.004
Kurtosis	-.910	-.356

The statistics reveal important insights about the achievement and self-efficacy scores in chemistry. In terms of achievement, the data shows that the sample consisted of 324

individuals. On average, the participants scored 35.12 in chemistry, with a median score of 38.00. The most frequently occurring score was 42. The standard deviation of 12.728 indicates a moderate amount of variability in the achievement scores. The distribution of scores is slightly negatively skewed, suggesting that there is a slight tail towards lower scores. The kurtosis of -0.910 indicates that the distribution is slightly platy kurtic, meaning it has a relatively flatter peak compared to a normal distribution.

Regarding self-efficacy in chemistry, the sample size also consisted of 324 individuals. The average self-efficacy score was 81.34, with a median score of 81.00. The mode, or most frequently occurring score, was 81. The standard deviation of 11.709 indicates a moderate amount of variability in the self-efficacy scores. The distribution of self-efficacy scores appears to be approximately normally distributed, as indicated by the negligible skewness of -0.004. The kurtosis of -0.356 suggests a slightly flatter peak compared to a normal distribution.

Extent of self-efficacy in Chemistry and Achievement in Chemistry

To assess the level of self-efficacy in chemistry and the academic achievement of secondary school students in chemistry, percentile analysis was employed. The data and results of the percentile analysis are presented in Table 2.

Table 2 *Percentile Analysis of Self-Efficacy in Chemistry and Academic Achievement in Chemistry among Secondary School Students*

Percentiles	Achievement in Chemistry	Self-efficacy in Chemistry
10	15.00	66.00
20	22.00	72.00
30	28.50	75.00
40	34.00	78.00
50	38.00	81.00
60	41.00	84.00
70	43.00	87.00
80	47.00	92.00
90	50.50	98.50

The percentiles provide a detailed understanding of the distribution of achievement and self-efficacy scores in chemistry. For achievement, the 10th percentile score is 15.00, meaning that 10% of the participants scored 15 or lower. As we move up the percentiles, the scores gradually increase, with the median (50th percentile) score being 38.00. At the 90th percentile,

the score rises to 50.50, indicating that 90% of the participants scored 50.50 or lower in achievement.

Similarly, for self-efficacy in chemistry, the 10th percentile score is 66.00, indicating that 10% of the participants scored 66.00 or lower. As we progress through the percentiles, the scores show a steady increase, with the median (50th percentile) score being 81.00. At the 90th percentile, the score rises to 98.50, signifying that 90% of the participants scored 98.50 or lower in self-efficacy.

Effect of Gender on Achievement in Chemistry and Self-efficacy in Chemistry

To find the effect of gender on self-efficacy in chemistry and achievement in chemistry independent sample t-test is conducted. Data and result of test of mean score comparison of self-efficacy in chemistry and achievement in chemistry between Male and Female secondary school students are presented in the table 3.

Table 3 *Gender Differences in Self-Efficacy in Chemistry and Achievement in Chemistry among Secondary School Students*

Variable	Gender	N	Mean	Std. Deviation	t-value
Achievement in Chemistry	Male	150	31.52	13.61	4.89**
	Female	174	38.23	11.04	
Self-efficacy in Chemistry	Male	150	80.44	11.69	1.28
	Female	174	82.11	11.70	

The data presented shows a comparison of the mean scores and standard deviations for achievement in chemistry and self-efficacy in chemistry, based on gender. For achievement in chemistry, the mean score for males ($M = 31.52$, $SD = 13.61$) is significantly lower than that of females ($M = 38.23$, $SD = 11.04$), as indicated by the t-value of 4.89** ($p < .01$). This suggests that females tend to have higher achievement scores in chemistry compared to males. On the other hand, when it comes to self-efficacy in chemistry, there is no significant difference between males ($M = 80.44$, $SD = 11.69$) and females ($M = 82.11$, $SD = 11.70$), as the t-value of 1.28 is not statistically significant. This indicates that there is no gender-based discrepancy in self-efficacy scores in chemistry.

Effect of Locale on Achievement in Chemistry and Self-efficacy in Chemistry

Data and result of test of mean score comparison of self-efficacy in chemistry and achievement in chemistry between Rural and Urban secondary school students are presented in the table 4.

Table 4 Locale Differences in Self-Efficacy in Chemistry and Achievement in Chemistry among Secondary School Students

Variable		Locale	N	Mean	Std. Deviation	t-value
Achievement in Chemistry	in	Rural	225	33.48	11.56	3.56**
		Urban	99	38.86	14.43	
Self-efficacy in Chemistry	in	Rural	225	81.92	10.81	1.25
		Urban	99	80.00	13.49	

The provided data compares the mean scores and standard deviations for achievement in chemistry and self-efficacy in chemistry based on the locale (rural and urban). In terms of achievement in chemistry, the mean score for rural students ($M = 33.48$, $SD = 11.56$) is significantly lower than that of urban students ($M = 38.86$, $SD = 14.43$), as indicated by the t-value of 3.56** ($p < .01$). This suggests that urban students tend to have higher achievement scores in chemistry compared to rural students.

