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Evaluating the Impact of Activity-Based Learning on Problem-Solving Skills and Academic Achievement: A Comparative Study Among Higher Secondary Students

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Abstract

This study investigated the impact of activity-based learning (ABL) on problem-solving skills, academic achievement, self-regulated learning (SRL), and critical thinking among higher secondary students in English. A quasi-experimental design compared an experimental group taught via ABL at Govt. HSS Khudmudi with a control group taught via traditional methods at Govt. HSS Bhimbhori (each n = 30). Pre-test and post-test scores in self-regulated learning (SRL), general academic achievement, and higher-order thinking (HOT) were analyzed using independent-samples and paired-samples t-tests along with Pearson correlation. Results showed that the experimental group's total score increased by 69.5 points (from 155.0 to 224.5), while the control group gained only 6.0 points (from 155.9 to 161.9). Independent-samples t-tests revealed significantly superior HOT performance for the ABL group (M = 20.10 vs. 13.20, $t(58) = 13.66$, $p < 0.001$). Paired-samples analyses indicated large gains in both problem-solving ($t(29) = 16.97$, $p < 0.001$) and SRL ($t(29) = 94.53$, $p < 0.001$). Within the ABL framework, post-activity reflective debriefing outperformed pre-activity scaffolding ($t(28) = 2.33$, $p = 0.028$). Inquiry-based activity engagement was strongly and positively correlated with HOT ($r = 0.72$, $p < 0.001$) and SRL ($r = 0.68$, $p < 0.001$), with HOT and SRL also highly correlated ($r = 0.84$, $p < 0.001$). All five null hypotheses were rejected, indicating that ABL significantly enhances problem-solving skills, self-regulated learning, academic achievement, and critical thinking, and that post-activity reflection and inquiry-based tasks are particularly effective components of the ABL framework.

Keywords: Activity-based learning, problem-solving skills, self-regulated learning, higher secondary students, critical thinking, inferential statistics.

1. Introduction

In recent years, Indian education researchers have increasingly criticized traditional, teacher-centred instruction for its limited impact on higher-order thinking and problem-solving skills, especially in language classrooms. Activity-based learning (ABL) has emerged as a promising alternative, emphasizing hands-on tasks, collaborative work, and inquiry-driven engagement to foster conceptual understanding and metacognitive development. In English,

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ABL can take the form of role-plays, debates, project work, and text-based problem-solving tasks that require students to apply language in authentic contexts.

Contemporary literature suggests that ABL improves academic achievement, motivation, and critical thinking across subjects, including English and social sciences. However, relatively few studies have systematically compared ABL with traditional instruction at the higher secondary level using both pre-test and post-test measures, while also examining self-regulated learning and the specific role of pre- versus post-activity.

Against this backdrop, the present study aims to evaluate the impact of ABL on: (1) academic achievement in English, (2) problem-solving skills, (3) self-regulated learning, (4) the relative effectiveness of pre-activity and post-activity approaches, and (5) the relationship between inquiry-based activities and critical thinking. The research is grounded in socio-constructivist and self-regulation frameworks, which posit that active engagement and reflection are central to the development of higher-order cognitive skills.

2. Objectives and Hypotheses

2.1 Objectives

1. To evaluate the impact of activity-based learning on the academic achievement of higher secondary students in English.
2. To analyze the difference in problem-solving skills among students before and after implementing activity-based learning methods.
3. To assess changes in self-regulated learning abilities resulting from the adoption of activity-based learning.
4. To compare the effectiveness of pre-activity (structured guidance before the activity) and post-activity (reflective debriefing after the activity) approaches on students' learning outcomes within an activity-based learning framework.
5. To determine the relationship between engagement in inquiry-based activities and the development of critical thinking and problem-solving capabilities in students.

2.2 Research Hypotheses

- H_{01}: There is no significant difference in problem-solving skills between higher secondary students who are taught using activity-based learning methods and those who are taught using traditional methods.
- H_{02}: There is no significant difference in problem-solving skills among students before and after implementing activity-based learning methods.
- H_{03}: Activity-based learning does not significantly influence the self-regulated learning abilities of higher secondary students.
- H_{04}: There is no significant difference in students' learning outcomes between pre-activity and post-activity approaches under an activity-based learning framework.
- H_{05}: There is no significant relationship between inquiry-based activities and the development of critical thinking and problem-solving capabilities in students.

3. Methodology

3.1 Research Design

A quasi-experimental, non-equivalent control-group design was employed. The experimental group (n = 30) was drawn from Govt. HSS Khudmudi, while the control group (n = 30) was from Govt. HSS Bhimbhori, both in the same district. The groups were matched on baseline academic performance and socio-demographic characteristics as far as possible. A pre-test and post-test design was used for both groups, with the experimental group exposed to an 8-week ABL intervention in English and the control group continuing with the conventional lecture-cum-discussion method.

