EFFECT OF COOPERATIVE LEARNING APPROACH ON ACADEMIC ACHIEVEMENTS OF SECONDARY SCHOOL STUDENTS IN THE SUBJECT OF CHEMISTRY

By

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Doctor of Philosophy

In

Education

FACULTY OF ARTS AND SOCIAL SCIENCES
NORTHERN UNIVERSITY, NOWSHERA
PAKISTAN 2016
DECLARATION

I hereby declare that the material presented in my thesis, titled, “Effect of Cooperative Learning Approach on the Academic Achievement of Secondary School Students in the Subject of Chemistry” completed under the supervision of Dr. R.A. Farooq, is my own work and that all the sources I have used or quoted have been indicated and acknowledged as complete reference.

__________________________
Amin Khan
CERTIFICATION

Certified that contents and format of the thesis titled, “Effect of Cooperative Learning Approach on the Academic Achievement of Secondary School Students in the Subject of Chemistry” submitted by Amin Khan have been found satisfactory for the requirement of doctoral degree.

(Dr. R.A. Farooq)
DEDICATION

This study is dedicated to the sweetest memories of my elder son

“Muhammad Ghassaan Khan”

(APSACIAN)

who martyred in the Prime of his youth at APS incident

December 16, 2014
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Amin Khan
ABSTRACT

The major purpose of the study was to investigate the effect of cooperative learning approach on the academic achievement of secondary school science students in the subject of chemistry. The main objectives of the study were: 1) to examine the effect of cooperative learning as an approach on the academic achievement in chemistry. 2) to see the difference between treatment effects for the students of different intelligence. 3) to see the difference between treatment effects for urban and rural students. 4) to examine the effect of cooperative learning on the retention of the secondary school students.

To achieve these objectives three null hypotheses were tested: 1) there is no significant difference between the mean scores of the students of experimental and control groups. 2) there is no significant difference between the mean scores of high achievers and low achievers of experimental and control groups. 3) there is no significant difference between the mean scores of urban and rural students of experimental and control groups. (4) there is no mean difference between the scores of both the groups on retention test. The population of the study consisted of government secondary school science students in Khyber Pakhtunkhwa. The students of 9th class of GHS No.1 Nowshera Kalan were taken as sample of the study. Only students studying chemistry as elective subject were included in the sample. The study is experimental in nature. The sample students were divided into two groups i.e. experimental and control groups. Treatment and control groups were equated on the basis of teacher made pre-test scores. Each group comprised 21 participants.

Both groups were exposed to same experience except the style of learning i.e. Slavin’s students team achievement division (STAD) model of cooperative learning was selected to teach chemistry to the experimental group while control group was
taught by using traditional method. At the end of treatment, a teacher made post-test was administered to experimental and control groups. After a gap of four weeks, the same post-test was administered as retention test, unexpectedly to the students. the significance of difference between the scores of groups was tested at 0.05 level by applying t-test and analysis of variance.
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<th>Abbreviation</th>
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<tr>
<td>CLA</td>
<td>Cooperative Learning Approach</td>
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<tr>
<td>STAD</td>
<td>Student Team Achievement Division</td>
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<td>ANOVA</td>
<td>Analysis of Variance</td>
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<td>GHS</td>
<td>Government High School</td>
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<td>KPK</td>
<td>Khyber Pakhtunkhwa</td>
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<td>TAI</td>
<td>Team Assisted Instruction</td>
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<td>TGT</td>
<td>Teams Games Tournament</td>
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<td>CIRC</td>
<td>Cooperative Integrated Reading and Composition</td>
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<td>GI</td>
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<td>CAT</td>
<td>Chemistry Achievement Test</td>
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<td>DF</td>
<td>Degree of Freedom</td>
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<td>EMIS</td>
<td>Education Management Information System</td>
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<td>HA</td>
<td>High Achievers</td>
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<td>LA</td>
<td>Low Achievers</td>
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<tr>
<td>SD</td>
<td>Standard Deviation</td>
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<td>RE</td>
<td>Randomly Selected Experimental Group</td>
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<td>RC</td>
<td>Randomly Selected Control Group</td>
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<td>SE</td>
<td>Standard Error</td>
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<td>IIS</td>
<td>Individual Improvement Scores</td>
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<td>IP</td>
<td>Improvement Points</td>
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<td>RRBS</td>
<td>Round Robin Brain Storming</td>
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Chapter 1

INTRODUCTION

Education refers to social procedure which initiates the individuals into proper forms of behavior and attitudes that lead to decent productive and peaceful life in society. A school is social institution that launches program to accomplish goals of bringing changes in the behavior, and attitudes of the students. The teacher is a designer and manager of instruction and an evaluator of students learning. He is supposed to plan, design, select and supervise the arrangement of learning events with the aim of stimulating and motivating learning in students. Hence, he is expected to perform an effective role in shaping the manners of thinking and acquitting among students. He must motivate the students for learning. He should establish circumstances in which students sense the requirement for learning (Ahmed, S. 2005). Mostly, the teachers in Pakistan are trained on classical basis and they usually, employ conventional strategies for teaching in classroom. Conventional teaching methods do not motivate the students for learning especially in heavy classrooms (Retallick & Farah, 2005). In this regard instructions towards purposeful direction are necessary for the success of learning process. Effective teaching learning process requires intended efforts by the teacher and students (Henry, 1980). The desire situation can be achieved through the process of learning things cooperatively.

Cooperative learning is an active learning andragogy to arrange the activities in classrooms, in order to improve educational and societal learning-experiences. This learning approach entails functioning in groups to attain a shared goal (Slavin, 2011). Social theorists such as Watson and Glaser (2006) claim that group work is far useful and positive results oriented learning technique than conventional teaching approach, which may be implemented efficiently, in classroom activities to attain intended
goals. A lot of studies, conducted previously, have discovered suitable association between the intellectual and affective domains, and collaborative learning styles (Tran & Lewis, 2012). Johnson et al. (2009) argue that cooperative learning has enhanced students’ attainment and their retention level. Cooperative learning strategy is creative, open ended and involve intellectual, affective and psychomotor skills. (Ross and Smith, 1995). These methods activate the student as dynamic receivers of understanding by sharing knowledge and skills through mutual discussion and giving responses at cooperative learning session (Lewin Kurt, 1951).