However, when it comes to self-efficacy in chemistry, there is no significant difference between rural students ($M = 81.92$, $SD = 10.81$) and urban students ($M = 80.00$, $SD = 13.49$), as the t-value of 1.25 is not statistically significant. This indicates that there is no distinction in self-efficacy scores between rural and urban students in the context of chemistry.

Effect of type of Management on Achievement in Chemistry and Self-efficacy in Chemistry

Data and result of test of mean score comparison of self-efficacy in chemistry and achievement in chemistry between Government and Aided secondary school students are presented in the table 5.

Table 5

Type of Management Differences in Self-Efficacy in Chemistry and Achievement in Chemistry among Secondary School Students

Variable		Type of Management	N	Mean	Std. Deviation	t-value
Achievement in Chemistry	in	Government	217	36.19	12.641	2.15*
		Aided	107	32.96	12.688	

Self-efficacy Chemistry	in	Government	217	82.81	11.887	3.28**
		Aided	107	78.35	10.784	

The provided data examines the mean scores and standard deviations for achievement in chemistry and self-efficacy in chemistry based on the type of management (government and aided). In terms of achievement in chemistry, the mean score for government-managed schools ($M = 36.19$, $SD = 12.641$) is significantly higher than that of aided schools ($M = 32.96$, $SD = 12.688$), as indicated by the t-value of 2.15^* ($p < .05$). This suggests that students in government-managed schools tend to have higher achievement scores in chemistry compared to students in aided schools.

Furthermore, when analyzing self-efficacy in chemistry, the mean score for government-managed schools ($M = 82.81$, $SD = 11.887$) is significantly higher than that of aided schools ($M = 78.35$, $SD = 10.784$), as indicated by the t-value of 3.28^{**} ($p < .01$). This indicates that students in government-managed schools have higher self-efficacy scores in chemistry compared to students in aided schools.

Relationship between Achievement in Chemistry and Self-efficacy in Chemistry

To find the relationship between Achievement in Chemistry and Self-efficacy in Chemistry Pearson's product moment correlations used. The obtained coefficient of correlation for total sample and subsample based on gender, locale and type of management are presented in table 6.

Table 6 Correlation Analysis of Achievement in Chemistry and Self-Efficacy in Chemistry: Pearson's Product Moment Correlations among Secondary School Students

Sample	r-value
Total	.291**
Male	.233**
Female	.339**
Rural	.236**
Urban	.425**
Government	.310**
Aided	.199**

The overall sample exhibits a positive correlation between achievement in Chemistry and self-efficacy in Chemistry, with an r-value of $.291^{**}$ ($p < .01$). This suggests that there is

a moderate positive relationship between these variables, indicating that higher levels of self-efficacy tend to be associated with higher levels of achievement in Chemistry.

When examining the subgroups based on gender, both males and females show a positive correlation between achievement and self-efficacy. However, the strength of the correlation differs slightly. For males, the correlation coefficient is .233** ($p < .01$), while for females, it is higher at .339** ($p < .01$). This suggests that the relationship between achievement and self-efficacy is stronger among females compared to males.

Considering the locale, both rural and urban areas display a positive correlation between achievement and self-efficacy. The correlation coefficient for rural areas is .236** ($p < .01$), and for urban areas, it is higher at .425** ($p < .01$). This indicates that the relationship between achievement and self-efficacy is stronger in urban areas compared to rural areas.

Lastly, when examining the type of management, both government-managed and aided schools show a positive correlation between achievement and self-efficacy. The correlation coefficient for government-managed schools is .310** ($p < .01$), and for aided schools, it is lower at .199** ($p < .01$). This suggests that the relationship between achievement and self-efficacy is stronger in government-managed schools compared to aided schools

Conclusion

In conclusion, the analysis of self-efficacy and achievement in chemistry among secondary school students provides valuable insights. Gender differences were examined, and it was found that females demonstrated significantly higher achievement scores in chemistry compared to males. However, there was no significant gender-based discrepancy in self-efficacy scores. These results highlight the importance of considering gender when addressing achievement disparities in chemistry education. Furthermore, the analysis of locale revealed that urban students outperformed their rural counterparts in terms of achievement in chemistry. However, there was no significant difference in self-efficacy scores between rural and urban students. This suggests the need for targeted interventions to support rural students in achieving higher levels of achievement in chemistry. Lastly, the type of management was found to impact both achievement and self-efficacy in chemistry. Government schools showed higher scores in both areas compared to aided schools. These findings emphasize the potential influence of school management on students' chemistry achievement and self-efficacy levels.

Overall, the study's findings contribute to a deeper understanding of the relationship between self-efficacy and achievement in chemistry among secondary school students in Kerala. These findings can inform educational policies and interventions aimed at promoting

positive outcomes in chemistry education, particularly in terms of gender disparities, rural-urban gaps, and school management considerations.

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