3.2 Sample

The sample comprised 60 higher secondary students (Classes XI–XII) studying English as a core subject. The experimental group (E01–E30) received ABL treatment, while the control group (C01–C30) followed the traditional curriculum. All students were from government schools and shared similar socio-economic backgrounds.

3.3 Instruments

Three main instruments were developed and administered:

- A Self-Regulated Learning (SRL) Scale (scored 1–23) measuring goal setting, planning, self-monitoring, self-evaluation, motivation control, metacognitive strategies, and higher-order thinking.
- A General Academic Achievement (General) Test (scored 24–50) covering comprehension, grammar, vocabulary, and writing in English.
- A Higher-Order Thinking (HOT) / Problem-Solving Subscale embedded within the achievement test, focusing on inference, analysis, synthesis, and application-level items.

In addition, for Hypothesis 4 and 5, a short Academic Achievement Test (AAT) and an Inquiry-Based Activity Engagement Scale were used to represent pre-activity scaffolding versus post-activity reflection and to capture students' engagement in inquiry tasks.

3.4 Intervention Procedure

- **Experimental Group (ABL):**

  Students in the experimental group were engaged in Activity-Based Learning (ABL) lessons in English, which incorporated a variety of learner-centered activities such as role plays, group discussions, debate-based tasks, project work, and text-based problem-solving exercises. Each lesson was systematically organized following a structured ABL cycle, consisting of a brief orientation, collaborative activity, and reflective debriefing. Inquiry-based tasks were also integrated to foster critical thinking by encouraging students to ask questions, formulate hypotheses, and engage in evidence-based reasoning.

- **Control Group (Traditional):**

  Students were taught the same English curriculum using traditional methods: teacher-centred exposition, textbook reading, and short-answer practice without structured group tasks or reflection routines.

3.5 Data Analysis

Data were analysed using both descriptive and inferential statistics. Pre-test and post-test means and standard deviations were computed for total scores, SRL, and general academic achievement. For inferential analysis:

- Independent-samples t-tests were used to compare ABL versus traditional groups on HOT scores (H_{01}, H_{04}).
- Paired-samples t-tests were used to assess pre-post changes in HOT and SRL scores (H_{02}, H_{03}).
- Pearson product-moment correlations were computed between inquiry-based activity engagement and HOT/SRL scores (H_{05}).

All tests were conducted at $\alpha = 0.05$.

4. Data Analysis and Results:

4.1 Descriptive Statistics

4.1.1 Control Group (Traditional Method - Govt. HSS Bhimbhori)

Test	SRL Mean (1–23)	General Mean (24–50)	Total Mean (1–50)	SD
Pre-test	70.9	85	155.9	1.3
Post-test	73.9	88	161.9	1.3
Gain	3	3	6	–

4.1.2 Experimental Group (ABL - Govt. HSS Khudmudi)

Test	**SRL Mean (1–23)**	**General Mean (24–50)**	**Total Mean (1–50)**	**SD**
Pre-test	70.6	84.4	155	0.8
Post-test	103.4	121.1	224.5	3.2
Gain	32.8	36.7	69.5	–

The experimental group showed a 69.5-point gain in total scores, while the control group gained only 6.0 points, indicating a substantially larger improvement under ABL.

4.2 Inferential Analysis

4.2.1 Hypothesis 1 (H_{01}): ABL vs Traditional Problem-Solving Skills

Group	Mean (M)	Standard Deviation (SD)	Mean Difference	t-value	p-value	Result
Control Group	13.2	1.8	6.9	13.66	< 0.001	Significant
Experimental (ABL) Group	20.1	2.1				

Interpretation: H_{01} is rejected. The experimental group scored significantly higher on problem-solving skills ($M = 20.10$, $SD = 2.10$) than the control group ($M = 13.20$, $SD = 1.80$), $t(58) = 13.66$, $p < 0.001$. The mean difference of 6.90 points represents approximately a 52% improvement relative to the control mean, indicating that ABL is substantially more effective than traditional instruction in developing higher-order thinking and problem-solving in English.

4.2.2 Hypothesis 2 (H_{02}): Pre- vs Post-ABL in Problem-Solving Skills

Test Phase	Mean (M)	Standard Deviation (SD)	Mean Difference (D)	t-value	p-value	Result
Pre-test	11.8	1.6	8.3	16.97	< 0.001	Significant
Post-test	20.1	2.1				

Interpretation: H_{02} is rejected. Post-test HOT scores ($M = 20.10$, $SD = 2.10$) were significantly higher than pre-test scores ($M = 11.80$, $SD = 1.60$), $t(29) = 16.97$, $p < 0.001$. The mean gain of 8.30 points (≈70% improvement from pre-test) demonstrates that ABL leads to a dramatic enhancement in problem-solving skills.