According to Johnson and Johnson (2009) main components of cooperative learning method are described as interdependence, accountability, definite interaction, utility of social skills and group procedure.

Definite interdependence assures students’ working together as an interconnected, group to reach common group goals (Yager, 2000). Slavin (2011) claimed that the learner would be accountable for his/her own learning as well as for group mates’ learning. According Johnson & Johnson (2008) students in cooperative learning group have to swim or sink together. Positive interdependence causes mutual collaboration among the learners that enhances every student’s outcomes in group activities. Hopeful interaction forms while group-members boosting and assisting one another’s attempts to complete the group task. Students have to work jointly, and provide verbal support to groupmates on learning activities to accomplish assigned work (Johnson & Johnson, 2008). Individual responsibility refers to students’ asking for help, sharing their thoughts, and learning as much as possible, helping the group-members to do function effectively, and taking care of one another (Johnson, 2009). Individual accountability assures common learning of group-members that depend on each other work (Slavin, 1996). The obligation potencies of individuals enhance in the
presence of group accountability and individual accountability (Johnson and Johnson, 2009). Indeed, socially skilled pupils in groups assure effective learning (Johnson & Johnson, 2007). Therefore basic learning skills of promotive interaction must be taught to accomplish intended objectives. Johnson & Johnson, (2005) state that cooperative learning keeps a stress on students to involve in cooperative learning activities and accomplish assigned assignment cooperatively. Hence it is more complicated learning than traditional learning.

Cooperative learning requires students to listen politely, ask question collaboratively, and discuss thoughtfully, to ensure groupmates cooperative participation in group tasks. Furthermore, every individual of group must be able to deal with variances of group members and to administer learning task cooperatively while taking decisions. Cooperative learning processes are considered to be unsuccessful in the absence of these skills. Therefore, proper use of those skills and group techniques are necessarily, taught to obtain significant positive cooperative learning outcomes (Slavin, 1996). Cooperative learning procedure assists to enhance influence of the student participation of obtaining common goals through meditation on the teaching-learning practices (Yamarik, 2007). According to researcher view, the aim of cooperative learning approach is to understand, reform, and promote the role of participants in contributing to the shared attempts to obtain the intended learning outcomes.

Slavin, (2011) claims that students in cooperative learning group pass on through more conclusive association among groupmates and between pupils and instructor, and more convinced self-esteem and beliefs about the course material. Cooperative learning environment provided better opportunities helping the learners to obtain high test scores and socio-psychological rewards at all educational levels.
Johnson et al. (2005) argued that cooperative learners thoroughly, contribute in group process, indicate cooperative attitudes, give valuable comments about member’s performance and collaborate with teammates, lead to get higher chance of obtaining better achievements and final grades at session closing. Subramanian et al. (2009) reported that cooperative learning treatment had showed positive impact on students’ academic performance.

Cooperative learning has been found dynamic approach that facilitated better test scores and reported an increase in attendance, stimulation and interdependence of students in treatment group.

Unfortunately in developing country like Pakistan, main disquiet is the falling standard of education. The education system is outdated and reveals contrary and unpleasant scenario. The learning procedure in classroom are particularly rather concerning and is completely based on rote memorization. Rote learning is the significant cause of poor quality education in country. Specifically, at secondary level, the quality of education is poor and needs to be improved by adopting a modern system of education. In Pakistan the instructor plays very dominant role in the teaching learning process while pupils have rare opportunities to participate actively in classroom activities.

According to the Govt. of Pakistan (2009) Planning Commission of Pakistan introduced “Vision 2030” to cope with these situations, which describes that prevailing education system would be updated to provide chance to the Pakistani students to achieve quality education, to utilize their actual capabilities and contribute fruitfully, to build developed Pakistani nation. The current teaching practices in teaching of science and humanity may be changed to raise the education quality that mainly depends on the conventional method of instruction through which the
instructor imparts the knowledge that the pupils receive it passively. Then they memorize some passages and omit these in examination hall. (Retallick, and Farah, 2005). Furthermore, it is obvious that presently. Majority of teachers are trapped in the middle of a change, for which they have not trained efficiently.

As a result of that, science teachers are faithfully motivated in how and when hopefully choose various science teaching strategies in order to obtained predetermined instructional objectives (Harwood & Mc Mahon, 1997). The factors arising from: instructors and pupil traits, instructional objectives, classroom learning situation, and the nature and requirements of the subject matter affect the teaching strategies may be applied by instructor at any given environment (Alebiosu, 2003). Obviously, the conventional teacher or traditional classroom learning activities has not succeeded to result in the lusted outcome of preparing thoughtful and reflecting learners. Cooperative learning promotes involvement, enhances learning and motivates the students. It promotes a shift from teacher-dominated to student-centered environment.

Jegede, (2007) describes that Chemistry is a key subject in the curriculum of Pakistani schools at secondary level. It is a fundamental branch of science that facilitates medical, engineering, agricultural and industrial sectors of a country. Nevertheless, chemistry is an essential science subject and governments strive to promote chemistry education, but commonly secondary level students evade the chemistry subject. Dori (1989) claims that the majority of students are avoided of chemistry learning. They perceive chemistry learning more complex as compared to other subjects because chemistry is the complicated science subject and majority of the chemistry instructors in Pakistan may employ traditional methodology. Therefore Students’ reluctance of chemistry education may be ascribed to pupil discerned
abstract and complex nature of chemistry subject; covering large mass of information; and its detachment from reality. Keeves & Morgenstem (1992) claims that pupils’ fearing of chemistry learning and its complex nature results in motivational loss regarding chemistry education. To overcome these challenges, cooperative learning approach may be employed in educational institutions to create interest and promote active involvement in learners towards enjoyable chemistry learning. However, in Pakistan, there are shortage of studies on the application of cooperative learning approach in chemistry on students’ achievement in secondary schools.

