The Impact of Guided Discovery and Blended Learning Approaches on Undergraduate Students' Attitudes towards Chemistry: A Comparative Study

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Abstract - This study investigated the effects of guided discovery and blended learning approaches on students' attitudes toward chemistry, examining overall attitudes and cognitive, affective, and behavioral components. A pre-test and post-test experimental design was employed with two experimental groups. The study involved 40 first-year undergraduate chemistry students from various colleges in Madurai District, Tamil Nadu. Using purposive sampling, students were equally divided into two homogeneous groups of 20 each: experimental group I using the guided discovery approach and experimental group II using the blended learning approach. Data were collected from pre-tests and post-tests administered to both groups. Paired t-tests were used to compare pre-test and post-test scores within each experimental group, with significance levels of 0.05 and 0.01 considered. Both approaches significantly improved students' overall attitudes towards chemistry. Group I (guided discovery) showed a significant improvement ($p<0.05$) in overall attitudes, with a pre-test mean of 74.30 increasing to 83.65 post-test. Group II (blended learning) revealed an even more substantial improvement ($p<0.01$) in overall attitudes, with a pre-test mean of 65.15 rising to 90.41 post-test. However, when examining individual attitude components (cognitive, affective, and behavioral), neither approach produced statistically significant changes. This suggests that while guided discovery and blended learning approaches can positively impact attitudes toward chemistry, their effects on specific attitudinal components may be more complex. The study highlights the potential of both approaches in improving students' overall attitudes towards chemistry, with blended learning showing auspicious results. These findings contribute to a better understanding of effective teaching approaches in chemistry education

Key Words: ***Effect, Guided discovery, Blended learning, Attitude, Cognitive, Affective, Behaviour and Chemistry.***

I. INTRODUCTION

In the teaching-learning process, efficient teaching is essential because it increases students' attention spans and level of engagement with the material. In similar ways, learning is crucial to the teaching-learning process. Learning encourages students to interact with their subjects in the classroom and to effectively participate in the subject matter. It also fosters a positive attitude toward the subject matter and intrinsic motivation. Most significant discoveries made in the 20th and 21st centuries have their roots in the physical science of chemistry, as interest in biological approaches and more environmentally friendly synthetic systems, such as forensic, environmental, soil, and water chemistry, grows.

Learner-centered and teacher-centered approaches are the two broad categories into which teaching methods can be divided. Learner-centered approaches often require more effort from the teacher in terms of preparation and facilitation. These approaches aim to develop students' ability to learn independently, gradually reducing their reliance on direct teacher guidance. Greeson (1988) reported that learner-centered approaches generated more ideas and questions compared to teacher-centered approaches. Learner-centered methods included personal goal setting, self-monitoring, individual conferences, and informal group discussions. In contrast, teacher-centered methods included lectures, formal tests, and assignments.

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Teachers can encourage active learning in the cognitive component by using practical experiments, role-playing, and problem-solving techniques. Establishing a happy and emotionally stimulating learning environment is part of the affective component. It is easier for students to understand the relevance of chemistry when concepts are connected to real-world applications and their effects on society are emphasized. Establishing a disciplined learning environment and communicating expectations is essential for the behavioral component. Giving students constructive criticism on their behavior as well as their academic performance aids in their progress. By working together, educators can develop a thorough and engaging chemistry curriculum that fosters students' positive behavioral traits, emotional engagement, and cognitive growth.

II. Review of Related Literature

Tekin et al., (2020) investigated the imagery and creativity of the 7th Grade students using the guided discovery method. The results of the study showed that there was a significant difference between the level of imagery and creativity of the 7th-grade students in favor of the post-test according to the guided discovery method. The results of the study also showed that the level of imagination and creativity of secondary school students participating in the experimental study showed a significant difference after the experiment. Finally, it concluded that, in different treatment groups the repeated effects of the factors of repeated measures on imagination and creativity were meaningful.

Tahira Anwar Lashari and Maizam Alias (2013) investigated a study on 'An Affective-Cognitive Teaching and Learning Approach for Enhanced Behavioural Engagements among Engineering Students'. The results indicated that the integrated affective-cognitive learning approach promotes some types of positive behavioral engagement while suppressing other types of negative engagement. Thus, it was concluded that the integrated teaching and learning approach was effective in promoting positive behavioral engagements among engineering students.

