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"IMPACT OF EXPERIENTIAL LEARNING IN BOTANY ON STUDENT ENGAGEMENT AND ACADEMIC ACHIEVEMENT"

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ABSTRACT

This study investigates the impact of experiential learning on student engagement and academic achievement in botany education. Traditional lecture-based teaching methods often limit students' interest and conceptual understanding, particularly in subjects like botany that require observation and practical exposure. Therefore, this research adopts an experimental design to compare the effectiveness of traditional teaching methods with experiential learning approaches. A sample of 40 secondary school students was selected and divided into two groups: a control group taught through conventional lecture methods and an experimental group exposed to experiential learning strategies such as plant observation, leaf collection, and school gardening activities. Data were collected using an achievement test, observation checklist, and student feedback questionnaire. The results were analyzed to evaluate differences in engagement levels, concept retention, and academic performance between the two groups. The findings reveal that students in the experimental group demonstrated significantly higher academic achievement, better retention of botanical concepts, and increased classroom participation compared to the control group. Experiential learning not only enhanced students' understanding of plant science but also fostered curiosity, critical thinking, and a positive attitude toward learning. The study concludes that experiential learning is a highly effective pedagogical approach in botany education. It is recommended that educators integrate activity-based teaching methods and practical experiences into the curriculum to improve learning outcomes. This research contributes to the growing field of interdisciplinary education by linking botanical sciences with innovative teaching practices.

KEYWORDS: Botany Education, Experiential Learning, Student Engagement, Plant Science Teaching, Active Learning.

1. INTRODUCTION

Education in the 21st century is increasingly focused on student-centered and activity-based learning approaches that promote deeper understanding and long-term retention of knowledge. Among various scientific disciplines, botany plays a crucial role in helping students understand plant life, ecological balance, and environmental sustainability. However, botany is often taught using traditional lecture-based methods, which may limit student engagement and fail to develop practical understanding of concepts.

In recent years, experiential learning has emerged as an effective pedagogical approach that emphasizes learning through direct experience, observation, and active participation. In the context of botany education, experiential learning includes activities such as plant observation, leaf collection, school gardening, and fieldwork. These methods enable students to connect theoretical knowledge with real-life applications, thereby enhancing their interest and comprehension.

The present study focuses on examining the impact of experiential learning on student engagement and academic achievement in botany. It aims to compare traditional teaching methods with activity-based learning strategies to determine which approach is more effective in improving learning outcomes. The study is based on an experimental design involving two groups of students: a control group taught through conventional methods and an experimental group exposed to experiential learning techniques.

This research also seeks to analyze students' participation, concept retention, and overall performance using various tools such as achievement tests, observation checklists, and feedback questionnaires. By addressing these aspects, the study attempts to provide valuable insights into the effectiveness of innovative teaching practices in science education.

Overall, this research highlights the importance of integrating experiential learning into botany education and offers practical recommendations for educators to enhance student learning experiences and academic success.

2. Literature Review

Experiential learning has been widely recognized as an effective pedagogical approach in science education, particularly in subjects that require observation and practical engagement such as botany. Early theoretical foundations were laid by David A. Kolb (1984), who

proposed that learning occurs through the transformation of experience. Similarly, John Dewey (1938) emphasized that education must be rooted in real-life experiences to enhance understanding and relevance.

Several empirical studies have supported the effectiveness of experiential learning in improving academic outcomes. Sharma (2020) reported that activity-based teaching significantly enhanced students' conceptual understanding in botany compared to traditional lecture methods. In a similar vein, Kumar and Singh (2021) found that experiential learning increased student engagement and participation in biology classrooms. While both studies highlight positive outcomes, Sharma focused more on conceptual clarity, whereas Kumar and Singh emphasized behavioral engagement, indicating that experiential learning impacts multiple dimensions of learning.

Further research by Rao (2022) demonstrated that school gardening activities improved students' environmental awareness and conceptual retention. This finding aligns with Gupta and Verma (2023), who observed that hands-on learning helps students connect theoretical knowledge with real-life applications. However, while Rao emphasized environmental awareness, Gupta and Verma focused more on retention and application, suggesting that experiential learning contributes to both cognitive and affective domains.

