

Effect of Cooperative Learning Approach on Ninth Grade Students' Achievement in Chemistry

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Abstract

Effective science teaching methods can increase the learning process of learners. It facilitates both teachers and learners in creating an environment of learning. Therefore, the researchers tried to find the effect of a cooperative learning approach on student's achievement in the subject of chemistry. The main objectives of the study were: a) to study the difference between cooperative learning and traditional methodologies in terms of achievement in chemistry teaching at grade-IX and b) to analyze the difference between both methodologies in terms of achievement while comparing students of diverse intelligence of both groups. To accomplish these targets null hypotheses were tested. The nature of this study was experimental (Pre-test, Post-test equivalent group design). Forty-Two students were selected as a sample from Government Boys High School No 1 Nowshera Kalan on basis of pre-test score. Then two equal groups were formed i.e. experimental and control having an equal number of students 21 each. Both groups were taught the same three lessons, selected from of 9th-grade chemistry book (Khyber Pakhtunkhwa, Text-Book board). The Control group was taught these three selected lessons through the traditional method of science teaching. On the other hand, some chapters were taught to the experimental group through Slavin's student's team achievement division (STAD). This treatment lasts for six weeks and in the end, a teacher-made post-test was administered to both groups. The collected data were analyzed by applying an independent sample *t*-test. It was concluded from the analysis of data that chemistry learning through STAD was more effective than the traditional method of science. The same was also noticed for low achievers and high achievers of both groups. Based on the conclusion, it is recommended that science teachers should implement this method in their classrooms. Furthermore, curriculum developers should design such a curriculum which will be in favor of teaching this method.

Keywords: Cooperative Learning, Achievement, STAD, Chemistry

Introduction

Education is a social way that brings positive changes in the manner, character, and knowledge of personalities. A school is one of the social institutes established to achieve specific aims to bring the changes in the behavior, knowledge, and character of the learners. The teacher is not merely a transmitter of knowledge; he is rather supposed to perform a clear role in shaping the behaviors of students. An instructor should ponder the plan and scheme of stirring learning in the students. The teachers must stimulate the students for their aims which are desired. The teachers may create an environment in which students sense the necessity to teach (Ahmed, 2005). Typically the instructors in Pakistan imply conventional strategies of teaching. Conservative instruction methods do not inspire the learners of science especially in overcrowded classrooms (Retallick & Farah, 2005).

For this purpose, a meaningful way is important for the accomplishment of the knowledge and learning method. Effective teaching-learning progression needs planned exertions by the teacher and learners. The demanded condition could be achieved through the procedure of education. Cooperative learning is a teaching technique of arranging the events in schoolrooms/classrooms (Slavin, 2011). The social theorists for example Watson and Glaser (2006) say that group work is

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further powerfully valid than individualistic and competitive learning. Many studies, conducted earlier, have exposed proper relationships among the higher mental and affective products and cooperative learning styles (Tran & Lewis, 2012a, Johnson & Johnson, 2005, Tran & Lewis, 2012b). Such methods are considered very fruitful to improve student's successes and to retain those (Johnson & Johnson, 2009). Cooperative learning is described as tasks such as logically challenging, creative open-ended, and involves higher-order intelligence. These approaches stimulate the students as active receivers of knowledge by allocating information and response in groups. Johnson & Johnson (2009) state that there are five key mechanisms of cooperative learning technique; Specific liability, Constructive dependency, face-to-face primitive interface, group work quality, and teaching of social skills.

Statement of the Problem

Pakistan is a developing country and quality science education may play an important role in its development. Unfortunately, in Pakistan science subjects are taught with old traditional methodologies that's why the researchers tried to find out the outcomes of a teaching which is prevalent in many countries in different subjects. Here, in this paper, the researchers tried to find out the effect of the cooperative method on students achievement in the subject of Chemistry. More specifically, the STAD model was used to know its usefulness.

Significance of the Study

The prevalent methods of science teaching have not shown its impact in science teaching because these methods are too old and developed countries have already worked on different new methodologies to make science teaching and learning more interesting and practically more involving for all the students. The present study will also be of great significance to fill the gap in the present literature such as in the subject of chemistry at the secondary level because this method is not implemented and sufficient research is also not conducted on this subject in Pakistan. Furthermore, the finding of this paper will be of great significance for curriculum developers to revise the curriculum as per the need of the nature of science subjects and to make it more involving and activity based. Policymakers may get benefits from this study to change their policies as per requirement and need of time. The method will be very useful for science teachers especially to change their present teaching methodologies as per need of the time and to get maximum benefit from it.

Objectives of the Study

- 1) To study the difference between cooperative learning and traditional methodologies in terms of achievement in chemistry teaching at grade-IX.
- 2) To analyze the difference between both methodologies in terms of achievement while comparing students of diverse intelligence of both groups.

