



EFFECTIVENESS OF FLIPPED CLASSROOM INSTRUCTION VERSUS TRADITIONAL METHOD ON ACHIEVEMENT IN MATHEMATICS OF HIGH SCHOOL STUDENTS

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Abstract:

The present study was conducted to find out the comparative effectiveness of flipped classroom instruction and traditional method of teaching-learning on achievement in mathematics of standard IX students. By way of experimental method, the investigator tested the effectiveness of both the flipped classroom instruction and traditional method using a pre-test - post-test experimental design. A sample of 28 students each in the experimental and control groups were selected for the experimental treatment. An achievement test and learning material for flipped classroom instruction were the tools used. ANCOVA was applied to find out the comparative effectiveness of both these methods. The study found that flipped classroom instruction is more effective when compared to the traditional method of teaching-learning in enhancing the achievement in mathematics of standard IX students.

Key Words: Flipped Classroom Instruction, Traditional Method, Standard IX Students.

Introduction:

The ever-evolving landscape of education, particularly in the high school setting, continually seeks innovative pedagogical approaches to enhance student learning and engagement. Traditional instruction, characterised by the teacher as the primary disseminator of information, has long been a cornerstone of mathematics education. However, its effectiveness in fostering deep understanding and active participation, especially in a subject demanding critical thinking and problem-solving, has been increasingly questioned. In response, the flipped classroom model has emerged as a prominent alternative, shifting direct instruction outside of the synchronous class time and dedicating in-class sessions to interactive activities, collaborative work and individualised support. This study aims to directly compare these two distinct instructional methodologies to determine their relative effectiveness on the achievement in mathematics of high school students.

What is a Flipped Classroom?

A 'flipped classroom' is an educational model that inverts the traditional sequence of instruction and homework. In a traditional classroom, students typically receive direct instruction in class and then complete practice exercises or homework independently at home. In a flipped classroom, this process is reversed. In a flipped classroom, content delivery is provided at home and active learning occurs in class. Students are introduced to new material before coming to class. This typically involves engaging with pre-recorded video lectures, readings or other digital resources. The goal is for students to gain initial exposure to the foundational concepts and information at their own pace and in their own time. Class time is then utilised for activities that involve higher-order thinking, application and deeper engagement with the material. This may include problem solving with peer collaboration and teacher guidance, discussions, group projects, personalised support and activities that benefit from direct teacher supervision and immediate feedback. The core idea behind the flipped classroom is to maximise the value of face-to-face class time by moving passive information transmission outside of it. This allows teachers to facilitate deeper learning and provide more personalised attention to students when and where they need it most (Somaa, 2024).

Significance of the Study:

The increasing complexity of the 21st-century educational landscape necessitates a continuous re-evaluation of instructional methodologies to optimise student learning. In this context, a study comparing the effectiveness of flipped classroom instruction and the traditional method on the achievement in mathematics of high school students holds significant educational and pedagogical relevance. Traditional teaching, while foundational, is often criticised for its passive nature, potentially limiting student engagement and deeper understanding, especially in subjects like mathematics that demand active problem-solving and critical thinking. The flipped classroom model, conversely, proposes shifting direct instruction outside of class time using videos and other materials and using in-class time for interactive activities, problem-solving and personalised support, thereby promising a more student-centred and active learning environment (<https://bokcenter.harvard.edu/flipped-classrooms>).

The significance of this study extends to curriculum development and instructional design at the high school level. Mathematics is a cumulative subject where a strong foundation is crucial for future academic and career success. If the flipped classroom model proves more effective in fostering mathematical achievement, it could advocate for a paradigm shift in how high school mathematics is taught, moving away from a 'one-size-fits-all' approach towards more dynamic and individualised learning experiences. The findings would provide empirical evidence to guide educators and policymakers in making informed decisions about resource allocation, teacher training and curriculum restructuring.

Furthermore, this research contributes to the broader academic discourse surrounding effective learning strategies. The results could shed light on the specific mechanisms through which each instructional method impacts student achievement. For instance, the flipped classroom might enhance self-regulated learning skills, encourage peer collaboration or provide more opportunities for immediate feedback on complex problems, all of which are crucial for mathematical proficiency. Understanding these underlying processes would not only explain if one method is better but also why, leading to more refined pedagogical theories. This deeper understanding can then be generalised to other STEM subjects, or even across different disciplines for a more holistic approach to effective teaching and learning in high schools.

From a practical standpoint, the study offers actionable insights for teachers, students and parents. For teachers, the findings would provide evidence-based guidance on adopting or adapting their instructional approaches to better meet the needs of their mathematics students. If the flipped model is found effective, it could motivate teachers to explore new digital tools and interactive classroom strategies. For students, understanding which instructional method is more beneficial could empower them to advocate for learning environments that best suit their needs and learning styles. Parents, too, would benefit from clearer information on how their children's mathematics education is evolving and how different teaching methods might impact their academic progress, enabling them to better support their children's learning at home.

