

## **Effect of the Flipped Science Classroom on Academic Achievement of Grade Seven Students**

**Hameed ur Rehman**

MS SLM

**Iqra Saeed**

School of Media and Communication Studies

University of Management and Technology

**Dr. Farhat Munir**

School of Social Sciences and Humanities

Department of Education

University of Management and Technology

Email: [farhat.munir@umt.edu.pk](mailto:farhat.munir@umt.edu.pk)

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### **KEY WORDS**

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Exponentially  
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Science Class,  
Learning strategy at  
secondary level.

### **ABSTRACT**

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This pilot study was carried out in a local secondary school to measure the effectiveness of digital literacy in terms of flipped classroom teaching. A grade seven science class was purposefully flipped and compared with traditional teaching classroom arrangement to evaluate the student's academic achievement. The population of study comprises all male and female 259 students of class seven, first term of academic session. Study sample was further divided into two groups: two sections of boys (61 male students) and two sections of girls (66 female students) were randomly selected as the experimental group, the flipped classroom. The remaining four sections (132 students) performed as a control group, the

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traditional classroom. Instructional strategies were the independent variable. Student's achievement grades in pretest, ongoing posttest assessments and term exam were dependent variables. Scores of pretest were compared with posttest ongoing assessments and school term exams. The analysis was made through t-test and ANCOVA. At the end of the thirteenth week, a Likert scale survey was conducted to evaluate the student's perception regarding the learning environment in flipped class. The results indicated that” (i) there is a statistically significant difference between achievement scores of the flipped class compares to traditional class students. Flipped class students achieved better results than conventional class learners. (ii) Analysis indicated that there is no significant difference in achievement scores among male and female students of the experimental and control group. (iii) Likert scale survey results showed students increased involvement, mutual interaction and in-depth learning in flipped classroom environment. This study is a contribution to a positive change in the prevailing education system of Pakistan by transferring a deeper understanding of the importance of student-centered learning. The technological tools motivate student of this age to collaborate academically and socially to become a self-standing, curious and creative learner.

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## Introduction

Digital learning is becoming essential for the contemporary education system and generating the demand for understanding the role of digital literacy in today's classrooms. In recent years, the education research tracing out ways to teach these exponentially growing minds. Although the traditional lecture format is still the most common pedagogical strategy used in classroom instruction, new pedagogies are emerging that seek to promote active participation in learning as well as to extend students' study time outside of the classroom (Güler, M., Kokoç, M., & Önder Bütüner, S., 2023). One of these teaching strategies is known as the flipped classroom (FC).

The FCM was developed as a mixed-mode methodology wherein in-person and online instruction are merged, and students work on the course materials outside of the classroom while devoting considerably more class time to problem-solving and other hands-on, interactive activities (Palazón-Herrera, J., & Soria-Vílchez, A., 2021). In the flipped classroom model, a student-centered approach helps students to put forth their abilities and develop a "can-do" attitude. (Jones, 2007), This approach is productive, stimulating, and congenial and allows students to mutually advance the educational content by the exchange of tools, materials, and ideas which ultimately steps towards a progressive society (Ornellas, A., & Muñoz Carril, P. C., 2014). Mutual interaction, discussion, sharing, and communication are the essential ingredients of the flipped learning model.

It is a fact that in flipped classrooms, the potential of hidden performance varies from class to class which ultimately affect the possible benefits. Under the influence of methodology and class level, some teachers may develop flipped classrooms much better than the others. There is no sufficient research available to describe

the exact method and technique for an effective flipped classroom (Lo, C. K., & Hew, K. F., 2017)

### **Literature Review**

Professor Eric Mazur from Harvard contributed to the conceptual development of the concepts persuading flipped teaching by developing a teaching strategy called "peer instruction". Mazur outlined his approach in a book entitled "*Peer Instruction: A User's Manual*". He discovered that his instructional strategy, which pass-on information transfer out of the classroom and information assimilation into the classroom, enabled him to enhance knowledge of his students other than the lecture (Mazur, 1997).