Therefore, study has planned to find out the effect of cooperative learning on the academic performance of students in our own culture and setting.

A technique STAD “student team achievement division” was selected by the investigator as it is widely applicable forms of cooperative learning and has been using in grade two through twelve, in wide range of subjects. It improves interaction, ability, education, understanding, thinking, ideas, capability, and manners of the students (Balfikih, 2003). STAD is simple values laden learning approach and desires investigation as an alternative method for teaching chemistry at secondary level in Pakistan.

1.1 PROBLEM STATEMENT

Cooperative learning has been using as an approach to promote learning in a couple of schools in Pakistan such as city and APS school system, but in public and private sector schools traditional teaching methods are in practice. Therefore, a study was designed to examine and describe any shift from current methods of teaching and learning to those possible with in a cooperative learning frame work. This study was intended to find out the Effect of cooperative learning approach on the academic performance of student in chemistry subject at secondary level.
1.2 **OBJECTIVES**

The objectives of this study were stated as under:

i. To investigate the effect of cooperative learning approach on students’ academic performance in chemistry.

ii. To examine the difference between treatment effects for high achievers and low achievers.

iii. To determine the difference between treatment effects for urban and rural students.

iv. To find out the effects of cooperative learning on the students’ knowledge retention in chemistry.

1.3 **HYPOTHESES**

The following null hypotheses were tested to get the objective of the study

i. There is no significant difference between the mean scores of students taught chemistry with CLA and without CLA.

ii. There is no significant difference between mean scores for students of high and low intelligence of treatment and control groups.

iii. There is no significant difference between the mean scores of urban and rural students of treatment and control groups.

iv. There is no significant difference between the mean retention scores for students of the treatment and control groups.

1.4 **SIGNIFICANCE**

The study was significant for the following reasons.

i. The study would be helpful to provide proper professional guideline in order to promote teaching learning process effectively.
ii. The study would be helpful to motivate the teachers to choose cooperative learning method for instruction in routine class-rooms.

iii. This study may inspire policy makers and curriculum designers to include cooperative learning as methodological aspect of curriculum.

iv. This study would be helpful to provide a guide line for future researchers to arrange and carry out further researches.

v. The study may be helpful to modify the manner of the student regarding of interaction and coordination with each other in cooperative groups.

vi. This research study would be the source of inspiration for broad use of cooperative learning in different subjects at various grade levels.

vii. The findings and conclusions of this research study may persuade the educational supervisors and administrators to promote the cooperative learning instruction.

viii. The study would be helpful for teacher to improve achievement of the student.

1.5 DELIMITATIONS OF THE STUDY

This study delimited to:

The science students of class ninth studying at Government High School No.1 Nowshera Kalan.

Contents of three chapters (structure of atom, periodic table and periodicity of properties, and structure of molecules) of the chemistry 9th class text book produced by Khyber Pakhtunkhwa Text Book Board Peshawar in 2013.
1.6 METHOD AND PROCEDURE

1.6.1 Population

0.281 million, secondary school science students (IX-X) in government sector in Khyber Pakhtunkhwa comprised the population of this research study.

1.6.2 Sample

Sample of this research study composed of forty-two science students studying in class ninth of Government High School No.1 Nowshera Kalan Nowshera. They were allocated to treatment and control groups by pair random sampling technique according to pre-test achievement scores.

1.6.3 Research Instrument

The following instruments were used for data collection.

i. Pre-test: To check the academic achievements of students before experiment.

ii. Post-test: To check the academic achievement of students after experiment.

iii. Retention-test: To check the knowledge retention of students after four weeks of treatment.

1.6.4 Collection of Data

There were two different treatment styles in the methods of teaching. Two teachers with same qualification and almost same experience have taught treatment and control groups. Conventional method was employed to teach the control group, and treatment group was treated by (STAD model) of cooperative learning approach for the duration of six weeks. Prior to the treatment, pre-test was given to the sample students.

Post-test was too given to sample students, at once after the treatment was over (8 students were remained absent from the post-test). After duration of four
weeks a post was given as retention test to the sample students. These tests were aimed to determine the academic scores of students containing the sample of study.

1.6.5 Data Analysis

Mean, standard deviation, and t-test were used to interpret the collected data. To find out the treatment effects for the urban and rural area students, and for higher and low achievers, the factorial design (2×2) analysis of variance and one way ANOVA were used at 0.05 levels.
Chapter 2

RELATED LITERATURE REVIEW

This experimental study was intended to probe the effects of cooperative learning strategy on students’ achievement in chemistry course at secondary level. This section presents a critical report of cited literature linked to cooperative learning in twelve areas, which were stated as under:

2.1 NATURE OF COOPERATIVE LEARNING

As a teaching strategy cooperative learning concept secured impulse in the early 1970s. According to Sharan (1994), “the new wave of cooperative learning appeared in the early 1970 following the pioneering work of John Dewey and later Alice and Herbert Thelen in the 1950s”.

Several re-known educationists and researchers have defined the cooperative learning. The most common one employed in education is possibly that of Johnson and Johnson of Minnesota University. They describe that students work in group in cooperative learning strategy, to achieve shared goals, under conditions of positive inter-dependence, individual and group accountability, face-to-face promotion, proper utilization of cooperative skills and group processing. Cooperative learning technique is different from group learning approach. An instructional strategy is recognized as cooperative learning to the degree to which these referred elements are present.

Woolf-folk argues that cooperative learning is structured instructional setup that facilitates learners working in heterogeneous groups and award is granted on the basis of whole group success. Sprint Hall et al. (2000) state that in cooperative learning method, students participate in structured learning activities in a small group and rewards are given on the basis of group success. In cooperative learning situation students contribute, and participate in cautiously planned learning activities to learn
effectively and they are also given chance to work as group in which they teach others and learn from other (Slavin 2000).

