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RESEARCH PAPER

Effect of Flipped Classroom Approach (FCA) on Grade 9 Students' Academic Achievement in the Subject of Chemistry

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ABSTRACT

This study aims to explain effect of FCA on grade 9 students' academic achievement in subject of chemistry and answers research question; is there any effect of flipped classroom approach on academic achievement of Grade 9 students in subject of chemistry? Revised Bloom's taxonomy for theoretical basis and quasi-experimental non-equivalent two-group research design is used. Grade-9 students of government schools were population of study. 62 students as sample were selected purposively; Groups were selected randomly. The experimental group received FCA intervention. Pretest and posttest is conducted for both groups. Validity of instruments was ensured by three experts; reliability was calculated as 0.70 and 0.86. The study concludes statistically significant difference in pre-posttest scores of both groups. There was large effect size on academic achievement of Grade-9 students after treatment. The researcher recommends that study may be replicated to investigate challenges and hindrances faced by chemistry teachers during implementation of FCA.

Keywords: Academic Achievement, Blended Learning, Flipped Class Approach (FCA)

Introduction

The flipped classroom approach was first formally introduced in 1998; therefore it has been used across the globe over the past decades. The flipped classroom approach shifted face – to – face classroom traditional lecture of the instructor to being delivered before – the – class (Gillette et al., 2018). According to Harrison and Stennett (2022), in traditional classrooms, students spend more time on the basic or background knowledge or information which they apply to solve more complex questions or problems outside of the class or in-home assignments. However, in flipped classes pre-class assignments are the source of knowledge or information and students apply that knowledge in the class time. Short videos are also a source of background information or knowledge. In flipped classes, students usually acquire content knowledge for the introduction of the topic before the class by:

- Recorded video lectures
- Pre-class Quizzes (before-class preparation and encouragement for students)
- Assessment and evaluation for students' understanding
- Higher-level cognitive activities: in–the–class activities e.g. peer learning, problem-solving activities, and active learning (McNally et al., 2017)

Brady and Voronova (2023), described that the Flipped classroom approach is a blended learning approach. Many previous research described flipped classroom as an effective approach for improving students' academic achievement, students ' engagement

and motivation. According to Cevikbas and Kaiser (2020), flipped classroom approach is a blended learning approach that is reformed oriented. Therefore, flipped class facilitates students learning and engages them in learning through the use of technology. Hence, technology is the main source in the teaching-learning process of a flipped class.

The present study aims to find the effect of flipped classroom approach on grade – 9 students' academic achievement in the subject of chemistry. There is a shift in the teaching and learning process after COVID–19. The use of technology for every walk of life has become a trend across the globe. Technology has been used for the teaching and learning process. I am working as headmaster in a public sector school in Lahore (city). It was the motivation for me to experiment flipped class approach in public sector schools. The use of technology cannot be denied as it's an international trend that use of technology is more in practice at all levels of education i.e. early childhood education, primary school education, secondary and higher secondary school education, and at tertiary level(colleges and universities). So, this study was a pioneer study for the implementation of flipped class approach on grade – 9 students in the subject of chemistry. As it is a new approach to implement in public sector schools of Lahore (city), Pakistan. Therefore, there was an urge to implement the flipped class approach in the public sector school of district Lahore, Pakistan. It is also evident from previous research that very few works is done so far in Asia. Thus, there is an international urge also to add more literature in the Asian context. Hence, this study has an addition to the literature in the national context. This literature is a valuable addition to international and national literature.

Literature Review

Flipped classroom approach is considered an effective pedagogical approach that has demonstrated valuable and encouraging results for improving students' academic achievement and performance. Flipped classroom approach has facilitated students for self – regulated learning. It prepares students to explore educational resources for learning rather than making them passive absorbers of knowledge (Baloch et al., 2022).

The flipped class approach helped in developing higher-order skills during the class and supported the achievement of lower-order learning goals, before class. However, students comprehend knowledge outside of the class and apply knowledge in –the – class (Oudbier et al., 2022).