Literature Review

In a cooperative teaching group, students go through more convincing relationships in the group and their beliefs towards the learning subject matter (Slavin, 2011). Students in a cooperative environment obtained better academic, social, and psychological rewards at all educational levels. They thoroughly contributed to the group process, indicated cooperative manners, gave valuable comments about member's performance, and collaborated with their group they have better chances to get better achievements and get a high score before closing the session (Johnson & Johnson, 2005). Particularly, supportive situation has been disclosed to upgrade learners test scores (Beck & Chizhik, 2008; Zain, Subramaniam, Rashid & Ghani, 2009; Sousa, 2006). In cooperative learning groups students, there must be a positive, cooperative relationship developed among the students and the teachers, also the self-esteem and behaviors developed. Experience is essential for positive relationships among group members (Slavin, 2011). In cooperative learning, the overall performance of the learner may be increased and their attitude towards the education may become stronger and achieved better academic, common, and psychological assistance. They were completely shared in group events, displayed collaborative behaviors, provided positive responses, and cooperated with their group to have a higher chance of getting higher test scores and course grades at the end of the session (Johnson & Johnson, 2005). Cooperative learning has been described to advance students' hypothetical success (Sousa, 2006; Beck & Chizhik, 2008; Zain, Subramaniam, Rashid & Ghani, 2009). Unfortunately in developing countries like Pakistan, the education system reveals contrary and unpleasant settings whereas the class situation is particularly rather concerning. At the secondary level, the teaching-learning procedure in the country is very weak and it is completely based on rote memorization. The

teachers play a very leading character in the instruction of the teaching-learning procedure while learners have lesser chances to take part vigorously in activities.

The concept of collaborative learning as an educational approach was started in the early 1970s. Sharan (1994) that, "cooperative learning models first emerged in the mid-1970s after their introduction. Various renowned educational experts have described cooperative learning. Perhaps the most famous in education are Johnson and Johnson from the University of Minnesota. According to Johnson and Johnson (2009), collaborative learning is a classroom policy in which students work in groups to achieve desired goals, in interdependence, in collective and individual responsibilities, indirect progress, in group treatment, and when properly applied, more collaborative Competencies. Cooperative learning methods are different from group learning methods.

A learning method only identifies as cooperative knowledge to the degree that the five mentioned rudiments are present. Cooperative learning is an approach in which learners work in varied groups and reward is decided based on whole group achievements. Slavin and Upper (1999) state that this method improves the academic as well as the social skills and this approach is often suggested for its optimistic effect on learners. Veenam et al. (2000) suggested that cooperative learning methods abode students in small groups so that they can maximize their learning and support each other to know the course outlines. They added that, in cooperative learning, students are likely to share, interconnect, and argument with everyone and filling the gaps.

Background of the Study

The backgrounds of the universal use of cooperative learning methods create in learning concepts. Study of related objects shows that this learning method is fifty years old which were used virtually but today it is used all around the globe at all education level in developed and developing countries. ;

Student's Team-Achievement Divisions (STAD)

STAD was developed by Slavin and in this approach, the learners take parts which have mixed ability and the groups are usually has four members having equal abilities for learning but they have different race and localities. In this approach, the lesson is prepared as in the class and the learners are reinforcing to learn their task. They focus individually as well as they assist their group members to learn the group materials effectively. Teachers give individuals tests to learners and then arrange a quiz among the group for their completion of the given materials. Group score is added by individuals' scores. The students gain the point and that points are added to the groups score (Slavin, 1995). STAD methods are considered better for all grades and subjects. Teachers present group activities that require five periods per day.

Implementation of STAD in the Classroom

Slavin (1995) states STAD is the most seasoned and most widely researched type of cooperative learning. It is likewise among the most broadly relevant type of cooperative learning, and has been utilized in each imaginable subject, from math to arts to social studies to science and having been utilized in level two to twelve. It is one of the easiest of all cooperative learning techniques and is an acceptable model regardless of instructors who are new to the cooperative approach. STAD is a general strategy for sorting out the classrooms instead of a far comprehensive technique for teaching a particular subject; educators utilize their exercises and materials. It comprises of five significant parts presentation, team recognition quizzes, teams, and individual improvement scores.

Research Related to Cooperative Learning

The Cooperative learning methods are considered better than the traditional lecture methods in the teaching of basics of science and particularly in Chemistry. Detail of various studies is stated as under:-

Doymus, Karacop, and Ada (2009) examined the effects of the Jigsaw method and group methods on student' performance in the subject of Chemistry. It was found the group methods were better than the Jigsaw. Simsek (2009) experimented and found that the cooperative learning students outscored as compared to individual tests were taken in the aqueous solution.