Ronchetti (2010) developed a VOLARE method to study the impact of the flipped classroom model. According to his research work, the purpose of the flipped classroom model is to take advantage of modern technologies to facilitate teachers and students for active participation in their learning.

Moreover, Wington (2013) explored the effect of the learning environment on student mathematics achievement, self-efficacy, and learning style in a ninth-grade Algebra I classroom in three different learning environments. On the other hand, Zengin (2017) investigated the influences of flipped classroom learning on the academic achievements of students. The findings of his research concede that flipped learning by using Khan Academy and mathematics software enhances the success rate of students' performance and facilitated student interaction and learning. Chyr et al (2017) proved that the intervention of technology-based learning intensifies student's self-efficacy, which increases their motivation for self-directed learning. On a similar ground, Smalhorn (2017) concluded her study and proved that a flipped classroom model not only increases student's face-to-face interaction but also improves their attendance in the classroom and their assignment submission

rate. Alsancak and Ozdemir (2018) studied the impact of the flipped classroom model on the learner's academic achievement, self-directed learning, readiness, motivation and retention. Zamzami and Corinne (2019) identified the difference between flipped and traditional classroom model based on "Self-determination theory". Indifference to the traditional learning method, the survey results indicated that students in the flipped class showed improved peer-to-peer interaction. Putri et al. (2019) recommended the flipped classroom model for teaching science at the school level. The purpose of their study was to evaluate the effects of altered flipped classroom approach on the conceptual understanding of students in the science class of grade eight students.

### **Statement of Research Problem**

Low student conceptual development, motivation, and poor academic achievement are real problems in public and private schools at all levels in Pakistan. Students are getting exposure from exponential word around, where technology is changing their perception in seconds, but education institutes are using the same linear conventional pedagogy to date. There is a big gap between student learning from digital exposure and system of instructions in our learning organizations.

Schools in Pakistan, except few private institutes, are producing a low-slung level of learning results, creating severe challenges to economic growth. A report showed the terrible state of science education results in Pakistan. Throughout the country, not a single province or region showed average score in the teaching of science in terms of student's academic achievement (Ailaan, 2017) Teachers in classes across Pakistan using rote learning as a teaching method. This teaching practice fails to encompass students in the learning process which limits student's capability. Consequently, the results are abysmal and leading to poor academic achievement. The reason

for this devastating situation is the content knowledge and teaching methodology.

### **Research Question**

**Q.** "Is there any significant difference in the academic achievement of class seven science students taught in a flipped classroom compared to the students in a traditional classroom?"

To further strengthen the above question, the following sub-questions are branched:

- i.** Is there any statistical difference in assessment scores of students between flipped and traditional class arrangement?
- ii.** Is there any statistical difference in achievement scores between male and female students of the flipped classroom?
- iii.** How do students perceive learning experience in the flipped classroom compares to traditional classroom learning?

### **Research Methodology**

This quasi-experimental research study compares the effects of flipped classroom learning with the traditional way of teaching in class seven science students. The whole cross-section was divided into two groups:

**Control Group:** Class seven students taught science in a teacher-centered traditional method using class lectures and homework (N=132)

**Experimental Group:** Class seven students taught science in student-centered flipped classroom teaching method (N=127)

The achievement of students in collective term exams of school and scores of pretest and posttest were dependent variables, class arrangement, according to the groups and discrimination of gender as independent variables. Following analysis were performed:

- a. Analysis with pre/posttest assessment and the score of term exam.* Scores of pretest were compared with posttest ongoing assessments and student's achievement scores in school term exams. The analysis was made through t-test and ANCOVA with
  - i. within-group independent variables of gender and teaching methodology
  - ii. dependent variables of the posttest and term exam
  - iii. covariate of pretest
- b. Analysis of student's perception of the learning experience.* A Likert scale adapted survey was used at the end of the term to evaluate the student's perception regarding the learning environment (Arano-Ocuaman, 2010).