III. Significance of the Study

This research holds significant importance in the field of chemistry education, particularly at the undergraduate level. As science education continues to evolve, understanding the effectiveness of different teaching approaches becomes crucial. This study's comparison of guided discovery and blended learning approaches offers valuable insights into innovative methods for improving students' attitudes toward chemistry. The focus on both overall attitudes and specific components (cognitive, affective, and behavioral) provides a comprehensive view of how these teaching methods impact student perceptions. This is particularly relevant given the challenges often associated with engaging students in chemistry courses. By examining these approaches with first-year undergraduate students, the study addresses a critical period in chemistry education where positive attitudes can significantly influence future academic and career choices. Furthermore, this research contributes to the ongoing dialogue about integrating technology and interactive methods in chemistry education. This present study ultimately aims to enhance the quality of chemistry education and student engagement in the sciences.

3.1 Operational Definition of Key Terms

A) Impact

The measurable change in students' attitudes towards chemistry, as determined by the difference between pre-test and post-test scores on a standardized attitude assessment tool.

B) Guided Discovery Approach

A teaching method where the instructor provides a framework and guidance for students to explore and discover chemical concepts independently. This approach involves structured activities, leading questions, and scaffolded learning experiences that encourage students to construct their understanding of chemistry principles.

C) Blended Learning Approach

An instructional strategy that combines traditional face-to-face classroom methods with online digital media. This study refers to a teaching method where students engage in both in-person chemistry lessons and online learning activities, such as virtual simulations, interactive quizzes, and digital resources.

D) Attitude

A student's overall disposition towards chemistry encompasses cognitive (knowledge and beliefs), affective (feelings and emotions), and behavioral (actions and intentions) components. It is measured using a multi-dimensional attitude scale specifically designed for chemistry education.

E) Chemistry

The scientific discipline that deals with the composition, structure, properties, and reactions of matter. In the context of this study, it refers to the undergraduate-level chemistry course content that students are engaged with during the experimental period.

F) Objectives

1. To assess the impact of a guided discovery approach on students' overall attitudes towards chemistry.
2. To evaluate the effect of a blended learning approach on students' overall attitudes towards chemistry.

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3. To examine the influence of guided discovery on students' cognitive, affective, and behavioral attitudes in chemistry.
4. To investigate the impact of blended learning on students' cognitive, affective, and behavioral attitudes in chemistry.
5. To compare the effectiveness of guided discovery and blended learning approaches in improving students' attitudes toward chemistry.

G) Hypotheses

1. There is a significant difference between the pre-test and post-test overall attitudes of students exposed to the guided discovery approach in chemistry.
2. There is a significant difference between the pre-test and post-test cognitive attitudes of students exposed to the guided discovery approach in chemistry.
3. There is a significant difference between the pre-test and post-test affective attitudes of students exposed to the guided discovery approach in chemistry.
4. There is a significant difference between the pre-test and post-test behavioral attitudes of students exposed to the guided discovery approach in chemistry.
5. There is a significant difference between the pre-test and post-test overall attitudes of students exposed to the blended learning approach in chemistry.
6. There is a significant difference between the pre-test and post-test cognitive attitudes of students exposed to the blended learning approach in chemistry.
7. There is a significant difference between the pre-test and post-test affective attitudes of students exposed to the blended learning approach in chemistry.
8. There is a significant difference between the pre-test and post-test behavioral attitudes of students exposed to the blended learning approach in chemistry.

IV. POPULATION OF THE STUDY

The population for the present study consists of first-year Undergraduate chemistry students studying in various colleges in the Madurai District in Tamil Nadu.

4.1 Sample and sampling techniques of the study

40 students from a homogeneous group were selected using the purposive sampling technique. The participants were divided into two groups like, experimental group I with 20 students, and experimental group II with 20 students. These groups were selected by the investigator to examine the impact of different teaching approaches on students' attitudes toward chemistry, specifically focusing on their attitudinal components (Cognitive, Affective, and Behavioural) at the undergraduate level.

4.2 Tools of the Study

The investigator constructed an attitude scale on cognitive, affective, and behavioral components toward learning chemistry at tertiary level students.

4.3 Statistical technique of the study

The collected data was statically analyzed by using the 't'-test technique.

a) Experimental group I - Students' overall attitude in guided discovery approach

There is a significant difference between the pre-test and post-test overall attitudes of students exposed to the guided discovery approach in chemistry.