Taran and Acar (2007) conducted a study in the class 9th students in metallic bond and found the students in the group perform better than the conventional way of methods used, the result suggested that the cooperative learning students mean score were significantly outstanding than the control group and developed positive perception. Zisk (1998) explored the impact of cooperative learning on hypothetical accomplishment and self-concept of secondary school students in chemistry courses. The results indicated positive gains in self-concept and performance for the pupils who were

busy in cooperative learning as compared to students in an old-style way of teaching methods. Hanze & Berger (2007) stated that the effect of cooperative learning on the success and self-esteem. They found that the cooperative learning students outscored the control group.

Methodology

Research Design

This study was experimental. Pre-test, Post-test equivalent group design was the design for this study.

Population

All the science students (281,284) of class 9th and 10th of government schools were taken as population. For this purpose data was collected from (EMIS) Education Information Management System (EMIS, 2019).

Sample

The study was delimited to Government High school No.1 Nowshera Kalan. Forty-two science students of class 9th were randomly selected out of 100 students in the school who were studying chemistry. Then a pre-test was administered to them. After the administration of the pre-test, it was marked and two groups were formed i.e. experimental and control groups were equally formed, 21 each through pair random sampling techniques. Each group has an equal number of students. Furthermore, high achievers and low achievers were also separated in the experimental and control group.

Research Instrument

Research instrument plays a vital role in experimental study. Therefore, the researchers developed a pre-test and post-test for this study. Both the tests were the same and consisted of an equal number of questions and consisted of 100 multiple choice questions having four options. It covered three units of chemistry, class 9th book (Khyber Pakhtunkhwa textbook board). These units were; 1) *structure of atom*; 2) *Periodic tables and periodicity of properties*, and 3) *structure of molecules*).

Validity

Creswell (2009) states that validity is the degree that how much a research instrument gives quality data and results. To decrease the menace of inside and outer validity, some points were reviewed in depth. This test was approved by subject experts and few changes were made such as the structure and suitability of the test. Therefore corrections were made in the test as it was recommended by the experts. In this way, the content validity of the test was measured. The test consisted of 100 questions, each question had four options. The students had to choose one of the most suitable answers to critically analyze it. These questions were based on conceptual understanding. For this purpose, language experts were also consulted to know the difficulty level of questions asked in the test.

Piloting/Reliability

After, the confirmation of the validity of the test, the research instrument was piloted at Government High School No 1 Nowshera Kalan, to check its validity and reliability of the test. The data was collected from 40 students. The reliability of the test was 0.78 using a split-half technique and as it should be higher than 0.70 for a good test (Fraenkel and Wallen, 2003).

Training of Teacher

Before the conduction of the experiment, it was necessary to train the teacher of the experimental group before the start of the experiment because the teacher who was selected for the experiment was not trained before for such kind of science teaching. For this purpose, the teacher who was selected for the experiment was trained for two weeks by the researchers. The lesson plan was developed by the researcher from the selected units and the teacher got training on how to teach lessons as per the requirement of the study.

Data Collection

Pretest and post-test was used for data collection. The pre-test served as a tool to know the prior knowledge of the subject and to equate them in two groups i.e. experimental and control groups. The treatment was for six weeks. In the end, the post-test served as a tool to know the achievement of both groups after the six weeks of instruction.

Analysis of Data

Data was analyzed by applying an independent sample t-test.

Results

Table 1: Experimental and Control groups comparison on Pre-Test

Groups	N	D.F	Mean	S.D	S.E	T. Value	
						Calculated Value	Table Value
Experimental	21	40	29	4.42	1.62	0.24	2.021
Control	21		28.61	5.98			

Not significant

Significance level: 0.05

Table No.1 shows that the calculated value of t was 0.24 and the table value was 2.021. It showed that the value of calculated t was less than the table value. Therefore, no significant difference was found between both groups. The experimental group and control group showed the same performance as prior knowledge was concerned. Therefore, both groups could be treated as similar.

Table 2: Comparison between High achievers of Experimental and Control groups on Pre-test

Groups	N	D.F	Mean	S.D	S.E	T. Value	
						Calculated Value	Table Value
Experimental High Achievers	11		32.27	3.31	1.28	0.07	2.086
Control High Achievers	11		32.18	2.68			

Not Significant

Significance level: 0.05

Table No.2 shows that the calculated value of t was 0.07 and the table value was 2.086. It shows that the value of calculated (t) was less than the table value. Therefore, no significant difference was found between both groups. The experimental group (high achievers) and control group (high achiever) showed the same performance as prior knowledge was concerned. Therefore, both groups could be treated as similar.

Table 3: Comparison between low achievers of the Experimental group and Control group on pre-test

Groups	N	Df	Mean	S.D	S.E	T-Value	
						Calculated Value	Table Value
Experimental	10	18	24.50	7.32	3.38	0.05	2.10
Control	10		24.30	7.80			

Not significant

Significance level: 0.05

Table No. shows that the calculated value of t was 0.05 and the table value was 2.10. It showed that the value of calculated (t) was less than the table value. Therefore, no significant difference was found between both groups. The experimental group (low achievers) and control group (low achievers) showed the same performance as prior knowledge was concerned. Therefore, both groups could be treated as similar.

