IMPACT OF FLIPPED LEARNING ON LEVELS OF COGNITION

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ABSTRACT
Flipped learning is an emerging pedagogy transforming the classroom of today. Flipped learning reverses the activities of the classroom with the homework activities. The current research studies the effect of Flipped learning method on achievement of different levels of Cognition (Knowledge, Understanding, application, analysis, synthesis and evaluation) and overall achievement in science subject. The study was a quantitative study employing Experimental method and Two Group Post- test Design. The Independent variable in this study was flipped learning method and Traditional Learning Method. The dependent variables under study were levels of cognition. The findings revealed no significant difference in knowledge level, a slightly significant difference in understanding level and a significant difference in the higher levels of cognition - Application, Analysis, Synthesis and Evaluation. The flipped learning model is effective in developing and enhancing the skills of Application, Analysis, Synthesis and Evaluation which are being currently ignored in the classrooms. The traditional learning model does not promote the development of Application, Analysis, Synthesis and Evaluation skills which are essential components in the cognitive development of the student.

Keywords: Flipped Learning, Levels of cognition, Achievement, Pedagogy of Science, Information and Communication Technology (ICT)

1. Introduction

Information and Communication Technology has invaded every walk of life and is changing the way in which things are being transacted in the world. Education is no different and the transaction of education has undergone a complete metamorphosis with the advent of ICT. ICT based teaching learning methodologies are gaining popularity and one of the most significant one among them is Flipped Learning. (Rahman et al., 2020), Flipped Class is the classroom of the 21st century. (Nawi et al., 2015), Flipped learning as the term itself suggests is flipping to classwork at home and home work in class. (Rahman et al., 2020), This flip can only be made possible with the use of ICT. Providing for classwork to be done at home involves the use of a variety of ICT tools like instructional videos, power-point presentations, web-based tutorials, reading materials, etc., which are mainly related to the first two levels of cognition - knowledge and understanding. The roles of the teacher and the student are reformed with the teacher playing a passive supervisory role and the student playing an active role in the classroom. (Kim et al., 2014), Home work in class targets the higher order levels of cognition- application, analysis, synthesis and evaluation. These are more difficult to achieve for the students on their own and with the help of flipping they are now done in class under the supervision of the teacher.

2. Review of related literature

"Flipping the classroom" has become a catchphrase in emerging pedagogies in recent times. (P21 Framework for 21st Century Learning, 2007), the flipped learning model is a blending of teaching learning focussing on the development of 21st century skills such as Creativity, Critical thinking, Collaboration and Communication. (Overmeyer, 2012), reiterates that lower levels of cognition i.e., knowledge and understanding are achieved outside the classroom by the students on their own and higher levels of cognition like application, analysis, synthesis and evaluation are achieved in class with the support of the peers and teacher**.** (Milman, 2012), supported the premise and also perpetrated that flipped classroom will make classroom instruction more effective as the students are prepared and familiarised with the learning material before coming to the class. (Fulton, 2012), enumerated the advantages of flipped classroom as students will learn at their own pace, the teacher will be able to identify the hurdles faced by students in doing the assignments as they will be done in the class, the teacher can revise and update the curriculum according to the student's needs, the classroom experiences are more active and effective, teacher can monitor the student's interest and flipped classroom provides an opportunity to use the technology tools and thus prepare the students with as the appropriate learning skills required in the 21st century. **,** (Driscoll & Petty, 2017), indicated that the exposure and guidance provided by technology will enable the students to