### **Contextual Framework and Participants**

This research work took place in a private school of Lahore, established in 1946, with a student population of 3200 from playgroup to matriculation. Population of this study comprises all the male and female 259 students of class seven first term of session 2019-20. Two sections of boys (61 male students) and two sections of girls (66 female students) were randomly selected as the experimental group. The remaining four sections (132 students) performed as a control group. With convenience sampling, one teacher was selected for the experimental group and one for the control group.

### **Instrumentation and Implementation Process**

The study purposefully selected the complete syllabus of first-term science in class seven to fulfill the aim of the research. With the help of a subject specialist (subject supervisor) syllabus for the flipped class was developed and learning objectives were defined. The syllabus was containing online videos, PowerPoint

presentations, experiment-based lab activities, and class presentations. Later on, this designed syllabus was sent to curriculum development department of the school for approval. After a detailed review of content and their validity to fulfill the requirement of flipped learning, it was approved for implementation.

After the curriculum development process, training sessions for flipped class teacher were conducted. The syllabus was implemented from the beginning of the session. Before the commencement of first term classes, a pretest was conducted in experimental and control groups. As there is no co-education in this school, so the same teacher was taking classes in girl's and boy's sections. In addition to the curriculum, ongoing two assessments were designed to measure the achievement level of both groups.

In a flipped classroom, the teacher presented lectures based on training. There were five lectures in a week. Each lecture lasted for 30 minutes, with two additional lab periods. Students were informed to have pre-class readings and preparations at home, including video lectures and written materials. Inside the class, lecture began with reflection from student's knowledge. Teacher involved students in activities and presentations for a deeper understanding of content. In the control group, students were taught by traditional ways of teaching more focused on presenting content through books, as a primary source and homework. The prime focus of the teacher was content delivery and students were asked to complete the assigned activity at home as homework. Both groups were assessed in posttest assessments and collective term exams of school.

### **Assessments and Data Collection**

Students of the experimental and control group appeared in pretest, posttest assessments and collective first term exam of school.



Assessments were developed with a collaboration of the curriculum development department of the school. Pretest was conducted at the beginning of the session. It was 80 marks test based upon the concepts which students had gone through in their previous class. Posttest consisted of two ongoing assessments. The first 15 marks assessment was taken in week six of the study plan. The second 20 marks assessment was taken in 12<sup>th</sup> study week. Cumulative result of assessment one and two was considered as posttest score. The scores of the posttest assessment were used for two types of comparisons. First, impact comparison between the experimental and control group after every chapter taught. Second, a difference of achievement on the base of pre/posttest assessment. At the end of week thirteen, all the students of control group and experimental group appeared in a collective first term exam to access the knowledge of concepts taught in first term. Student achievement scores were used for comparison between pretest and collective term exam, posttest and collective term exam and validate pre/posttest difference. All the students of experimental group participated through survey within four areas of class arrangements.

## Data Analysis and Interpretation

### Reliability of Instruments

**Table 1**

*Reliability Statics on Pre & Posttest Assessments, Term Exam and Flipped Class Student Perception Likert Scale Survey*

Assessment	Cronbach's $\alpha$
Pretest, Posttest Assessments and Term Exam	.90
Flipped Class Student Perception Likert scale Survey	.86

Table 1 shows the alpha of all assessment exam was .90, which is best for analysis according the general rule of thumb.

**Table 2**

*Descriptive Statistics on Pretest Result and Posttest Results*

Group	N	Mean	SD	Mean Difference
Flipped (Pre)	127	63.57	12.50	3.00
Traditional (Pre)	132	60.56	12.94	
Flipped (Post)	127	53.46	19.06	4.10
Traditional (Post)	132	49.35	18.91	

Results of pretests assessment indicate that the mean of experimental group, the flipped class, (M = 63.57, SD = 12.50) is higher than the mean of the control group, traditional class, (M = 60.56, SD = 12.94) with a DM = 3.00. On the other hand, the flipped class, (M = 53.46 with SD = 19.06) is higher than the mean of traditional class, the control group, (M = 49.35 with SD = 18.91) with a DM = 4.10.