Table – 1: *Showing the significance of the mean difference between the overall pre-test and post-test experimental group I students' attitude in chemistry subject by using a guided discovery approach*

Experimental group I	Students' overall attitude in guided discovery approach			
	M	SD	't' test	Level of Significance
Pre-test	74.30	15.73	2.09	S (0.05 Level)
Post-test	83.65	12.32		

***Significant at 0.05 level*

Table 1 analyses the overall pre-test and post-test experimental group I students' attitudes in chemistry subject by using a guided discovery approach. The pre-test and post-test experimental group I students' attitudes in chemistry subject have significant differences. Hence the hypothesis is accepted.

b) Experimental group I - Students' cognitive attitude in guided discovery approach

There is a significant difference between the pre-test and post-test cognitive attitudes of students exposed to the guided discovery approach in chemistry.

Table – 2: *Showing the significance of the mean difference between the overall pre-test and post-test experimental group I cognitive students' attitude in chemistry subject by using a guided discovery approach*

Experimental group I	Students' cognitive attitude in guided discovery approach			
	M	SD	't' test	Level of Significance
Pre-test	81.50	16.20	0.19	NS (0.01 Level)
Post-test	82.50	16.94		

NS – Not Significant

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Table 2 analyses the overall pre-test and post-test experimental group I students' cognitive attitude in chemistry subject by using a guided discovery approach. The pre-test and post-test experimental group I students' cognitive attitudes in chemistry subject have no significant difference. Hence the hypothesis is rejected.

c) Experimental group I - Students' affective attitude in guided discovery approach

There is a significant difference between the pre-test and post-test affective attitudes of students exposed to the guided discovery approach in chemistry.

Table – 3: *Showing the significance of the mean difference between the overall pre-test and post-test experimental group I affective students' attitudes in chemistry subject by using a guided discovery approach*

Experimental group I	Students' affective attitude in guided discovery approach			
	M	SD	't' test	Level of Significance
Pre-test	83.90	15.57	0.32	NS (0.01 Level)
Post-test	85.50	15.39		

NS – Not Significant

The above Table 3 notices that the overall pre-test and post-test experimental group I students' affective attitude in chemistry subject by using a guided discovery approach. The pre-test and post-test experimental group I students' affective attitude in chemistry subject have no significant difference. Hence the hypothesis is rejected.

d) Experimental group I - Students' behavioral attitude in the guided discovery approach

There is a significant difference between the pre-test and post-test behavioral attitudes of students exposed to the guided discovery approach in chemistry.

Table – 4: *Showing the significance of the mean difference between the overall pre and post-test experimental group I behavioral students' attitude in chemistry subject by using a guided discovery approach*

Experimental group I	Student's behavioral attitude in the guided discovery approach			
	M	SD	't' test	Level of Significance
Pre-test	88.55	13.85	0.36	NS (0.01 Level)
Post-test	90.10	13.13		

NS – Not Significant

Table 4 indicates the overall pre-test and post-test experimental group I students' behavioral attitude in chemistry subject by using a guided discovery approach. The pre-test and post-test experimental group I students' behavioral attitudes in chemistry subject have no significant difference. Hence the hypothesis is rejected.

e) Experimental group II - Students' overall attitude in Blended learning approach

There is a significant difference between the pre-test and post-test overall attitudes of students exposed to the blended learning approach in chemistry.

Table – 5: *Showing the significance of the mean difference between the overall pre-test and post-test experiment group II students' attitude in chemistry subject by using a blended learning approach*

Experimental group II	Students' overall attitude in the blended learning approach			
	M	SD	't' test	Level of Significance
Pretest	65.15	13.47	5.80	S (0.01 Level)
Post-test	90.41	14.08		

****Significant at 0.01 level***

The above Table 5 notices that the overall pre-test and post-test experimental group II students' attitudes in chemistry subject by using a blended learning approach. The pre-test and post-test experimental group II students' attitudes in chemistry subject have significant differences. Hence the hypothesis is accepted.

f) Experimental group II - Students' Cognitive Attitude in Blended Learning Approach

There is a significant difference between the pre-test and post-test cognitive attitudes of students exposed to the blended learning approach in chemistry.