According to Mashxura and Siddiqov (2023), with the advent of technology, the modern education system encourages educators to practice various teaching methods for teaching different subjects with technology. The use of technology in flipped classes has created a link between pedagogy and learning outcomes therefore; as a result process of assessment and evaluation also changed. This scenario is mostly witnessed in secondary schools. It is evident from the research that flipped classroom approach is blended learning which has inverted traditional classes. Where students are independent learners and speak in class to make their concepts enrich and clear their doubts (Chen et al., 2017). According to Khanam (2018), chemistry education involves learning knowledge about man's requirements for food, health, care, and other materials which are required to advance man's life. Chemistry is the study of metamorphosis occurring in the universe. It is an organized form of scientific knowledge that required an understanding of matter. It is the study of the chemical and physical properties of matter (Ojokuku, 2012). According to Upahi and Olorundare (2012), a technology-driven society needs to learn chemistry through the use of technology.

The urge of chemistry students for learning new ideas and concepts through technology has improved students' academic achievement. An instructional setting which is used for showing pre- recorded audio – visual recordings and pre – recorded videos to the

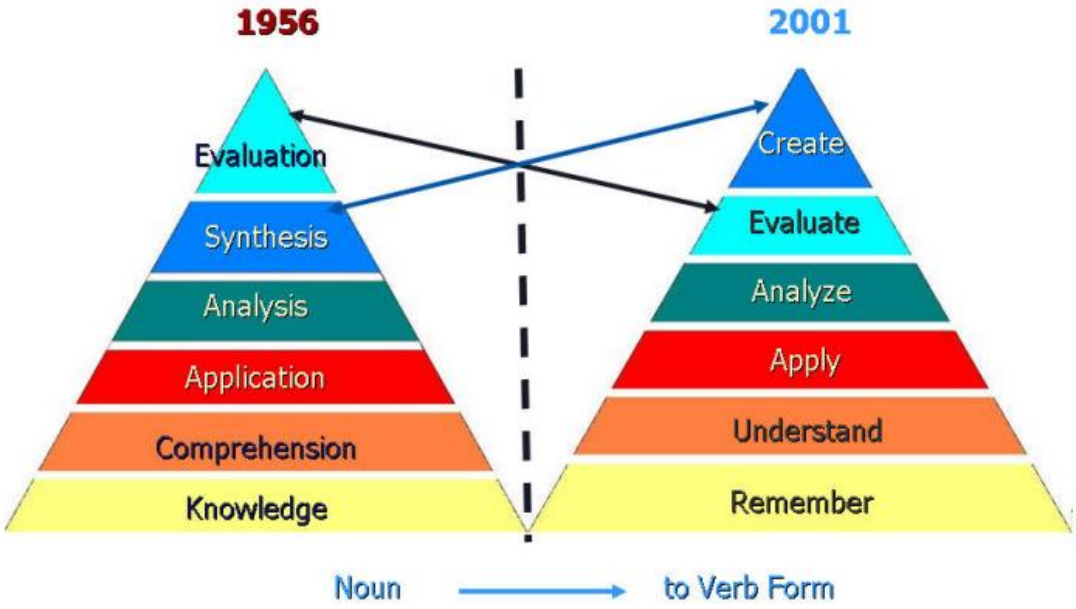
students with the integration of technology is called flipped classroom approach (Dogan et al., 2023).

Flipped Classroom Approach and Revised Bloom Taxonomy

Revised Bloom's taxonomy helped in devising the pretest and posttest of the study. Anderson and Krathwohl's (2001) explained the taxonomies of the cognitive domain which have given below:

- **Remembering:** It is the ability to recognize and recall knowledge from memory. Remembering is used to retrieve information, facts, figures, definitions, previously learned information, or knowledge and lists.

- **Understanding:** It is the ability to interpret, exemplify, classify, explain, compare, summarize and infer from written information, messages, and other activities.



Note: *Wilson, L. O. (2016). Anderson and Krathwohl Bloom's taxonomy revised understanding of the new version of Bloom's taxonomy. The Second Principle, 1-8.*

- **Applying:** It is the ability to execute, implement, proceed, and relate to situations where learned materials were used through products like simulations, interviews, and presentations.