**Table 3**

*ANCOVA Test Statistics on Gender, Groups and Cumulative Posttest Result*

SOV	SS	df	MS	F	p-value
Pretest Result	36681	1	36681.514	305	<.001
Group	729	1	729.773	6.1	.014
Gender	673	1	673.056	5.6	.019
Group*Gender	53	1	53.173	.44	.507
Error	30542	254	120.245		
Total		259			

Results of ANCOVA shows a statistical difference among the performance of male and female students on the cumulative result of posttest assessment.

**Table 4**

*ANCOVA Test Statistics on Term Exam*

Source of variation	SS	df	MS	F	p-value
Pretest	31602.517	1	31602.517	596.372	<.001
Group	2829.700	1	2829.700	53.399	<.001
Error	13565.770	256	52.991		
Total		259			

Table shows statistically significant result indicates that there is a significant difference in scores of term exam among the experimental and control group, resulting that there is a significant difference in the academic achievement of class seven science students taught in a flipped classrom compared to the students in a traditional classroom at the alpha .000.

**Table 5**

*ANCOVA Test Statistics on Gender, Groups and Term Exam Result*

SOV	SS	df	MS	F	P-value
Pretest Result	31441.652	1	31441.652	590.580	<.001
Group	2856.437	1	2856.437	53.654	<.001
Gender	.001	1	.001	.000	.998
Group*Gender	43.163	1	43.163	.811	.369
Error	13522.596	254	53.239		
Total		259			

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Results in descriptive statistics demonstrate a statistical difference among the performance of male and female students on the term exam. Male students achieved a higher mean than the female students. Non-statistically significant result of the ANCOVA analysis indicated that there is no significant difference in scores of term exam among male and female students of the experimental and control group  $F = <.001$  with a  $P = .998$ .

### Discussion

An individual learner must effectively fabricate information and skills within build construct in the external environment (Huit, 2003). Students' academic achievement has identified the difference between flipped and traditional classrooms based on "Self Determination Theory". The current study is carried quasi-experimental method to compare the flipped classroom learning with the traditional way of teaching among grade 7th science students. 259 sample of the students divided into two groups which two boys' sections (61males students) and two sections of students (66 female students) with adapted questionnaire from Johnson, L. (2012). The remaining four sections (132 students) performed as the controlled group with convenience sampling.

As a result, student achievement student's achievement scores have used a comparison between pretest and collective term exam, posttest and collective term exam and validate pre/posttest difference. In the same manner, the teaching content primarily embodies knowledge learning and idea understanding. Several repeated exercises and activities are needed to enhance students' competence in learning (Myers et.al;2012). Before running the ANCOVA, the Shapiro-Wilk Shapiro-Wilk test ( $p > .05$ ) and inspection of Q-Q plots and histogram showed that only traditional class results of the cumulative posttest and term exams were not

normally distributed. The rest of the results were approximately normally distributed for both groups. Although flipped classroom course is limited than traditional classroom teaching, flipped classroom course has significant Fresno test score than the traditional course due to transformation of information with the shortage of teaching method. Consequently, the exactness of learning is increasing and the cognitive burden level is decreased (Karaca & Ocak, 2017).

### Conclusion

The flipped learning approach is used to make an effective teaching environment at the school level. Consolidation practices, critical thinking, and active collaboration are practices in the flipped classroom environment. Thus, the students are more dynamic in the class, internationalizing the content via several classroom tasks (Crouch & Mazur, 2001). The following outcomes of this research showed a positive impact of flipped teaching methodology on the student's academic achievement as well as these teaching strategies are planned to comprehensively use class time and supportive activities for home time reinforcement which result in more considerable improvement. At the same time, there is a difference observed between female and male students in terms of academic achievement.

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