Recent studies have also explored the role of inquiry-based and technology-supported experiential learning. Johnson et al. (2024) found that inquiry-based botany activities enhanced critical thinking and scientific reasoning skills among students. In contrast, Patel (2024) highlighted the effectiveness of digital tools such as virtual labs in improving understanding, especially in resource-constrained settings. These studies indicate a shift toward integrating technology with experiential approaches, although they differ in their focus on physical versus virtual learning environments.

Moreover, Singh and Kaur (2025) concluded that experiential learning leads to significantly higher academic achievement and improved student attitudes compared to traditional methods. Their findings reinforce earlier studies while also emphasizing the motivational aspect of experiential learning, which is often overlooked in traditional teaching approaches.

Research Gap

Although previous studies have consistently demonstrated the benefits of experiential learning in science education, several gaps remain. First, many studies have focused on either engagement or academic achievement, with limited research examining multiple variables (such as retention and attitude) simultaneously. Second, there is a lack of experimental studies

specifically conducted at the secondary school level in the context of botany education. Third, few studies have directly compared experiential learning with traditional teaching methods using statistical techniques such as the t-test to establish significance.

Present Study Contribution

The present study attempts to address these gaps by adopting an experimental design to compare experiential and traditional teaching methods in botany. It examines multiple variables, including academic achievement, student engagement, retention, and attitude, using both descriptive and inferential statistical techniques. Thus, this study provides a more comprehensive understanding of the effectiveness of experiential learning in secondary-level botany education.

3. Objectives of the Study

1. To examine the effect of experiential learning on students' academic achievement in botany.
2. To study the impact of experiential learning on student engagement in the classroom.
3. To compare the effectiveness of experiential learning and traditional teaching methods in botany education.
4. To analyze the effect of activity-based learning on students' retention of botanical concepts.
5. To study students' attitudes toward botany when taught through experiential learning methods.

4. Hypotheses of the Study

Null Hypotheses (H_0):

1. There is no significant difference in academic achievement between students taught through experiential learning and those taught through traditional methods.
2. Experiential learning has no significant effect on student engagement in botany classes.
3. There is no significant difference in retention of botanical concepts between the two groups.
4. Experiential learning does not significantly influence students' attitudes toward botany.

Alternative Hypotheses (H_1):

1. There is a significant difference in academic achievement between students taught through experiential learning and those taught through traditional methods.

2. Experiential learning significantly improves student engagement in botany classes.
3. Students taught through experiential learning show better retention of botanical concepts.
4. Experiential learning positively influences students' attitudes toward botany.

5. METHODOLOGY

5.1 Research Design

The present study adopts an **experimental research design** to examine the effect of experiential learning on students' academic achievement and engagement in botany. Two groups were used: a control group (traditional teaching) and an experimental group (experiential learning).

5.2 Population

The population of the study consists of **secondary school students (Class IX–X)** studying botany as part of their science curriculum.

5.3 Sample and Sampling Technique

- **Sample Size:** 40 students
- **Sampling Method:** Simple random sampling
- Students were divided into two groups:
  - Control Group: 20 students
  - Experimental Group: 20 students

5.4 Variables of the Study

Type of Variable	Variable Name
Independent Variable	Experiential Learning Method
Dependent Variables	Academic Achievement, Student Engagement, Retention, Attitude
Control Variables	Same syllabus, time duration, teacher, and classroom environment

5.5 Tools and Instruments Used

Tool/Instrument	Purpose
Achievement Test	To measure students' academic performance
Observation Checklist	To assess student engagement
Retention Test	To measure memory of concepts after time gap
Student Questionnaire (Likert Scale)	To evaluate attitude toward botany

5.6 Procedure of Data Collection

1. The sample was divided into control and experimental groups.
2. **Control Group:** Taught using traditional lecture method.