Table 4: Experimental and Control groups comparison on Post-Test

Groups	N	D.F	Mean	S.D	S.E	T. Value	
						Calculated Value	Table Value
Experimental	21	20	52.80	14.88	3.59	3.59	2.02
Control	21	20	49.42	7.11			

Significant

Significance level: 0.05

Table 4 shows that the calculated value of t was 3.59 and the table value of t was 2.02. Which showed students who had to learn through cooperative learning performed better than the traditional way of teaching science and Cooperative learning method was found better?

Table 5: Comparison between High achievers of Experimental and Control groups on Post-Test

Groups	N	D.F	Mean	S.D	S.E	T. Value	
						Calculated Value	Table Value
Experimental High achievers	11	10	65.81	16.40	4.00	2.70	2.08
Control High achievers	11	10	55.00	4.04			

Significant

Significance level: 0.05

Table 5 shows that the calculated value of t was 3.59 and the table value of t was 2.02. Which showed students who had learned through the cooperative learning method performed better than the

traditional way of teaching science and the Cooperative learning method was found effective for science teaching?

Table 6: Comparison between low achievers of the Experimental group and Control group on Post-Test

Groups	N	D.F	Mean	S.D	S.E	T. Value	
						Calculated Value	Table Value
Experimental Low achievers	10	9	58.50	12.73	4.20	3.61	2.10
Control Low achievers	10	9	43.30	3.83			

Significant

Significance level: 0.05

Table 6 shows that the calculated value of t was 3.61 and the table value of t was 2.10. Which showed students who had learned through the cooperative learning method performed better than the traditional way of teaching science and the Cooperative learning method was found effective for science teaching?

Discussion

Pre-test results of both groups i.e. experimental and control groups were the same and showed that students of both groups had an almost equal level of knowledge before the experiment. Pre-test results were used for the equal distribution of students in both groups. The same results were found for both groups of high achievers on the pre-test. Similarly, low achievers of the experimental group and control group were also the same in conceptual knowledge of chemistry in the three units of class 9th.

However, the post-test results were different while comparing both groups. The experimental group who was treated with a cooperative learning approach (STAD) showed a significant effect because it had surpassed the control group in the conceptual knowledge which was devised by researchers in terms of valid and reliable questionnaires. Musdaeni and Hisbudin (2018) concluded in their study that the cooperative learning approach (STAD) was better for teaching chemistry than a direct way of teaching. Therefore their study results confirmed the result of this study.

Similar results could also be seen for high achievers of the experimental group who showed a lot of involvement in their study as compared to the high achievers of the control group. Chebii et al. (2018) also found in their study that students who were taught through STAD performed better than the conventional group. This confirms the results of this study.

The same results could also be seen for low achievers of both groups. Learning through STAD had a clear impact on the achievement of students and they outscored low achievers of the control group because learning through small groups and activities engaged the students of the experimental group. These results are in line with the findings of (Ishtiaq, Ali., & Salem, 2017). Who conducted an experimental study to know the effects of the cooperative learning method (STAD) on the achievement of adult learners while learning English as a foreign language than the traditional way of teaching EFL to adult learners?

Conclusion

After the analysis and finding the following conclusion were made

The cooperative learning approach was a new method for teaching science in public sector schools in Pakistan. Therefore, this experimental study was conducted. It was concluded based on results that if the Cooperative learning method will be implemented in true spirits then it would show its impact on student's achievements as in this study experimental group which was treated with cooperative learning approach outclassed the control group because, in cooperative learning approach, STAD model was used. It involved the students mentally and the presentational skills of students were enhanced which resulted in better results than the control group.

It was also found that the high achievers students of the experimental group showed good results as this method was more involving and engaging. Similarly, it was also concluded that low achievers who learned through STAD were better than the group who was taught through the conventional scientific method. Overall, it was concluded that the Cooperative learning approach (STAD) was found better for diverse achievers.

Recommendations

The following recommendations are suggested based on the result as,

- a) The educators need to adopt the cooperative learning process in the classrooms especially for science teaching. For this purpose, teachers need to be trained and updated. Furthermore, students need to be encouraged by teachers to work in small groups.
- b) Curriculum developer needs to revise the science curriculum by inculcating different activities and in this way group activities will be easy to implement for a teacher in their science classroom.
- c) The heads of the institutions need to create an environment for cooperative learning in their schools particularly in the science subjects. Teachers and students need to be encouraged by heads of intuitions for such type of teaching.
- d) Such types of studies may also be conducted in other subjects and grades with a larger sample size with different age groups to find more about its utility.

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