Table – 6: *Showing the significance of the mean difference between the overall pre-test and post-test experiment group II cognitive students' attitude in chemistry subject by using a blended learning approach*

Experimental group II	Students' cognitive attitude in the blended learning approach			
	M	SD	't' test	Level of Significance
Pre-test	92.50	16.71	0.54	NS (0.01 Level)
Post-test	95.30	16.04		

NS – Not Significant

Table 6 indicates the overall pre-test and post-test experimental group II students' cognitive attitude in chemistry subject by using a blended learning approach. The pre-test and post-test experimental group II students' cognitive attitudes in chemistry subject have no significant difference. Hence the hypothesis is rejected.

g) Experimental group II - Students' affective attitude in Blended learning approach

There is a significant difference between the pre-test and post-test affective attitudes of students exposed to the blended learning approach in chemistry.

Table – 7: *Showing the significance of the mean difference between the overall pre-test and post-test experiment group*

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II affective students' attitudes in chemistry subject by using a blended learning approach

Experimental group II	Students' affective attitude in the blended learning approach			
	M	SD	't' test	Level of Significance
Pre-test	81.65	17.55	0.06	NS (0.01 Level)
Post-test	82.00	15.80		

NS – Not Significant

The above Table 7 notices that the overall pre and post-test experimental group II students' affective attitude in chemistry subject by using a blended learning approach. The pre-test and post-test experimental group II students' affective attitude in chemistry subject have no significant difference. Hence the hypothesis is rejected.

h) Experimental group II - Students' behavioral attitude in Blended learning approach

There is a significant difference between the pre-test and post-test behavioral attitudes of students exposed to the blended learning approach in chemistry.

Table – 8: *Showing the significance of the mean difference between the overall pre-test and post-test experiment group II behavioral students' attitude in chemistry subject by using a blended learning approach*

Experimental group II	Student's behavioral attitude in the blended learning approach			
	M	SD	't' test	Level of Significance
Pretest	78.00	18.45	0.41	NS (0.01 Level)
Post-test	80.40	18.00		

NS – Not Significant

Table 8 analyses the overall pre-test and post-test experimental group II students' behavioral attitude in chemistry subject by using a blended learning approach. The pre-test and post-test experimental group II students' behavioural attitudes in chemistry subject have no significant difference. Hence the hypothesis is rejected.

4.4 Findings and Discussion

The study reveals that both guided discovery and blended learning approaches significantly improve overall student attitudes toward chemistry. This finding aligns with previous research suggesting that interactive and technology-enhanced learning methods can increase student engagement and positive perceptions of science subjects.

The blended learning approach showed a more substantial improvement in overall attitudes compared to guided discovery. This could be attributed to the flexibility and diverse learning opportunities offered by blended learning, which may cater to a wider range of learning styles and preferences.

Interestingly, neither approach produced statistically significant changes in individual attitudinal components. This unexpected result warrants further investigation. It may suggest that overall attitudes are more readily influenced by teaching approaches, while specific components like cognitive understanding, emotional connection, and behavioral intentions towards chemistry are more resistant to change or require more targeted interventions.

4.5 Recommendations

- Implement blended learning approaches more widely in undergraduate chemistry courses, given their significant positive impact on overall attitudes.
- Integrate elements of guided discovery into traditional chemistry curricula to improve student attitudes toward the subject.
- Conduct further research to understand why these approaches did not significantly affect individual attitudinal components (cognitive, affective, and behavioral).
- Develop and test targeted interventions to address specific attitudinal components in chemistry education.
- Investigate the long-term effects of these teaching approaches on student performance and retention in chemistry-related fields.
- Explore combinations of guided discovery and blended learning approaches to potentially maximize their benefits.

V. CONCLUSION

This study showed that both guided discovery and blended learning approaches can significantly improve undergraduate students' overall attitudes toward chemistry, with blended learning showing particularly promising results. However, the complexity of attitudinal change is evident in the lack of significant impact on specific attitudinal components. These findings underscore the potential of innovative teaching approaches in enhancing student engagement with chemistry. The study also highlights the need for a detailed understanding of how different pedagogical approaches influence various aspects of student attitudes. While the study provides valuable insights into effective teaching strategies for chemistry education, it also opens new avenues for research into the mechanisms of attitudinal change in science education. Educators and researchers are encouraged to continue exploring and refining these approaches to optimize learning outcomes and student experiences in chemistry and other scientific disciplines.

DECLARATIONS

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