become more autonomous in learning and the teacher's role will be that of a facilitator and motivator. (Millard, 2012), also stated that the flipped classroom focuses on interactive discussions in the classroom, provides freedom to students, establishes a personal communication between teachers and students regarding the subject, homework and progress. It also helps to establish strong team work and increase student involvement and engagement. He further stated that the flipped classroom helps those students who due to a number of reasons are not able to attend the class will now be able to review the subject and obtain the materials of learning thus overcoming any lacuna in learning. (Leicht et al., 2012)research findings showed that flipped classroom has a positive effect on the student achievement, enhanced student engagement, positive attitudes toward school and learning and better and improved job satisfaction. (Logan, 2015), enumerated many benefits of the Flipped Classroom, the flipped classroom will save the students' precious classroom time which is spent listening to lectures because they will be using time at home to watch the lecture on video. Classroom time will be better utilised to conduct activities like solving problems and holding discussions, flipped classrooms help students to take responsibility for their own learning. The students can repeatedly watch the online video lecture as and when required. Personal interaction is established between teacher and students both inside and outside the classroom. The flipped classroom model helps to make the students more active as well as interactive both inside and outside the classroom. (Rodríguez et al., 2019) concluded that Flipped classroom is shown to have better learning outcomes and a positive impact on critical thinking, creativity and student satisfaction. (Alsowat, 2016) reported a highly significant relationship between higher order thinking skills of Analysis, Synthesis and Evaluation and student satisfaction and student engagement. (Kharat et al., 2015) stated that teachers helped students to apply their knowledge through the use of the flipped learning model. (Lee & Lai, 2017) inferred that students as well as teachers perceived that it is possible to improve students higher order thinking skills through appropriate use of Flipped classroom method. (Van Alten et al., 2019) in his metanalysis has summarised that Implementation of flipped classrooms requires careful attention to its design, maximising face-to-face time and appropriate assessments of out of the class learning. According to (Nouri, 2016) Low achievers reported a more positive attitude as compared to high achievers towards the use of Flipped Learning Method. (Cabi, 2018) motivation and readiness of students to learn outside the classroom needs to be ascertained before implementing the Flipped Classroom. (Yasar Kazu & Kurtoğlu, 2020) has given five dimensions of student readiness for flipped classroom: 'self-directed learning, technology self-efficacy, in-class communication self-efficacy, motivation for learning and doing and found positive. Students with a computer and technologically competent had more positive opinions and readiness. (Amanisa & Maftuh, 2021), flipped classrooms provide more learning opportunities to the students in both F2F and online mode which helps in enhancing higher-order thinking skills.

3. Objectives and Hypothesis

The main objective of this research is to find out the effect of Flipped learning method on achievement in different levels of Cognition (Knowledge, Understanding, Application, Analysis, Synthesis and Evaluation) and overall achievement in science subject. The following hypothesis have been formulated for the purpose.

1. $H_0 1$- There is no significant difference in achievement between traditional learning method and Flipped learning method.

2. $H_0 2$- There is no significant difference in Knowledge, Understanding, Application, Analysis, Synthesis and Evaluation level between traditional learning method and Flipped learning method.

4. Methodology

The study was a quantitative study employing Experimental method and Two Group Post- Test Design. The Independent variable in this study was flipped learning method and Traditional Learning Method. The dependent variables under study were levels of cognition (Knowledge, Understanding, Application , Analysis, Synthesis and Evaluation).

The targeted population were all students studying science subject in class IX in English medium schools. The sample was selected for the study after ascertaining that all students studying in class IX have access to computer/laptop/tab and internet connection at home. The school has two sections of class IX. 28 students studying science subject in class IX A were selected as Control Group and 25 students studying science subject in class IX B were selected as Experimental group.

The selection of topic / content to be taught was limited to Topics of Science - Work, Motion, Force and Energy. The lesson plans for both Traditional and Flipped learning were prepared. All the necessary resources selected for flipped learning were partly developed and partly sourced from the internet and a trial run was conducted for feasibility. The teaching of both the Experimental group and the Control group by the Flipped learning and

Traditional learning methods was carried out for one month. After one month the students were tested using the researcher developed and standardized achievement test.

This tool was a standardised achievement test with 60 multiple choice questions covering Knowledge, Understanding, Application, Analysis, Synthesis and Evaluation to test levels of cognition of the students. The test was initially constructed with 20 multiple choice questions each covering Knowledge, Understanding, Application, Analysis, Synthesis and Evaluation to test levels of cognition of the students. The achievement test was developed through the following steps - Designing the Structure of test, construction of test items, Expert opinion, Pilot Study, scoring and item analysis for difficulty level and discriminatory power (Table 1), determining reliability and validity and finally test standardization.