- **Analyzing:** It is the ability to present mental functions through the representation of spreadsheets, diagrams, graphs, and surveys. It is the ability to break concepts, differentiate, organize, distinguish between components or parts, make connections between parts, and interrelate concepts.

- **Evaluating:** It is the ability to make judgments through a particular standard or criteria. The process of evaluation can be demonstrated through critiques, reports, and recommendations.

- **Creating:** It is the ability to plan, generate, produce or reorganize elements into new patterns. It is the ability to create new products. It is the preparation to put parts together in a new way. This is the most complex level in the newly revised taxonomy.

Flipped Classroom Approach (FCA): Flipped classroom approach is a pedagogical approach with an innovation that inverted traditional class. It is a student-centered learning approach. It transformed the spotlight from teachers to student-centered learning. Flipped classroom approach is an approach where learning materials are provided outside –of– class. It ensures in–the–class active learning (Cevikbas & Kaiser, 2021). The study believes that flipped classroom approach is a student-centered learning approach that inverted traditional classes. It involved students in active learning by engaging them in the class and in – the – class and activities with the use of technology.

Academic Achievement: Academic achievement refers to the performance of the students during the process of teaching-learning and assessment in a school. It represents the examination results of the students in the form of marks, grades, and numbers (Zehng & Mustappha, 2022). The study believes that academic achievement is the score of the student's academic performance in an assessment test or examination. The students demonstrate their academic achievement by earning different grades and marks during the process of teaching-learning, assessment, and evaluation.

Blended Learning: Blended learning is an integration of technology during the class room activities. This approach facilitates continuous learning with timely effectiveness and flexibility (Beckmann et al., 2021). The study believes that the blended learning is an effective approach adopted by many educational institutions. Blended learning is an approach which engages students in quality learning through face – to – face interaction, technology integration during the class and out of the class activities. Blended learning facilitates deep learning through flexibility in class room activities and improves academic achievement of the students i.e. through discussion and engagement

Material and Methods

The researcher investigated the effect of flipped classroom approach on grade – 9 students' academic achievement in the subject of chemistry. For this purpose, the researcher used a non-equivalent two-group quasi-experimental research design. The researcher followed the positivist paradigm approach. Public sector school of district Lahore, Pakistan was the population of the study. A purposive sampling technique was used and a random sampling technique for the selection of the group. The researcher developed flipped technology lesson plans based on the revised Bloom's taxonomy. The researcher also developed pre-test and posttest. The validity of the instrument was ensured by three experts while the reliability Cronbach alpha coefficient of the instrument was calculated as 0.70 for the objective type test and 0.86 for the subjective type test. Pretests were taken before intervention while the posttests were taken after the treatment. Hence, results were calculated.

Data Analysis

Data were analyzed by calculating mean, standard deviation, and paired–sample t-test. Therefore, the following results and findings were found.

Table 1

States of Matter Pretest – Posttest Results of Paired – Samples t-test for the Effect of Flipped Class (N=31) on Academic Achievement

Paired Differences

States of Matter Pretest – posttest	Pre-test		Post-test		Pretest – Posttest		95%Confidence Interval of the Difference		T	Df	Sig.(2-tailed)	Effect size
	M	SD	M	SD	M	SD	Lower	Upper				
	6.41	3.47	37.5	14.5	31.1	14.8	36.5	25.6	-11.6	30	.000	0.90

Note: Analysis of academic achievements of secondary school students in grade-9 chemistry: States of Matter has been developed by the researcher (2023)

Table 1 implies that a paired-sample t-test was conducted to find the effect of flipped class approach on grade -9 students' academic achievement in the subject of chemistry. There was a statistically significant difference in the pretest-posttest scores of states of matter. There was a statistically significant increase in states of matter test scores from pre-test (M=6.41, SD=3.47) to post-test (M=37.5, SD=14.5); t (30) = -11.6, p<.0005 (two-tailed). The mean increase in the score of the post-test was 31.1 with a 95% confidence interval ranging from 36.5 to 25.6. The eta squared statistic (0.90) indicated a large effect size.