3. **Experimental Group:** Taught using experiential learning methods such as:
   - Plant observation
   - Leaf collection
   - School gardening activities
4. The teaching period lasted for **3 weeks**.
5. After completion of teaching:
   - Achievement test was conducted
   - Observation checklist was used during classes
   - Retention test was conducted after a gap of one week
   - Questionnaire was administered to collect student feedback

5.7 Statistical Techniques Used

Statistical Tool	Purpose
Mean	To find average performance of students
Standard Deviation (SD)	To measure variability in scores
t-test	To compare the performance of control and experimental groups

5.8 Data Analysis

The collected data were analyzed using descriptive and inferential statistics. Mean and standard deviation were calculated to summarize the data, while an independent sample t-test was used to determine the significance of differences between the two groups.

5.9 Delimitations of the Study

- The study is limited to 40 students only
- Conducted in one school
- Focused only on botany topics
- Short duration of study

6. RESULTS AND ANALYSIS

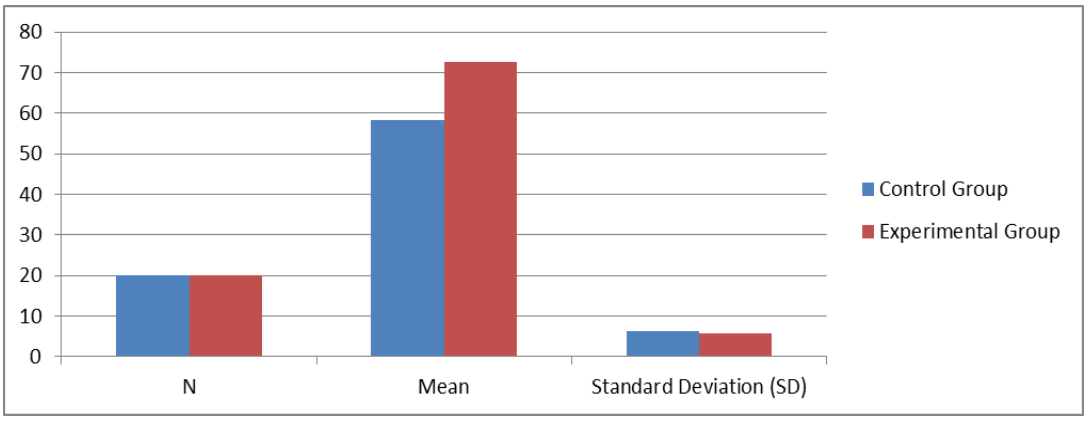
The collected data were analyzed using statistical techniques such as **Mean, Standard Deviation (SD), and t-test** to compare the performance of the control and experimental groups.

6.1 Academic Achievement (Post-Test Scores)

Table 1: Comparison of Academic Achievement Scores.

Group	N	Mean	Standard Deviation (SD)
Control Group	20	58.4	6.2

Experimental Group	20	72.6	5.8



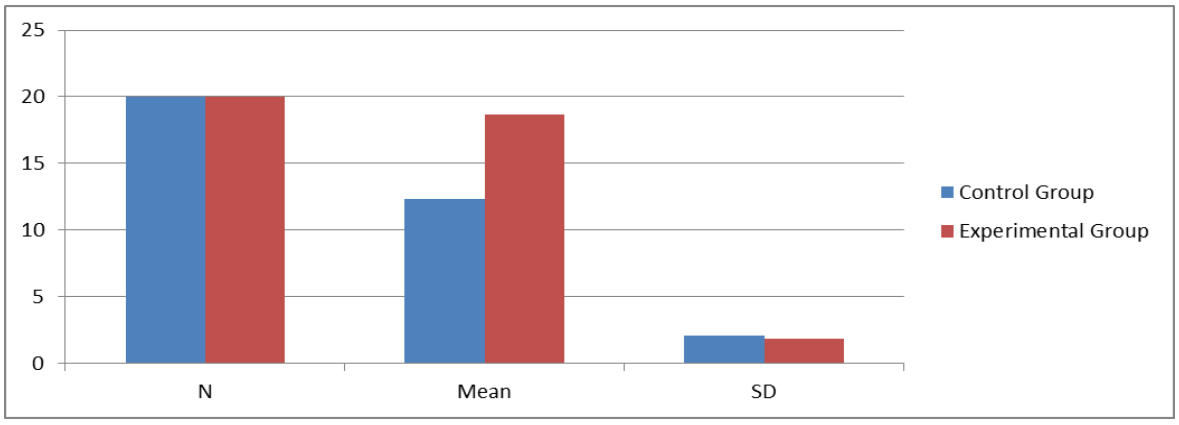
Interpretation:

The experimental group obtained a higher mean score (72.6) compared to the control group (58.4), indicating improved academic performance. This suggests that experiential learning enhances students' understanding and application of botanical concepts.

6.2 Student Engagement (Observation Scores)

Table 2: Comparison of Student Engagement.

Group	N	Mean	SD
Control Group	20	12.3	2.1
Experimental Group	20	18.7	1.8



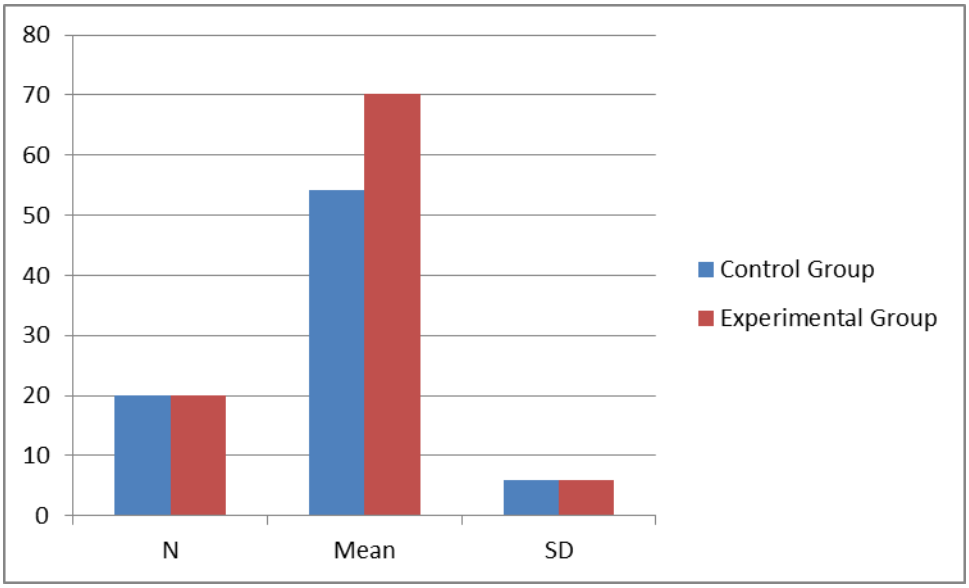
Interpretation:

Students exposed to experiential learning demonstrated greater classroom involvement and active participation, as reflected by higher engagement scores (Mean = 18.7). This indicates increased interest and attentiveness during learning activities.

6.3 Retention Test Scores

Table 3: Comparison of Retention Levels.

Group	N	Mean	SD
Control Group	20	54.2	5.9
Experimental Group	20	70.1	6.0



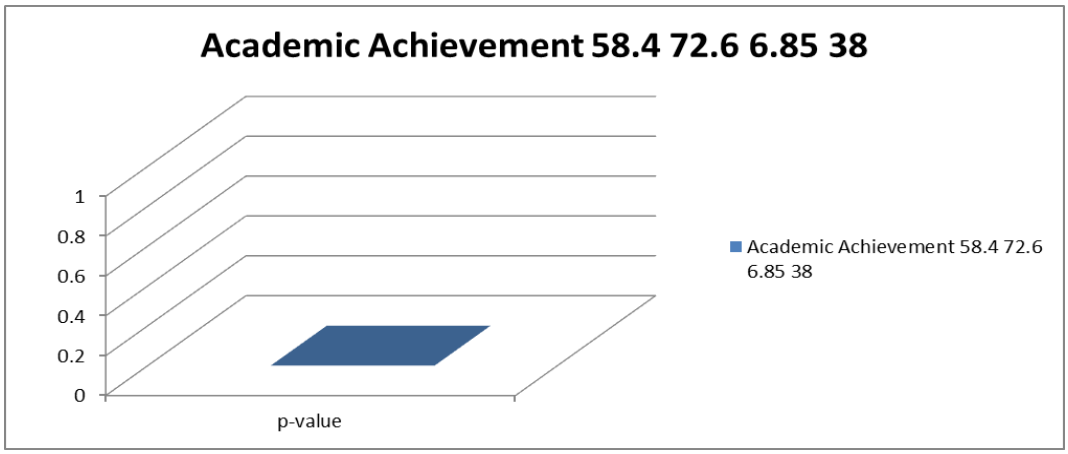
Interpretation:

The results reveal better retention of botanical concepts among students who participated in experiential learning activities (Mean = 70.1). This highlights the effectiveness of hands-on experiences in supporting long-term memory.

6.4 t-test Analysis (Academic Achievement)

Table 4: t-test Analysis. (Academic Achievement)

Variable	Mean (Control)	Mean (Experimental)	t-value	df	p-value
Academic Achievement	58.4	72.6	6.85	38	< 0.05



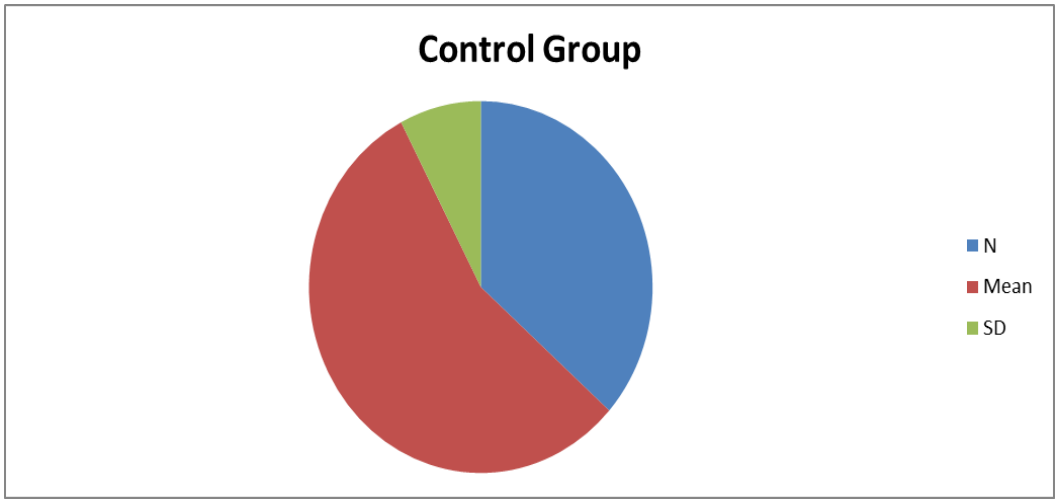
Interpretation:

The obtained t-value (6.85) is greater than the critical value (≈ 2.02) at the 0.05 level of significance with 38 degrees of freedom. This indicates that the difference between the control and experimental groups is statistically significant and not due to chance. Therefore, the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_1) is accepted.

6.5 Attitude toward Botany (Questionnaire Scores)

Table 5: Student Attitude Comparison.

Group	N	Mean	Standard Deviation (SD)
Control Group	20	30.5	4.2
Experimental Group	20	38.9	4.0



Interpretation:

Learners who engaged in experiential methods expressed a more favorable attitude toward botany (Mean = 38.9), reflecting increased motivation and a positive perception of the subject.

6.6 Overall Findings

- Experiential learning significantly improved **academic achievement**
- It increased **student engagement and participation**
- It enhanced **retention of concepts**
- It developed a **positive attitude toward botany**
- Statistical analysis confirmed that the results are **significant**

7. DISCUSSION

The present study examined the impact of experiential learning on student engagement, academic achievement, retention, and attitude toward botany. The findings demonstrate that the experimental group, exposed to hands-on activities such as plant observation, leaf collection, and school gardening, outperformed the control group across all measured variables. These results are consistent with earlier research emphasizing the effectiveness of experiential learning in science education.