Thus, an experimental study on the effectiveness of flipped classroom instruction versus traditional method in high school mathematics achievement is highly significant. It addresses critical questions about optimising learning outcomes in a core subject, offers practical implications for educators and policymakers and contributes valuable empirical data to the ongoing debate about effective pedagogy. The potential for this research to initiate pedagogical shifts, enhance student engagement and ultimately improve mathematical proficiency among high school students underscores its profound importance in contemporary educational research.

Several studies have been conducted on the effectiveness of flipped classrooms on academic achievement of students. Cotta et al. (2016) studied the effectiveness of a flipped classroom instructional model in teaching pharmaceutical calculations and found that flipped classroom is effective in enhancing the achievement of students compared to the traditional method. Moreover, it was found that majority of students preferred the flipped method over the traditional method. Yu et al. (2023) studied the impact of flipped classrooms on student performance and problem solving skills in secondary level chemistry courses which found that flipped classroom significantly improved student academic performance compared to the non-flipped classroom and had a more progressive impact on students' problem solving skills. A comprehensive meta-analytical study by Wagner (2020) also confirmed the effectiveness of flipped classroom on academic achievement of secondary students. The study by Schultz et al. (2014) also demonstrated the effectiveness of flipped classrooms on achievement in chemistry of high school students. A comprehensive review of the literature revealed that there are very few studies in Kerala on the effectiveness of flipped classrooms on the academic achievement of secondary level students. Hence, the investigator carried out the present study.

Objective of the Study:

To test the comparative effectiveness of flipped classroom instruction and traditional method on achievement in mathematics of high school students.

Hypothesis:

There is no significant difference between the experimental and control groups in their adjusted post-test mean scores.

Method:

The study was done through Experimental method. Two intact standard IX classrooms from a school in Kollam district was selected for the experiment and they were divided into two groups as experimental and control groups. Though there were more than 40 students in each class, only 28 students in the experimental group and 30 students in the control group completed all the procedures such as the pre-test, experimental teaching and the post-test. The investigator selected 28 students each from the experimental and control groups as the final sample for the study.

For testing the achievement of students on the topic 'Introduction to Euclid's Geometry', an achievement test for 25 marks was prepared by the investigator. Prior to the experimental teaching the achievement test was given as pre-test to the students and after the experimental intervention, the same test was given as post-test. The test scores of both the experimental and control groups were statistically analysed using ANCOVA to find out the comparative effectiveness of flipped learning and traditional method. For the experimental teaching, the investigator prepared learning materials for flipped learning.

Learning Materials for Flipped Learning:

The investigator prepared pre-recorded lessons on the topic 'Introduction to Euclid's Geometry' in phases. The first phase involved identifying clear learning objectives by breaking down the lesson into manageable, bit sized topics. For example, the lesson was broken down into 'Understanding Points, Lines and Planes', 'Types of Angles and Their Properties', 'Perimeter and Area of Basic 2D Shapes', 'Introduction to 3D Shapes (Prisms, Pyramids, Cylinders, Cones)' and 'Basic Transformations' (Translations, Reflections, Rotations). Then the pre-class materials were video recorded as 10 minutes videos which include definitions, formulas and simple examples. Clear diagrams, animations and on-screen writing were used to illustrate geometric concepts. How points, lines and planes are represented and angle types were clearly shown in the video. It was ensured that the narration is clear and precise. A few worked-out examples were also given for students to follow, reinforcing the concepts introduced in videos. Short quizzes or questions were also integrated. The students were asked to use the video material at their pace at home either on a PC or smart phone.

Procedure:

In the flipped classroom, activities that require students to apply the concepts learned at home were designed and applied. Students were encouraged to work in small groups (5 students in each group) on challenging geometry problems that require multiple steps or deeper reasoning. They were encouraged to use protractors and compasses to explore properties of shapes, construct figures or measure angles. Open-ended problems that lead students to discover geometric relationships themselves were provided. Students were provided opportunities to present their solutions to complex problems and the class provided feedback. As the teacher, the investigator acted as a facilitator by providing individualised coaching. Whenever needed, the students were encouraged to watch the videos again. The students enthusiastically participated in the experimental learning throughout the session. The control group students were taught the topic in the traditional method. The entire experimental teaching lasted for 4 weeks (45 minutes in each class) and it was carried out after regular class hours.

Analysis of Data:

The scores of standard IX students in the experimental and control groups was analysed using Analysis of Covariance and the details are given below.

As a first step, the pre-test and post-test scores of students were analysed using ANOVA. The results are given in table 1.

Table 1: Analysis of Variance of the Pre-test and Post-test Scores of the Experimental and Control Groups (N = 28)

| Source of Variation | df | SSx | SSy | MSx | MSy |
|---------------------|----|------|-----|------|--------|
| Among Means | 1 | 0.07 | 236 | 0.07 | 236.16 |
| Within Groups | 54 | 148 | 347 | 2.7 | 6.4 |
| Total | 55 | 148 | 584 | | |

$F_x = 0.03$

$F_y = 36.71$

From Table F for df 1, 55 F at 0.05 level = 3.96

F at 0.01 level = 6.96

The F ratio for the pre-test and post-test were tested for significance. Since the obtained value of F_x ($F_x = 0.03$; $p > 0.05$) is less than F at 0.05 level (i.e., 3.96), it can be concluded that the experimental and control groups do not differ significantly with regard to pre-test achievement scores.