Table 1: Discriminatory Power of Test Items

| Range	Quality	Total Items	Action
> 0.39	Excellent	38	Preserve
0.30-0.39	Good	22	Possibilities for enhancement
0.20-0.29	Average	18	Need to verify/review
0.00-0.20	Poor	22	Reject or review in depth
< 0.01	Worst	20	Remove
	Total	120	60 items in final Questionnaire

The Reliability of the Achievement test was determined by two methods Split – half method and test Retest method. In the Split half method the odd numbered items were administered to one group and the even numbered items were administered to the other group. Coefficient of correlation between the groups was computed and found to be 0.83. In test-retest method the test was administered on a group of 20 students and then repeated on the same group after a time interval of one month. The reliability coefficient by this method was found to be 0.87.

Validity of the achievement test was ensured through careful structuring of the test, keeping track of the adequacy of sampling of test items with regard to levels of cognition to be measured and a thorough, detailed and meticulous analysis of the test items by a team of three experts.

The scores of the students were tabulated and analysed. The mean scores of both the groups and their percentages gave a preliminary view of the performance of the student's overall achievement levels and achievement in levels of cognition taught by the Traditional method and the Flipped method. The mean, standard deviations and paired group t-tests were used to draw conclusions about the significance of difference between overall achievement levels and achievement in levels of cognition of experimental and control groups.

5. Result

The results of the overall achievement levels in terms of calculated mean of both the groups is presented graphically in Fig:1
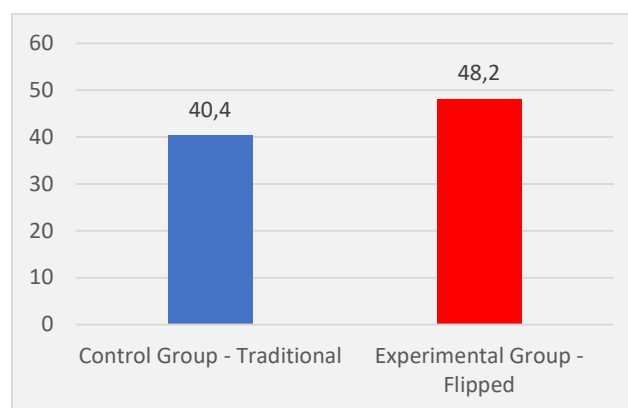
Figure 1: Comparison of Mean Scores in Achievement Test

The average score of overall achievement of students taught by the traditional method was found to be 40.4/60=67.33% and the average score of overall achievement of the students taught by the flipped learning method was found to be 48.2/60=80.33%. Thus the overall achievement of students taught by flipped learning was found to be way better than the overall achievement of students taught by traditional method.

Table 2: Overall Achievement of Students

Cognition level	Group	Mean	ST DEV	t- value	Result
Overall Achievement	CG	40.4	6.05	5.18	$H_0 1$ Rejected
	EG	48.2	4.68		

*Table t-value = 2.00@0.05, 2.39@0.02,

The statistical significance of the overall achievement of the students was tested through the t-test and the results showed a significant difference between means of control group and experimental group. The obtained t value was much higher than the table value and thus this statistically proves that the flipped learning model is indeed a very effective method of teaching as the overall achievement of the students taught by flipped learning method was much better than that of the students taught by the traditional learning method.

The results of achievement in different levels of Cognition (Knowledge, Understanding, Application, Analysis, Synthesis and Evaluation) in terms of calculated mean of both the groups is presented graphically in Fig:2
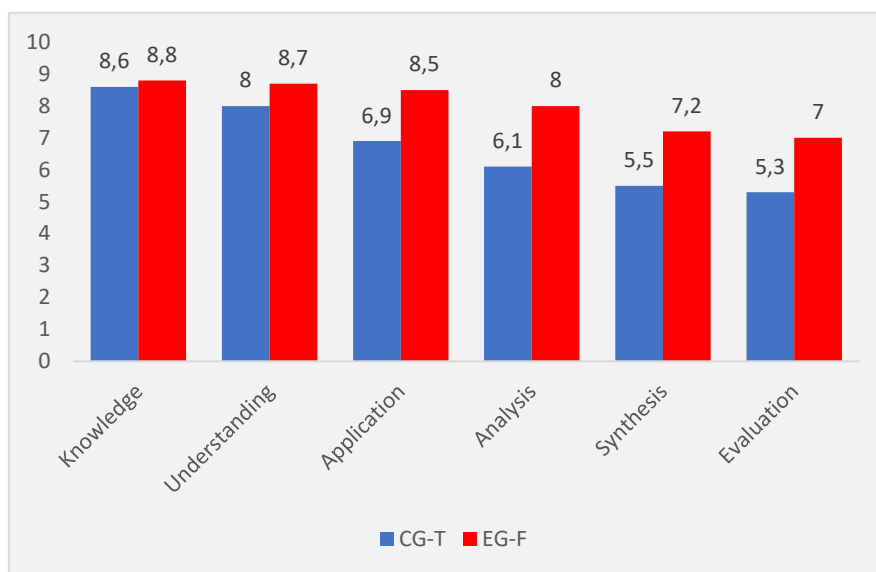
Figure 2: Comparison of Achievement Scores by Levels of Cognition