4.2.3 Hypothesis 3 (H_{03}): Influence of ABL on Self-Regulated Learning

Test Phase	Mean (M)	Standard Deviation (SD)	Mean Difference (D)	t-value	p-value	Result
Pre-test	70.6	0.5	32.8	94.53		
Post-test	103.4	1.4				

					< 0.001	Significant

Interpretation: H_{03} is rejected. Post-test SRL scores (M = 103.40, SD = 1.40) were significantly higher than pre-test scores (M = 70.60, SD = 0.50), $t(29) = 94.53$, $p < 0.001$. The mean gain of 32.80 points (≈46% increase) indicates that ABL strongly enhances students' ability to set goals, plan, monitor, and evaluate their learning, aligning with prior work showing that structured, active learning environments foster self-regulated learning strategies.

4.2.4 Hypothesis 4 (H_{04}): Pre-Activity vs Post-Activity Approaches

Subgroup	Mean (M)	Standard Deviation (SD)	Mean Difference	t-value	p-value	Result
Pre-Activity Scaffolding	38.4	4.51	4.33	2.33	≈ 0.02	Significant
Post-Activity Reflective	42.73	5.62				

Interpretation: The table presents the comparison between pre-activity scaffolding and post-activity reflective subgroups within the experimental group. The post-activity reflective subgroup (M = 42.73, SD = 5.62) scored higher than the pre-activity scaffolding subgroup (M = 38.40, SD = 4.51), with a mean difference of 4.33 points. The calculated t-value (2.33) with approximately 28 degrees of freedom exceeds the critical value (≈2.048) at the 0.05 level of significance. The p-value (≈0.02) indicates that the difference is statistically significant. This suggests that reflective activities following ABL contribute significantly more to learning outcomes compared to scaffolding activities alone.

Table 4.2.5: Pearson Correlation Matrix between Inquiry Activities, HOT, and SRL

Variables Compared	Pearson Correlation (r)	Coefficient of Determination (r^2)	p-value	Strength of Relationship	Result
Inquiry Activities & HOT	0.72	0.52	< 0.001	Strong Positive	Significant
Inquiry Activities & SRL	0.68	0.46	< 0.001	Moderate to Strong Positive	Significant

HOT & SRL	0.84	0.71	< 0.001	Very Strong Positive	Significant

Interpretation: The table shows the Pearson correlation coefficients among inquiry-based activities, higher order thinking (HOT), and self-regulated learning (SRL). All relationships are positive and statistically significant at the 0.01 level ($p < 0.001$). The correlation between inquiry-based activities and HOT ($r = 0.72$) indicates a strong positive relationship, suggesting that increased student engagement in inquiry-based activities is associated with higher levels of critical thinking and problem-solving skills. The coefficient of determination ($r^2 = 0.52$) reveals that approximately 52% of the variance in HOT scores is explained by inquiry-based activities.

Similarly, inquiry-based activities show a moderate to strong positive relationship with SRL ($r = 0.68$), while the relationship between HOT and SRL is very strong ($r = 0.84$), indicating that both higher order thinking and self-regulated learning tend to develop together. Therefore, the null hypothesis (H_{05}) is rejected, confirming a significant positive relationship between inquiry-based activities and the development of critical thinking and problem-solving capabilities.

5. Conclusion

The present study provides strong empirical evidence supporting the effectiveness of Activity Based Learning (ABL) in enhancing key educational outcomes among higher secondary students in English. Using a quasi-experimental design with both control and experimental groups, the findings consistently demonstrate that ABL significantly improves problem solving skills, academic achievement, self-regulated learning (SRL), and critical thinking abilities.

The experimental group exposed to ABL showed substantially higher gains compared to the control group taught through traditional methods. The dramatic increase in total scores, along with statistically significant differences in higher order thinking (HOT), confirms that ABL is far more effective than conventional teaching approaches in fostering deeper cognitive engagement. The paired sample analyses further revealed that ABL leads to significant improvements within learners, particularly in problem solving and self-regulation, indicating that the method not only enhances performance but also strengthens learning processes.

An important contribution of the study lies in highlighting the role of instructional components within ABL. The findings indicate that post-activity reflective practices are more effective than pre-activity scaffolding, emphasizing the importance of reflection in consolidating learning and promoting higher order thinking. Additionally, the strong and significant correlations between inquiry-based activities, HOT, and SRL suggest that active engagement and inquiry play a crucial role in developing critical thinking and autonomous learning skills.

All five null hypotheses were rejected, confirming that ABL has a significant positive impact on students' cognitive and academic development. The study reinforces socio-constructivist and self-regulation theories by demonstrating that learning is most effective when students actively participate, collaborate, inquire, and reflect on their experiences.

In conclusion, ABL emerges as a powerful pedagogical approach for secondary education, particularly in language learning contexts. It not only enhances academic outcomes but also equips students with essential 21st-century skills such as critical thinking, problem solving, and self-directed learning. The study recommends the wider adoption of ABL in classrooms, along with teacher training and curriculum support, to maximize its potential in improving educational quality.

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