Slavin and Cooper (1999) state that cooperative learning methods enhance academic, cognitive and social standards, as an approach that is frequently recommended for its positive effects on pupils. Veenam et al. (2000) claim that cooperative learning technique place students in groups to maximize their learning and assist the group-mates to comprehend the course contents. They further proposed that, in cooperative learning, students are expected to communicate, share and debate with each other, filling the gaps in each other’s’ understanding.

Ravenscroft et al. (1999) stated that cooperative learning approaches provide foundation of an active process for students to learn and to share information through interaction, leading to deeper learning. Felder’ and Brent (2001) claimed that cooperative learning creates chances for pupils to work on an assigned task or project in small groups under some requirements, comprising that the group members have to assured individual accountability for the whole subject matter of the assigned task or project.

Felder and Brent’ (2001) further proposed that cooperative learning refers to team work that maximizes happening of favorable situations and enhancing contentment and learning that occurs from doing work through significant performance of group. Veenam, et al. (2005) claimed that rewarding structure and shared goals of cooperative learning may establish situations where group members may desire to assist group members to attain their personal goals. This viewpoint has been advocated through empirical studies of Johnson, Johnson and Smith, 1991. They claimed that the collaboration of team incentives and team goals increases attainment more significantly than group goals alone.
2.2 THEORETICAL UNDERPINNING OF COOPERATIVE LEARNING

The roots of pervasive use of cooperative learning instruction originate in learning theories. Study of allied material shows that fifty years ago the cooperative learning was virtually insignificant but today cooperative learning is a typical learning approach in a most developed and developing countries at all levels of education (primary, elementary and secondary schools, colleges and universities).

Most of the researchers (e.g. Slavin 1992, 1993, 1995, Johnson & Johnson 1999) have proposed broad scope of theoretical models to describe the higher ranking of cooperative learning. The theories related to cooperative learning approach are classified in two main groups, motivational theories and social cognitive theories. These two groups of theories are narrated as under:

2.2.1 Motivational Theories

Motivational outlook of cooperative learning concentrates generally on the incentive structures and team goals formulation as it provides foundation to these theories of cooperative learning through which learners participate in learning activities. According to Deutsch (1949) there are three goal structures. (i) Cooperative goal structure, in which every member of cooperative group has to put his efforts to support others’ goal attainment. (ii) Competitive goal structure, in which every individual has to put his efforts to hinder others’ goal attainment. (iii) Individualistic goal structure, in which every individual’s efforts does not affect others’ goal attainment.

Cooperative goal structures provide environment to the individual, where team members may acquire their goals if and only if each member is successful (Johnson et al., 1981, and Slavin, 1983a). Therefore, team members are held responsible to assist...
and motivate their group fellows to make use of utmost efforts in connection with attainment of their personal goals. In other words, cooperative groups rewards criteria rested on the total performances of participants, and sets up of interpersonal incentive structure where group participants may allow or retain supports in response to team-members task associated attempts (Slavin 1983a).

Motivational theorists claimed that in conventional classrooms, traditional grading and reward structure established peer norms that lead to resist educational endeavors. However when pupils participate in group work under cooperative goal structure to achieve instructional objectives, their learning efforts help their group mates succeed (Deutsch 1949). Slavin (1975) explored that students working in cooperative groups up-graded their social position in classroom for gaining in academic achievement, while students in conventional classrooms failed to win their status.

These variations in the social consequences of academic success can be very important. Brook-Over, et al. (1979) claimed that group-mates’ assistance to attain was the major forecaster of their success (controlling for ability and social class).

Obviously, cooperative goal structures leads to create pro-academic norms amongst participants of treatment group, and these norms promote academic attainment of learners. Locke and Lathan’s (1990) claim that goals regulate the manners of individuals and elements like team goals, role modeling, support, and assessment affect the establishing of personal goals. These elements are consistent with cooperative learning model of Salvin (1995). Goal setting theory claims that team goals results, in greater goal responsibility to the personal goals than goals only .if team goals are arranged on the top of personal goals. Similarly, the cooperative
learning style claims that the establishing of team goals will quicken the inspiration to learn, motivation to support team-mates to learn.

Slavin (1995) claims that cooperative goal structure implementation leads to the group contingency, in which behavior of team members provides base for allocating group rewards. The group contingencies theory does not need the team members having ability to really assist groupmates. The result is reliant on mutual way of conduct. It is ample to encourage participants to involve in behavior, that assists the team to be awarded, for the team rewards persuades individuals to motivate goals oriented behavior amongst their team members.

![Diagram](attachment://model.png)

2.2.2 Social Cognitive Theories

Slavin (1995) argues that cooperative learning style leads to make learning process more easy and standardized because it inspires students to achieve common goals and it also places learner in a social setting, in which he matures cognitive growth through utilization of Slavin cooperative learning model.

Merriam & Caffarella (1999) and Hansman (2001) state that learning needs social setup. It does not happen in a void, rather learning may be structured through the nature of the interaction amongst students, the ways and means they utilize in their interaction, the learning pursuit and the social setting where the activity occurs. It carries the social setting, conventions of life, and techniques and apparatus for
learning to be occurred in the learning environment. Cognitive theories are classified into two major groups:

i. Developmental theories

ii. Cognitive elaboration theories

2.2.3 Developmental Theories
These theories are based on the premise that learners’ cooperative interaction around suitable activities enhances the skills of critical thinking of students (Damon, 1984; Murray, 1982).

Vygotsky is one of well-known social cognitive theorists that necessitate social setting meaningful to cognitive growth. He argues that cognition progress basically depends on social interaction. According to Vygotsky, (1978) internalization of knowledge is growth that starts with social interaction of learners before it advances into an individual one; a learner’s growth initially occurs in the social setting before it goes on to the personal level.

Vygotsky, additionally, ascertained that social process makes learning easier and interesting as the procedure of social learning presents a chance to participants of working with in their proximal development zone. He stated that the zone of proximal development is the gap between the level of factual growth as established by working independently and the level of latent growth as established through working collaboratively with talented fellows. Bransford et al. (2000) described the inter-relationship of collaborative learning and social setting regarding the idea “zone of proximal development”. They claimed that cooperative learning assured the stable social interaction with talented fellows.