Table: 2

Solutions Pretest – Posttest Results of Paired – Samples t-test for the Effect of Flipped Class (N=31) on Academic Achievement

Solutions Pretest – posttest	Pre-test		Post-test		Paired Differences Pretest – Posttest		95%Confidence Interval of the Difference		t	Df	Sig.(2-tailed)	Effect size
	M	SD	M	SD	M	SD	Lower	Upper				
	8.25	2.90	37.5	12.8	29.2	11.9	33.6	24.9	-13.6	30	.000	0.92

Note: Analysis of academic achievements of secondary school students in grade-9 chemistry: Solutions has been developed by the researcher (2023)

Table 2 implies that a paired-sample t-test was conducted to find the effect of flipped class approach on grade – 9 students' academic achievement in the subject of chemistry. There were statistically significant differences in the pretest-posttest scores of solutions. There was a statistically significant increase Solution test scores from pre-test (M=8.25, SD=2.90) to post-test (M=37.5, SD=12.8); t (30) = -13.6, p<.0005 (two-tailed). The mean increase in the score of the post-test was 29.2 with a 95% confidence interval ranging from 33.6 to 24.9. The eta squared statistic (0.92) indicated a large effect size.

Findings

The study had the following findings:

i. There were statistically significant differences in the pretest-posttest scores of states of matter. There was a statistically significant increase in states of matter test scores from pre-test (M=6.41, SD=3.47) to post-test (M=37.5, SD=14.5); t (30) = -11.6, p<.0005 (two-tailed). The mean increase in the score of the post-test was 31.1 with a 95% confidence interval ranging from 36.5 to 25.6. The eta squared statistic (0.90) indicated a large effect size (Table 1).

ii. There were statistically significant differences in the pretest-posttest scores of solutions. There was a statistically significant increase in Solution test scores from pre-test (M=8.25, SD=2.90) to post-test (M=37.5, SD=12.8); t (30) = -13.6, p<.0005 (two-tailed). The mean increase in the score of the post-test was 29.2 with a 95% confidence interval ranging from 33.6 to 24.9. The eta squared statistic (0.92) indicated a large effect size (Table 2).

Discussion

The purpose of the study was to investigate the effect of flipped classroom approach on the academic achievement of grade – 9 students in the subject of chemistry. The study used descriptive statistics for investigating the effect of flipped classroom approach. The key findings of the study had drawn and structured around the research question of the study as follows:

The findings of the study implied that there was a significant difference in the pretest and posttest scores of the experimental group and control group. The findings represented that initially, the academic achievement level of both the experimental group (Flipped class) and control group (Traditional class) was the same although there was a difference in their mean and standard deviation scores. After the intervention, there was a significant difference in the pretest and posttest scores of the experimental group. There was an increase in the academic achievement of flipped class (experimental group) after the treatment. The findings from the paired–sample t-test highlighted that there was a significant difference in the pretest post-test scores of the experimental group after the treatment hence, a large effect size was calculated. The results of the study were consistent with the previous study by Swafford (2016). His study also found significant differences in the academic achievement of pretest and posttest scores of students in the subject of chemistry.

Conclusion

The researcher concluded that there was a significant increase in the academic achievement of grade – 9 students in the subject of chemistry. The results and findings concluded that the flipped classroom approach had largely affected the academic achievement of grade – 9 students in the subject of chemistry. The significant difference in the pretest and post-test scores of the experimental group and control group implied that there was a significant increase in the scores of academic achievement of grade – 9 students in the subject of chemistry. This study further concluded that there was a significant difference in the pretest and posttest scores of the experimental group after the treatment. The treatment (Flipped classroom approach) largely affected the academic achievement of grade – 9 students in the subject of chemistry after the treatment.

Recommendation

The researcher recommended that this study may be replicated and involve chemistry teachers to explore challenges and hindrances faced by them during the implementation of flipped classroom approach in their chemistry class.

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