



## **ASSESSING THE FEASIBILITY AND PRECISION OF STEAM-BASED TEACHING METHODS IN SECONDARY EDUCATION**

**Ms. Achala Bhor**

*Research Scholar*

**Dr. Mary George Varghese**

*PhD Guide MES's Pillai College of Education and Research, Chembur*

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### **Abstract**

*This study examines the effectiveness of STEAM-based teaching in enhancing academic performance and higher-order thinking skills among secondary school students. A quasi-experimental research design was employed, with an experimental group receiving STEAM-based instruction and a control group following traditional teaching methods. The study utilized pre-test and post-test assessments to measure students' academic achievement and higher-order thinking skills. Additionally, a pilot study was conducted with 50 Grade 8 students from one educational board to assess the feasibility and precision of the research instruments. The findings contribute to understanding the impact of interdisciplinary learning approaches in secondary education.*

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### **Introduction**

Education today demands an approach that prepares students for an increasingly complex and interconnected world. STEAM education—integrating Science, Technology, Engineering, Arts, and Mathematics—has emerged as a transformative model that promotes creativity, problem-solving, and critical thinking. Unlike traditional subject-specific instruction, STEAM-based learning emphasizes interdisciplinary problem-solving, real-world applications, and innovative thinking. By engaging students in hands-on and inquiry-based learning experiences, STEAM aims to enhance both academic performance and higher-order thinking skills.

Despite the growing global adoption of STEAM education, there is limited empirical evidence on its direct impact on students' learning outcomes, particularly at the secondary school level. This study addresses this gap by evaluating whether STEAM-based instruction significantly

improves students' academic achievement and higher-order cognitive skills. Through an experimental research design, this study measures the effectiveness of a validated STEAM-based lesson plan in comparison to traditional teaching methods.

### Methodology

The experimental group developed and implemented a validated STEAM-based lesson plan, while the control group followed conventional instruction. The research utilized a pre-test and post-test tool to evaluate students' learning outcomes. The tool's validation included expert review and statistical reliability testing.

### Pilot Study

Before implementing the full-scale study, a pilot study was conducted to assess the feasibility and precision of research instruments. A sample of 50 Grade 8 students from one educational board participated in the pilot study. The objectives were to evaluate the clarity, appropriateness, and reliability of the assessment tools and lesson plans. The pilot study provided critical insights, allowing necessary refinements in instructional strategies and assessment tools before broader implementation.

### Validation of Research Tools

To ensure the reliability and accuracy of the pre-test and post-test tools, a rigorous validation process was conducted. Subject matter experts reviewed the assessment tools for content relevance, difficulty level, and alignment with STEAM education objectives. Additionally, statistical analysis was performed to determine the reliability of the tools.

The tool was validated using split-half reliability, and the analysis revealed the following:

- **Correlation Coefficient ( $r$ ) = 0.978:** Indicates a very strong positive linear relationship between the two halves of the test.
- **Coefficient of Determination ( $r^2$ ) = 0.9566:** About 95.66% of the variance can be explained by the linear relationship between the two halves.
- **Slope = 1.024096:** For every one-unit increase in one half, the other half is expected to increase by about 1.024 units.
- **Y Intercept = -0.674699:** When the score on one half is 0, the score on the other half is expected to be about -0.675.
- **Standard Error of Estimate = 0.7028:** A measure of the accuracy of predictions made with the regression line.

### Confidence Intervals:

- **0.95 CI for  $\rho$  (rho):** (0.282, 1) – There is 95% confidence that the true correlation coefficient is between 0.282 and 1.
- **0.99 CI for  $\rho$  (rho):** (-0.315, 1) – There is 99% confidence that the true correlation coefficient is between -0.315 and 1.
- **0.95 CI for Slope:** (0.3591, 1.6891) – There is 95% confidence that the true slope lies within this interval.
- **0.99 CI for Slope:** (-0.508, 2.5562) – There is 99% confidence that the true slope lies within this interval.

These results confirm that the assessment tool is highly reliable and statistically valid for measuring students' academic achievement and higher-order thinking skills.

### Findings of the Study

The research tool was found to be feasible and precise in measuring the intended learning outcomes. Expert reviews and statistical validation confirmed the reliability of the tool, ensuring its effectiveness in assessing academic achievement and cognitive skills. The expert comments provided valuable insights, leading to refinements in the assessment instruments and instructional materials. These improvements contributed to the overall accuracy and validity of the research study.

### Discussion

The findings confirm the reliability and precision of the STEAM-based assessment tools, providing confidence in their use for future experimental studies. Expert feedback played a crucial role in refining the assessment tools, ensuring their relevance to secondary school students' cognitive development. The study highlights the importance of rigorous validation processes in educational research to develop effective and reliable measurement instruments.

### Conclusion

This research provides empirical evidence supporting the feasibility and precision of STEAM-based teaching methods in measuring academic performance and higher-order thinking skills. The validated tools serve as effective instruments for assessing the impact of interdisciplinary learning approaches in secondary education. Given these findings, future studies can build upon these results to further explore the role of STEAM education in enhancing student learning outcomes.

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