Additionally, Vygotsky claimed that cooperative learning strategy raises participants’ development because participants of the same ages have tendency to
work within one another’s zones of proximal growth, working in the cooperative
group manners were aptly more effective than those they would work lonely.

Vygotsky proposed that collaborative activity increases learning and
socialization allows participants, operating within their level of proximal growth. If
students avail a chance to work nearly, within their level of proximal growth, then
they may have an opportunity to gain interpretation that are offered to them in a plain
and more understandable mode than those they were supplied by individual of higher
mental ability of similar age.

Study of related material indicates that socialization’s gain is symbolized by
Piaget in social environment. He assured that social setting facilitates the learning of
moral principles, conventions, manners, norms, traditions and languages.
Conventional schooling system was harshly criticized by Piaget (1932) that uses
traditional teaching methods, competitive assessment, and assigns home work on
individual basis. He claimed that problem may be rectified through working in teams.
He argues that cooperative learning promotes mental growth of learners.

Piaget and Duckworth (1964) stated that practical involvement in activity is
basic key for mental growth, but he also insisted that the student active participation
in the learning process is compulsory for learning to occur effectively. They proposed
that all growths and developments be composed of temporary disputes and
inconsistencies which should be controlled to achieve desired level of balanced state.

Hartman (1999) reports that equilibration entails assimilation and
accommodation activities. Individuals utilize their present thinking plans to
understand the outward world in the process of assimilation. While Individuals
change their present views or set up new ones in the process of accommodation if
they see that present thinking does not completely incorporate the truth of the external
world. Cooperative learning approach facilitates situation for those activities to happen, while conventional way of teaching does not support such activities to be carried out. Proximal development zone of Vygotsky and Piaget’s social transmission theory are consistent with each other, and Piaget argued the implementation of cooperative learning. He opined that individuals are eager to acquire new knowledge only, when they have a frame work which facilitates them to take in and understand it and cooperative learning group frequently provides opportunity to participants to assist group members to proceed to the next domain of growth. These conclusions provide rationale for broad use of collaborative learning approach in educational institutes (Damon and Wadsworth, 1984). They state that social interaction amongst the participants on learning activities will situate the learners to increase their achievement. When participants discuss the content, cognitive disputes will appear, weak logical argument will reveal, and deep understanding will emerge. Therefore, students will learn from one another in cooperative learning group.

Bandura (1986) introduces a causality model in which elements of environment, deportment and cognition are interactive and work as causal factors of each other. Bandura named this mutual link as “triadic reciprocity”
Nature wise the causal relation assures interaction among these three elements. To produce a definite impact several elements are usually needed. Bandura claims that triadic design ensures closely inter-relation of those three elements. Nevertheless, he also stated that the degrees of impact practiced by each of the three sorts of elements differ for various persons, deportments, and contexts.

Bandura (1986) proposes that modeling and social inter-action may form, supervise and refine thinking and feelings of learners. Aiming attention, increasing motivation, enhancing achievement, and stimulating emotions, is only possible through modeling. Verbal modeling provokes thought processes and facilitates growth of cognitive ability.

Bandura stated that learner would observe only the final outcome without knowing, how the task has been performed if modeling facilitates problem solving activities without establishing the thinking process. Verbal modeling of thought strategies is essential to facilitate the growth of cognitive skills as they involve in problem solving practices. The directed actions of personal thoughts are become noticeable through apparent representation, useful qualities of both thought and actions are supportive in creating generalized developments in cognitive skills.
The impact of modeling has supported by Bandura and he also ascertained that span of time is needed for modeling to employ its effect on the growth of cognitive skills.

2.2.4 Cognitive Elaboration Theories

Review of related literature shows that cognitive elaboration perspective is different from the developmental outlook. Wittrock (1978) investigated that if facts and figures have to be maintained in mind and associated to information pre-existing in memory, then observer would take part in certain type of cognitive elaboration, of contents. One of the most valuable ways of learning is to explain learning material to other learners.

Students, who were engaged in explaining the material to others learners were those who obtained more from cooperative learning-approach (Webb, 1989). Cognitive Elaboration facilitates the learner to learn more than that who worked alone but less than that who explained material to others (Donald Dansereau, 1988). Research studies explored that cooperative learning method provides opportunities to students to play the role of presenter and observer. A portion of material is studied by them simultaneously, and then presenter presents the summary of learned material whilst observer rectifies mistakes, and completes the gape of any overlooked material, both participants can recall the important concepts. On the next stage, the learners interchange their roles. Devin et.al (1976) argued that both tutor and tutee gained more advantages from peer learning. Staven (1991) argued that collaborative learning situates the students to evaluate, explain, and elaborate the learning activities to one another, and so they effectively observe and learn the complicated cognitive process. Face to face meaningful interaction, which is the fundamental feature of cooperative learning carries one or more cognitive processes (Mackeachie, 2002). Summarizing
information into one’s own words is significant elaboration, providing by one learner to another is a win/win setting. Elaboration increases learning of the those observers who receive the explanation and reinforces the learning of those observers who provide the explanation.

With reference to cooperative learning, cooperative integrated reading and composition/languages arts program (Steven et al, 1987) and reciprocal teaching (Palincsar and Brown, 1984) are the examples of practical use of cognitive elaboration potential.

2.3 RATIONALE OF THE STUDY

A study of the related literature proposes that endeavors to precede cooperative learning have tended to be initiated in American or European contests (Jolliffe and Hutchinson, 2007).

