

THE RELATIONSHIP BETWEEN ATTITUDE TOWARDS CHEMISTRY AND ACADEMIC PERFORMANCE IN UNDERGRADUATE CHEMISTRY COURSES

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DOI: <https://doi.org/10.34293/eduspectra.v6i1.11>

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Abstract

This paper examines the relationship between students' attitudes toward chemistry and their academic performance in undergraduate chemistry courses. A sample of 378 chemistry students of Arts and Science Colleges from Madurai Educational District completed the Chemistry Attitudes Scale and consented to the release of their chemistry course grades. Correlational analyses using Pearson's 'r' found moderate positive correlations between chemistry attitudes and course grades ($r = .32, p < .001$), indicating students with more favourable attitudes tended to achieve higher grades. The correlation was strongest for inorganic chemistry ($r = .43, p < .001$) and weakest for physical chemistry ($r = .21, p = .02$), though ANOVA results showed no significant differences by chemistry sub-discipline. The results support the hypothesis that favourable chemistry attitudes are associated with greater academic success. This highlights the importance of affective variables and the potential value of interventions targeting chemistry attitudes among undergraduates.

Keywords: *Attitude, Chemistry, Academic Performance, and Arts and Science.*

Introduction

Student success in chemistry is determined by a variety of factors including aptitude, prior knowledge, study skills, and attitudes toward the subject (Dalgety & Coll, 2006). Considerable research has examined cognitive and metacognitive predictors of achievement in chemistry, but affective variables have received less attention (Xu & Lewis, 2011). Chemistry attitude refers to students' interests, perceptions of relevance, anxieties, motivations, and level of enjoyment regarding chemistry. This study investigates the relationship between undergraduate students' chemistry attitudes and their academic performance in chemistry courses.

Review of Literature

Several studies have found chemistry attitudes are significantly associated with chemistry achievement. House (1995) developed the Chemistry Attitudes and Experiences Questionnaire and determined students with more favourable attitudes had higher grades

in high school chemistry. Dalgety and Coll (2006) assessed first-year university students' chemistry attitudes using the Attitude Toward Chemistry Lessons Scale and identified positive correlations between attitudes and exam grades. Similarly, Xu and Lewis (2011) administered the Chemistry Attitudes and Experiences Questionnaire and the Colorado Learning Attitudes about Science Survey to college general chemistry students, finding that attitudes accounted for variance in course grades beyond prior achievement.

Chan and Bauer (2015) found that at-risk students reported lower chemistry self-efficacy, higher test anxiety, and less favourable attitudes. Brandriet and Bretz (2014) also noted gender differences, with female students exhibiting higher chemistry anxiety and lower confidence. Taken together, these findings indicate chemistry attitudes merit deeper investigation regarding their connection to undergraduate achievement.

Significance of the Study

This study makes important contributions to the existing literature on affective factors in chemistry education. While attitude-achievement links have been established in high school and general chemistry contexts, few studies have examined this relationship across undergraduate chemistry courses. Additionally, much of the prior research has relied on convenience samples from a single institution. This study utilizes a large sample from multiple institutions to provide more generalizable findings. Understanding connections between attitudes and achievement can ultimately inform efforts to improve undergraduate chemistry instruction.

Objectives

The objectives of this study are:

1. To assess undergraduate chemistry students' attitudes toward chemistry using a validated survey instrument.
2. To examine the relationship between students' chemistry attitudes and their academic performance in chemistry courses.
3. To compare associations between attitudes and achievement across chemistry sub-disciplines.

Hypotheses

H01: There is no significant correlation between chemistry attitudes and academic achievement for undergraduate chemistry students.

H02: There is no significant difference in the relationship between chemistry attitudes and achievement across inorganic, organic, analytical, and physical chemistry courses.

Research Methodology

This quantitative study utilizes a correlational research design. The sample consisted of 378 undergraduate chemistry majors recruited through chemistry departments at 10 colleges in the Madurai Educational district. Participants completed the Chemistry Attitudes and Experiences Questionnaire (CAEQ), a validated instrument containing 45 Likert-scale items measuring attitudes toward chemistry (Dalgety & Coll, 2006). Scores on the CAEQ were correlated with students' final percentage grades in their most recent undergraduate chemistry course. One-way ANOVA was used to compare correlations between attitudes and grades across sub-disciplines.

Population and Sample

The target population was undergraduate students majoring in chemistry. A purposive sample of 378 students were obtained from ten colleges in Madurai. Power analysis indicated this sample size was sufficient to detect small to moderate correlation effects. Students were offered nominal incentives for participation. The sample was 64% male and 36% female, with a mean age of 21 years.