Since the obtained value of F_y ($F_y = 36.71$; $p < 0.01$) is greater than F at 0.01 level, it can be concluded that the groups differ significantly with regard to post-test achievement scores.

Comparison of Achievement Scores of the Experimental Group and the Control Group Using Analysis of Covariance (ANCOVA):

The details of ANCOVA are given in table 2.

Table 2: Summary of Analysis of Covariance of Pre-test and Post-test Scores of the Experimental and Control Groups (N = 28)

| Source of Variation | df | SSX | SSy | SSxy | SSyx | MSyx | SDyx |
|---------------------|----|-----|-----|------|-------|------|------|
| Among Means | 1 | 0 | 236 | 4.1 | 236 | 236 | 2.56 |
| Within Groups | 53 | 148 | 347 | 2.4 | 347.4 | 7 | |
| Total | 54 | 148 | 584 | -2 | 584 | | |

$F_{y.x} = 36.04$

From Table F for df 1/54 F at 0.05 level = 3.96

F at 0.01 level = 6.96

The obtained value of $F_{y.x}$ is 36.04 and is greater than F at 0.01 level (6.96). This shows that the experimental and control groups differ significantly with regard to post-test achievement scores after adjusting for the difference in their pre-test scores.

The adjusted means for the post-test achievement scores of the experimental and control groups were computed using correlation and regression. The details are given in table 3.

Table 3: Data for Adjusted Means of Post-test Scores of the Experimental and Control Groups

| Groups | N | Mx | My | My.x (adjusted) |
|---------------|----|-------|-------|-----------------|
| Experimental | 28 | 9.93 | 18.21 | 18.20 |
| Control | 28 | 10.00 | 14.11 | 14.10 |
| General means | | 9.96 | 16.16 | 16.16 |

$t = 6.00$

From Table D for df 53 t at 0.05 level = 2.01

t at 0.01 level = 2.68

The obtained t -value is 6.00 which is above the table value for significance at 0.01 level (2.68). This reveals that there is significant difference between the experimental and control groups in their achievement in mathematics after the treatment using the flipped classroom learning. The adjusted mean score of the experimental group is higher for the experimental group ($My.x = 18.20$) than the control group ($My.x = 14.10$). This reveals that the experimental treatment using flipped classroom learning is more effective than the traditional method in enhancing the achievement mathematics of standard IX students.

Tenability of the Hypothesis:

The hypothesis states that there is no significant difference between the experimental and control groups in their adjusted post-test mean scores. Analysis of the data revealed that the adjusted mean score of the experimental group is significantly higher than the adjusted mean score of the control group. Thus, the hypothesis is rejected.

Conclusion:

The analysis of data revealed that the flipped classroom learning is more effective than the traditional method in enhancing the achievement in mathematics of standard IX students.

Recommendations:

A proven success of flipped classroom learning in Standard 9 mathematics demands strategic integration. Schools should launch pilot programmes for flipped mathematics classes, carefully adapting the curriculum and securing vital digital resources.

Educators should be given comprehensive professional development in designing and implementing flipped classroom instruction. Training must cover not just creating engaging pre-class content, but also mastering active in-class learning strategies and utilising formative assessment data.

Finally, successful adoption hinges on student and parent engagement, alongside continued research. Students must be provided orientation to the flipped model, including effective self-directed learning techniques and parents should be oriented on their supportive role. Future research should include longitudinal studies, explore influencing student characteristics, gather qualitative insights and compare flipped learning with other blended approaches to continually refine best practices in mathematics education.

References:

- Best, J.W. (1991). Research in education. . New Delhi: Prentice Hall of India Pvt. Ltd.
- Cotta, K., Shah, S., Almgren, M., Macias-Moriarity, L., & Mody, V. (2016). Effectiveness of flipped classroom instructional model in teaching pharmaceutical calculations. Currents in Pharmacy Teaching and Learning. 5, 646-653. doi: 10.1016/j.cptl.2016.06.011.
- Garrett, H.E. (1986). Statistics in psychology and education. Bombay: Vakils, Feffer and Simons Pvt. Ltd.

4. <https://bokcenter.harvard.edu/flipped-classrooms>
5. Schultz, D., Duffield, S., Rasmussen, S. C., & Wageman, J. (2014). Effects of the flipped classroom model on student performance for advanced placement high school chemistry students. *Journal of Chemical Education*, 91(9), 1334-1339.
6. Soma, F. (2024). The flipped classroom approach: A review of cognitive styles and academic performances. *Cureus*, 16(7), e63729. doi: 10.7759/cureus.63729
7. Wagner, M. (2020). Effectiveness of a flipped classroom instruction on secondary education. Ph.D., Thesis, University of Passau, Germany.
8. Yu, L., Li, Y., Lan, Y., & Zheng, H. (2023). Impacts of the flipped classroom on student performance and problem solving skills in secondary school chemistry courses. *Chemistry Education Research and Practice*, 24, 1023-1034. <https://doi.org/10.1039/D2RP00339B>