Research has been less conducting in other countries of the world. This doctoral thesis is an answer to lack of research on cooperative learning approaches in Pakistan. An evaluation of the broader educational picture in Pakistan emphasizes the need to more widely affect current teaching practice in schools and more specifically to implement alternative teaching methods, such as cooperative learning, in the education system. Cooperative learning activities not only facilitate situation for wide range of communicative skills but too develop interdependence among team mates (Siddique, 2003). It is supposed that co-operative learning group ensures effective learning and purposeful interaction among students. Therefore, it is essential to investigate it as learning method in a conventional school setting. Slavin (1995) suggests that there are number of reasons to advocate the proceeding development and application of cooperative learning technique in educational institutes which is stated as under:
i. A numerous research studies indicate the positive impacts of using cooperative learning on measures of school achievements, and peers acceptance.

ii. It is realized that learners want to absorb information, to ponder, to resolve conflicts, to exchange information and experience in the learning process and to implement their skills to promote achievements.

iii. Students who participate in cooperative learning have ability to gain experience in building deep understanding through observational learning on certain topic under discussion.

iv. Cooperative learning may promote variety in the classroom as a resource rather than a problem. Students from different ethnic and racial backgrounds provide alternative sources of information for their group members, which may enhance learning of the lessons.

v. Cooperative learning demonstrates the positive effects on relationship among students of different backgrounds and between mainstream and special educational needs pupils (Slavin, 1995).

Research shows that cooperative learning increase student’s academic achievements, social relationships, peers interaction and thinking skills (Johnson & Johnson, 1989, 2003; Slavin, 1995; Vermette and Fotte, 2001; Tarhan, 2008; Law, 2008).

According to (Slavin, 1996; Kagan, 1994; Rittschof and Griffin 2001; Johnson and Johnson, 2004) there is significant uncertainty and lack of understanding on why cooperative learning approaches affect outcomes and under what classroom conditions cooperative learning produces intended results. They propose that there is still dire need for investigation to be carried out at the bisecting point of curriculum
and cooperative learning in diverse contexts and in different subjects and at various levels. Cohen et al. (2008) states that despite the fact that numerous of field researches have been conducted to evaluate the effectiveness of cooperative learning, there is still much more to be explored at all grades and in a wider range of educational institutions and schools.

2.4 DIFFERENCES BETWEEN COOPERATIVE LEARNING AND COLLABORATIVE LEARNING

General population and some educational practitioners use “cooperative learning” and “collaborative learning” terms interchangeable, comprising those who use cooperative learning in schools (Adams, 2000; Walling, 1987). (Chiu, A. Longman English dictionary, 2000) states the difference between the collaboration and cooperation regarding their natures while others do not. According to (Oxford Dictionary and Thesaurus, 2014) cooperation means to toil together for a common end and collaboration means to work in partnership. Obviously, the two definitions are alike. However cooperative learning and collaborative learning are different in many ways.

Adams, (2003) differentiated the two techniques as under: Cooperative learning is based on the premise that intra-group competition be allowed to hinder learning, whereas collaborative learning is rested on the premise that the autonomous body of authority be allowed to hinder learning. Owing varying premises, collaborative learning stresses student self-governance over structure, while cooperative learning components like mutual interaction and individual responsibility situate the leaners to participate actively in group activities and lessen competition amongst teammates.
Fundamental elements of cooperative learning ensure that every group member is fulfilling his liability for making contributions. Collaborative learning does not emphasize these elements because students have powers to take decision by themselves about things being happened. To ensure mutual interaction and accountability, instructor keeps under observation learners’ deportment in cooperative learning group; however collaborative teacher does not want to put at risk the autonomy of student. Cooperative and collaborative learning can differentiate on the basis of group formation. Cooperative group is organized, systematized and commonly requires prior instructor’s groundwork and collaborative group is commonly rested on the learners’ concerns (nearness or interests).

Johnson and Johnson (2004) states that application of cooperative, competitive, and individualistic techniques facilitates value systems in school. Participating in cooperative endeavors inculcates the values of devotion to one’s own and other’s success, devotion to the communal well-being, and natural way of life necessitates aiding and boosting the attainment of others. The values induced by competitive endeavors contain commitment to get more than others, commitment to beat and defeat others, and think that natural way of life is to oppose and hinder the success of others. Involving in individualistic endeavors inculcates values of devotion to have self-interest and consider that fostering and elevating the others’ attainment is insignificant and beside the point. Various values are induced in learners at educational setting and the learning techniques utilized, affect those values that learners assimilate.

Johnson and Johnson (1991) differentiated amongst cooperative learning, competitive learning and individualistic learning. He describes cooperation as working together for obtaining common ends. Cooperative setting situates students to
search the results that are beneficial to every teammate. In cooperative learning group participants participate in teaching learning process to enhance the learning of each and every group member. In competitive learning, Learners toil against one another and compete each other to obtain an academic goal in competitive learning. So they do not cooperate with each other and obstruct each other’s success because they think that they can succeed if other students drop in the class. Individualistic learning situates the learners to carry out their learning activities independently from other fellows to obtain instructional objectives. They do not interact and do not promote one another success. In cooperative and individualistic learning criterion referenced evaluation is used to measure the students’ performance, whereas in competitive learning, students’ performance is determined through norm-referenced evaluation.

Cooperative learning techniques have no significant limitations regarding its implementation. Therefore, these techniques may be utilized to work-out any learning assignment in all subject areas at all educational levels. But limitations are there about appropriate implementation of competitive and individualistic learning methods.
Table 1: Presents abstract of differentiation in connection with cooperative and collaborative approaches

<table>
<thead>
<tr>
<th>Headings</th>
<th>Cooperative approach</th>
<th>Collaborative approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underlying premise</td>
<td>Competition may hinder learning</td>
<td>The hierarchical authority structure may hinder learning</td>
</tr>
<tr>
<td>Emphasis</td>
<td>Interdependence and accountability</td>
<td>Student autonomy</td>
</tr>
<tr>
<td>Group formation</td>
<td>Heterogeneous groups</td>
<td>Round or interest groups</td>
</tr>
<tr>
<td>Positive interdependence</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Individual accountability</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Responsibility</td>
<td>For self and each other</td>
<td>For self</td>
</tr>
<tr>
<td>Task and group processing</td>
<td>Both stressed</td>
<td>Only task stressed</td>
</tr>
<tr>
<td>Group skills</td>
<td>Taught directly</td>
<td>Not taught commonly</td>
</tr>
<tr>
<td>Method &amp; procedure</td>
<td>Set out by instructor</td>
<td>Set out by student</td>
</tr>
<tr>
<td>Instructor monitoring and interference</td>
<td>Frequently</td>
<td>Rarely</td>
</tr>
<tr>
<td>Learning task</td>
<td>Group wise</td>
<td>Either individual or group wise</td>
</tr>
</tbody>
</table>