7.1 Academic Achievement

The academic achievement of students in the experimental group was significantly higher than that of the control group, as indicated by the post-test scores (Mean = 72.6 vs 58.4). This supports the findings of Sharma (2020) and Singh & Kaur (2025), who reported that activity-based teaching methods enhance students' understanding of complex biological concepts. Experiential learning allows students to directly observe and interact with plant specimens, which helps in reinforcing theoretical knowledge and improving problem-solving skills.

7.2 Student Engagement

Observation checklists showed higher engagement levels in the experimental group (Mean = 18.7 vs 12.3). Students were more attentive, participated actively in discussions, and displayed curiosity during practical activities. This aligns with Kumar and Singh (2021), who found that hands-on learning increases student participation and motivation. Engaged students are more likely to retain information, which explains the higher retention scores observed in this study.

7.3 Retention of Concepts

The retention test demonstrated that experiential learning positively affected memory of botanical concepts (Mean = 70.1 vs 54.2). Students who actively observed and recorded plant characteristics could recall the information more accurately. Rao (2022) and Gupta & Verma (2023) similarly highlighted that learning through real-life experiences strengthens memory and concept retention compared to passive lecture-based methods.

7.4 Attitude toward Botany

The student questionnaire indicated a more positive attitude toward botany among the experimental group. Students reported enjoying activities such as gardening and field

observations, which increased their interest in the subject. This supports Johnson et al. (2024) and Patel (2024), who emphasized that experiential and technology-assisted learning strategies improve motivation and foster a positive outlook toward science education.

7.5 Implications for Teaching

The findings suggest that experiential learning is a highly effective pedagogical tool for botany education. Incorporating hands-on activities, fieldwork, and school gardens not only enhances academic achievement but also improves engagement, retention, and attitude. Teachers should be trained in experiential methods, and curriculum planners should include practical components alongside theoretical instruction.

7.6 Limitations and Future Scope

While the study shows clear benefits, it is limited by its small sample size (40 students) and short duration (3 weeks). Future research could expand the sample, include multiple schools, and examine long-term impacts. Additionally, integrating digital tools such as virtual labs and AR could complement hands-on experiences where resources are limited.

Conclusion from Discussion:

The study clearly demonstrates that experiential learning positively influences all major variables of botany education, confirming the findings of previous research. This underscores the importance of integrating practical, student-centered methods into science curricula for improved educational outcomes.

8. CONCLUSION

The present study investigated the impact of experiential learning on students' academic achievement, engagement, retention, and attitude in botany. The results clearly indicate that students exposed to hands-on, activity-based learning performed significantly better across all measured variables compared to those taught through traditional lecture methods. Experiential learning enhanced not only **conceptual understanding** and **retention** but also **motivation**, **participation**, and **positive attitudes** toward botany.

The study confirms that integrating practical activities, such as plant observation, leaf collection, school gardening, and field trips, is highly effective in promoting active learning. Moreover, the findings support previous research emphasizing that experiential learning bridges the gap between theory and practice, making education more meaningful and engaging. Overall, the study reinforces the importance of moving beyond rote learning in

science education and adopting **student-centered, experiential teaching methods** to improve learning outcomes.

9. Recommendations

Based on the findings, the following recommendations are proposed for educators and institutions:

1. **Incorporate Experiential Learning:** Teachers should include practical activities like school gardens, plant observation, and fieldwork in the botany curriculum.
2. **Teacher Training:** Educators should receive training in designing and implementing activity-based learning methods effectively.
3. **Use of Technology:** Digital tools such as virtual labs, AR applications, and simulations can complement hands-on experiences.
4. **Curriculum Development:** Education boards should revise curricula to balance theoretical instruction with experiential activities.
5. **Student Engagement Strategies:** Encourage group activities, projects, and inquiry-based learning to foster curiosity and participation.
6. **Long-term Studies:** Schools and researchers should implement longitudinal studies to assess sustained impacts of experiential learning.

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