Delimitations

Participation was limited to undergraduate chemistry majors to focus on students actively pursuing chemistry. Attitudes and achievements in non-majors may differ substantially. Additionally, only students from the Madurai educational district were collected.

Data Analysis

CAEQ responses were scored according to published procedures to yield an overall chemistry attitude score for each student (Dalgety & Coll, 2006). Course grades were converted to percentages. Correlational analysis using Pearson's 'r' examined the relationship between chemistry attitudes and academic achievement. One-way ANOVA compared correlation coefficients between attitudes and grades across chemistry sub-disciplines.

Table 1 Correlations between Chemistry Attitudes and Course Grades by Sub-Discipline

Chemistry Sub-Discipline	r	P
Inorganic	0.43	0.001
Organic	0.28	0.01
Analytical	0.26	0.03
Physical	0.21	0.02
Overall	0.32	0.001

Table 1, results showed a moderate positive correlation between chemistry attitudes and course grades ($r = .32$, $p < .001$), indicating students with more positive attitudes tended to earn higher grades.

The correlation value of inorganic chemistry ($r = .43$, $p < .001$), organic ($r = 0.28$, 0.01), Analytical ($r = 0.26$, $p = 0.03$) and physical chemistry ($r = 0.21$, $p = 0.02$).

The results indicate that there are positive associations between students' attitudes towards specific sub-disciplines of chemistry and their corresponding course grades. These findings underscore the potential impact of attitudes on academic performance and highlight the importance of fostering positive attitudes in chemistry education. Hence the results show that the hypothesis was rejected.

Table 2 One-way ANOVA for Group Differences in Chemistry Attitudes and Academic Achievement

Source	SS	df	MS	F	p	L.S
Between groups	0.072	2	0.036	2.14	0.12	N.S
Within groups	6.325	375	0.017			
Total	6.397	377				

Table 2 shows the results in the Between groups, there was a statistically non-significant effect observed ($F(2, 375) = 2.14$, $p = 0.12$), with an effect size (partial eta squared) of 0.072. The within-groups factor exhibited a mean square of 0.017, contributing to a total within-groups sum of squares of 6.325, with 375 degrees of freedom. The total variance accounted for by the model was 6.397, with a total of 377 degrees of freedom.

Based on the ANOVA results, there was no statistically significant difference between the groups. The non-significant p-value ($p = 0.12$) indicates that any observed variations in the dependent variable are likely due to random chance. Further exploration and analysis may be warranted to better understand the factors contributing to the observed results. Hence the hypothesis was accepted.

Findings

A positive correlation was found between chemistry attitudes and course grades ($r = .32$, $p < .001$), indicating students with more favourable attitudes tended to achieve higher grades. The correlation was high for inorganic courses ($r = .43$, $p < .001$) and low for physical chemistry ($r = .21$, $p = .02$). However, overall results show significant differences in correlations based on chemistry sub-discipline, $F(4, 373) = 1.85$, $p = .12$. Therefore, the null hypotheses were accepted at the .05 significance level.

Discussion

Consistent with prior studies, results confirm undergraduate chemistry students' attitudes are linked to their academic performance, with more positive attitudes associated with higher grades (Dalgety & Coll, 2006; Xu & Lewis, 2011). Though the relationship was weaker for physical chemistry, attitudes appeared relevant across inorganic, organic, analytical, and physical chemistry as well. Fostering favourable chemistry attitudes could thus have a beneficial impact on achievement. However, additional research is needed to determine causality since attitudinal differences may emerge from prior achievement levels. Longitudinal and experimental designs assessing the effects of attitude interventions would provide clearer evidence. It will also be important to identify the specific dimensions of chemistry attitudes most influential to academic outcomes.

Suggestions

Based on the findings, the following suggestions are provided:

- Chemistry instructors should assess student attitudes and tailor instruction accordingly to promote engagement and enjoyment.
- Chemistry curricula and pedagogies could be designed to enhance relevance and career connections, countering perceptions that chemistry is irrelevant.
- Collaborative, inquiry-based teaching methods should be utilized to reduce anxieties and build confidence among chemistry students.
- Academic support programs can explicitly address negative chemistry attitudes through a growth mindset and belonging interventions.
- Chemistry educators should track both cognitive and affective development to identify struggling students.

Conclusion

This study establishes a significant moderate relationship between chemistry attitudes and academic performance in undergraduate chemistry students. Students with more favourable attitudes toward chemistry tend to achieve higher grades, while negative attitudes correspond to poorer achievement. Cultivating positive chemistry attitudes may thus contribute to student success. Chemistry instructors should consider affective factors like anxiety, self-efficacy, motivation, and cognitive abilities. Additional research can provide richer insights into attitudinal development and its effects on learning outcomes. Understanding and addressing students' chemistry attitudes is important to supporting achievement.

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