(Adam, 2000)

2.5 HISTORICAL BACKGROUND OF COOPERATIVE LEARNING

Concept of cooperative learning has been existed in history of ancient time. Teachers have persuaded their pupils to work together on occasional group projects, in group debates or peer tutoring methods since immemorial time (Slavin, 1995). Quintilian had explained the concept of group debates in the early first century, who argued that peer learning would facilitate the pupils (Johnson Johnson and Smith, 1991). Marcus Fabius Quintilian was famous roman teacher from about 68-88 AD (Pappas, 2003).
Pappas, (2003) stated that concept of peer learning was mentioned in the Talmud too (Collection of ancient writings on Jewish Law, and traditions), which emphasized the peer learning (Chiu, 2000). Two Talmud: the Palestinian Talmud and the Babylonian Talmud have written by Jewish scholars. The importance of group debates between 400 AD and 600 AD was favored by Johnson, Johnson and Smith (1991). Political harmony, educational cooperation, religious reforms were highlighted by john Comenius in his works (Pappas, 2003). Johnson & Smith (1991) claimed that Comenius advocated that during group debates practice, students would learn by receiving instruction and providing instruction to others. They stated that Joseph Lancaster and Andrew Bell had started peer learning groups based schools in 1800 in England respectively.

Evolution of these schools promoted peer learning extensively and the idea of group debates learning was used up across the Atlantic Ocean. In 1806 peer learning groups based school was initiated on the basis of Lancastrian concepts in New York City. During common school practices peer learning based schools gained support in USA in first quarter of 19th century.

Priority was given to Implementation of group debates learning in class in the last quarter of 19th century (Colonel Francis Parker, 1875-1880). He was competent to manage more than 30000 visitors per years to examine his implementation of peer learning (Campbell, 1965). Implementation of peer tutoring was also advocated in John Dewy famous project method attributing the Parker efforts.

Johnson, and Smith (1991), stated that peer learning techniques were dominated American education system till the ending of the century. Meanwhile Parker was also boosting with devotion the application of peer learning. Turner and
Triplet (1897) initiated comparative studies on competitive, individualistic, and peer learning in England and America respectively.

Johnson, Johnson and Smith (1998) stated that Mayer in Germany and Ringelman in France were preceded their endeavors through research studies in the early 20th century. Miller was probably one of the pioneer researchers, who conducted experimental study on peer learning strategies in 1929. Deutsch, (1949) claimed that May and Doob were reviewed literature on cooperative and Competitive learning until 1937.

Cooperative learning has passed through the stages of success and failure in the educational institutes of America. In 1930s competitive learning achieved attention in American education and peer learning failed to keep its interest in educational practices (Pepitone, 1980). Peer learning reclaimed the interest in American education system when community schools were promoted to amalgamate in 1960s.

Peer learning was implemented in the classrooms because researchers and educators were advocating to produce mutual interaction among the learners belonging to various races and to assist the learners of minority group to enhance their educational attainment (Oslen & Kagan, 1992). In America few research studies carried out to promote and evaluate cooperative learning methods in classroom through the end of 20th century (Slavin, 1991b). For example, Elliot Aronson and his companions developed jigsaw technique at Texas University Austin. Learning together was developed through efforts of Johnson and Johnson at Minnesota University America. Slavin and companions introduced Games-Tournament and STAD techniques at Johns Hopkin University America. Currently useful and effectual cooperative learning approaches are available for instruction of various subjects at
various educational levels because of practical implementations by numerous instructors and many years of research. Today instructors have opportunities to select empirical cooperative learning technique to be used efficiently for teaching any subject at different levels. Hence, instructor could use cooperative learning approach to organize classrooms for valuable instruction (Slavin 1995).

2.6 PITFALLS OF COOPERATIVE LEARNING

According to Slavin (1995), the hazards related to the cooperative learning methods are following.

i. Free Rider: Free rider effect is one of hazards related to cooperative learning and could occur when learning pursuits has not organized properly, cooperative learning techniques may create an environment of free rider effect, in which probably most of the learning tasks was completed by few teammates while the remaining peers do not participate in learning activities. When the team mates have to complete single task (prepare a single report, or work on one project), the free rider effect will occur.

ii. Diffusion of Responsibility: it is another difficulty of cooperative learning that can create a setting in which competent team-mates can turn blind eye to learners, supposed to be less talented group members. When complicated science problem is handed over to students as a team-work to solve that problem, then active participation of talented members would be evolved/matured and the other less skilled members’ contributions might be disregarded, and active participants may not likely to take time to describe less active participating behavior of members in the problem solving activity (Slavin, 1983a).

iii. Learning a part of task specialization: In cooperative learning methods (like Jigsaw and Group Investigation) team’s assignment is divided into parts and
every group member is assigned responsibility to work on specific portion of team’s task. Therefore, the possibility is there that students may become expert and master only that assigned part of the task

a. Teacher’s loss of control. Conventional learning is a teacher centered approach that facilitates environment where instructors play dominant role in the teaching learning process and educate their pupils. It is assumed that students are helpful and sensible in traditional classroom. Instructors believe that they may retain their primary position in traditional classroom. While cooperative learning is a student centered technique and teachers may not keep their central position in class. In cooperative learning approach instructor observes, monitors and guides the students. Hence instructor has to keep in sight and supervise group work, in place of prominently delivering the lesson (Garfield, 1993). Therefore, many instructors are reluctant to employ cooperative learning techniques in class as they believe that they can deprive of their pivotal position in class.

iv. Time requirement: Vaughan, (2000) states that administration and parents impose pressure on instructors to complete course work well in time, and they force teachers to continue with traditional method of instruction. However, course work would not be completed in cooperative learning situation as group task requires additional time. So instructors probably hesitate to use cooperative learning in schools.

v. Reluctance to change: Traditional method of instruction is commonly used in Pakistani schools. Instructors and school management do not want to modify the prevalent traditional teaching measures. Ample time is needed to shifting intro cooperative learning structure. It is also hard to amend the existing state and
everlasting habits. School’s management and subject experts have reservations about innovations on task specialization themselves but not about the rest of the content.