The graph depicts the difference in Achievement Scores by Levels of Cognition. The students taught by flipped learning method have performed slightly better at Knowledge and Understanding level. The difference in performance at Application, Analysis, Synthesis and Evaluation is much greater.

A further analysis of data using statistical method of t-test helped in determining the significance of the difference between the scores by levels of cognition (Knowledge, Understanding, Application, Analysis, Synthesis and Evaluation) in a traditional and flipped classroom setting. The results are presented in Table 3.

Table 3. Summary of Data Analysis by t-test

Cognition levels	Group	Mean	SD	t-value	Result
Knowledge	CG	8.6	0.83	0.71	$H_0 2$ Accepted
	EG	8.8	0.82		
Understanding	CG	8	1.12	2.61	$H_0 3$ Accepted
	EG	8.7	0.84		
Application	CG	6.9	1.11	5.85	$H_0 4$ Rejected
	EG	8.5	0.92		
Analysis	CG	6.1	0.98	6.56	$H_0 5$ Rejected
	EG	8.0	1.15		
Synthesis	CG	5.5	1.17	5.79	$H_0 6$ Rejected
	EG	7.2	0.87		
Evaluation	CG	5.3	1.56	4.35	$H_0 7$ Rejected
	EG	7	1.10		

*Table t-value = 2.00@0.05, 2.39@0.02,

The t-value indicated that there was no significant difference in knowledge levels of the experimental group taught by the flipped learning method and the control group taught by the traditional method and thus the H_01 is accepted. The t-test also revealed no significant difference in understanding level of experimental and control group thus proving that there is no difference in understanding gained by flipped learning method and traditional method. A significant difference was found between experimental group and control group in the higher levels of cognition - Application, Analysis, Synthesis and Evaluation. This proves that the flipped learning model is effective in developing and enhancing the higher order learning skills of Application, Analysis, Synthesis and Evaluation whereas the traditional learning model does not promote the development of Analysis, Synthesis and Evaluation skills which are essential components in the cognitive development of the student.

6. Conclusion

The levels of knowledge and understanding in achievement did not show any significant difference between the flipped classroom and the traditional classroom but the flipped classroom was more effective in developing the higher order skills of cognition than traditional classroom instruction. The results proved that learning quality is better flipped classroom as higher order cognitive skills are developed. Flipping the classroom helped in providing more time and better supervision to develop the higher order skills of cognition without compromising the amount of syllabus that can be covered. The flipped classroom is indeed an effective and efficient method of teaching learning as the activities aimed at developing Application, Analysis, Synthesis and Evaluation are conducted in the classroom, due to which complete monitoring is possible, problems faced in completing assignments are solved instantly and any hurdles faced by the student in learning are overcome immediately.

7. Discussion

The flipped classroom model is an innovation of the 21st century which can revolutionize the whole scenario of transaction of pedagogy without compromising on quality but on the contrary enhancing the standard of learning. Flipped learning model is one model which has the potential to completely revolutionize, overhaul, transform, revamp and enhance the quality of education being imparted in our classrooms by enriching the learner with higher order skills which are critical to the achievement of success in all walks of life. The success of education is not measured by the mastery of the lower order thinking skills of knowledge and understanding but by the mastery of the higher order thinking skills - HOTS i.e., Application, Analysis, Synthesis and Evaluation. The flipped learning model has proved to be more effective in the teaching learning of science subject. The onus of the success of the flipped model of teaching learning basically depends on the teacher's ability to effectively plan, select or prepare resources, monitor students learning outside the classroom i.e., at home and mentor the student's activities in the classroom. The 21st century learners are "Digital Natives" and thus ICT based learning pedagogies will be the new norm in classrooms of the future.

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