Slavin, (1986 a) states that this problem can eliminate if students have to be individual accountable for their learning as in the student group-learning techniques. Incentives are given to groups on the basis of sum of group members’ individual test achievements. Student team learning strategies may not allow any member to be a free-rider and ensure that each group member has learned the material. In group’s task, it is hard for group to brush aside any of its members.

2.7 ELEMENTS OF COOPERATIVE LEARNING

Johnson and Johnson, (1991) describes that mix-ability grouping, positive interdependence, mutual interaction, individual and group responsibility, social skills coaching, group techniques, and parallel chances of success, are the common elements of all the cooperative learning approaches. However, five fundamental features may be derived from the above mentioned elements to utilize cooperative learning approach more effectively in class. The elements have described as under:

2.7.1 Interdependence

It’s a core component of cooperative learning approach, that refers to the learning liability of learners for own and others. Positive interdependence is characteristic that requires focus on joint performance. Students should be guided to know that one member’s success depends on the success of all other members of group and if one fails, they all do (Kagan, 1994). According to Johnson, Johnson, & Smith, (1991) leaners swim or sink together.

Olsen and Kagan, (1992) argued that it was essential to take measure to structure positive interdependence amongst group’s members for successful implementation of cooperative learning techniques. Positive interdependence may be
set up if: participants formulate shared answer for group (group product goal interdependence), participants ensure that every individual of team may describe the group’s answer correctly, (learning goal interdependence), participants are asked to fulfill assigned role responsibilities (role interdependence), members have to create group reward e.g shared grade (reward interdependence), participants are ensured to share available resources (resource interdependence).

Johnson, Johnson, and Stanne (1989) explored that the collaborative use of goal and resource interdependence notably enhanced learners’ attainment. However the utilization of only resource interdependence did not promote significantly learners’ attainment. Therefore, the combined treatment of both resource and goal interdependence is recommended to produce positive impact on learners’ achievements.

### 2.7.2 Face-to-face Promotive Interaction

Teachers are required to ensure promotive interaction of group members in collaborative group learning, through supporting one another to fulfil the assigned work. They assist, encourage, praise, facilitate and promote each other’s success and efforts to learn effectively. In cooperative learning session, group members may have to ensure oral explanation to one another to solve the problem, talk over and analyze the nature of learned ideas, transform their information to other group members, and describe one another, the association between current and previous learning. Passive group members of collaborative learning are non-active participants and they do not play their roles significantly, in the learning of others as well as themselves. There are three steps to promote meaningful face to face promotive interaction amongst teammates, which are stated as under: (i) Prepare time schedule for meeting of the groups. (ii) Ensure interaction through establishing positive interdependence amongst
group members to help each other to achieve group goals. (iii) Assess the teams to promote face to face interaction among team members.

2.7.3 **Individual Accountability**

Individual accountability is an important characteristic of all cooperative learning techniques. Individual accountability is ascertained through appraisal of each and every member performance. Individual and group receives feedback in terms of outcomes to liken it against a standard measure. Contribution to the team’s final result is shared by every group member, who is made accountable by other members. Group members provide required assistance to poor individual to fulfil the assigned work. It is prerequisite for group members to keep in view that the work of others would not be passed on by them. Cooperative learning element like individual responsibility promoted higher attainment when it was organized (Hooper et al., 1989). Individual accountability and positive interdependence are correlated to each other, when one increases among teammates, the other increases too (Johnson et al., 1994). Slavin (1995, 1996) stated that individual accountability had contributed effectively to the success of cooperative learning performance. Combination of individual accountability and group goals has increased the utilization of cooperative learning.

Johnson, Johnson and Smith (1991) claimed that the individual accountability would be organized through the ways stated as under:

i) Ensure small group size. Individual accountability increases with decreasing size of group.

ii) Individual exams may be given to each student using self and peer assessment.

iii) Ensure group’s work presentation by students randomly, in class.

iv) Let students be ensured to teach each other, what they have learned.
2.7.4 Proper utilization of Social Skills

Johnson et al. (2009) argue that socially skilled participants can take part in group task effectively. Therefore, participants are keenly required to learn interpersonal skills and employ them to obtain predetermined team’s aims. In cooperative learning, participants be aware of their teammates and entrust the group members. They share and exchange information. They recognize and assist each other and solve issues and disputes cooperatively.

2.7.5 Group Processing

In cooperative learning, instructors ascertain the discussion of group members, necessary to know the effectiveness degree of group’s goals attainment and supporting group working relation. They evaluate contribution of group members and decisions are taken, concerning their actions to carry on or modify. It may ensure to refine and make better the contribution of the members to the joint endeavors to get the shared goals and to improve the effectiveness of team work. Johnson et al. (1999) necessitates five measures to ensure the formation of group processing, which are stated as under:

i. In a cooperative group, students toil together to facilitate and promote each other learning. Hence, the standard of interaction is assessed among group members to structure group processing.

ii. In group processing, instructor needs to ensure the process evaluation through which, individuals participate in group activities and give comments about the performance of each learning group.

iii. Goals setting is arranged to increase groups’ efficacy.

iv. Whole class processing session may be organized to promote group processing. (v) Instructors have to manage collaborative group and entire class revelries.
2.8 TYPES OF COOPERATIVE LEARNING

Johnson et al. (1998) described the following three kinds of cooperative learning on the basis of group work duration.

2.8.1 Formal Cooperative Learning

Cooperative learning approach becomes formal cooperative learning when learners work in small group and complete assigned work to obtain common goals, for at least one schooling period to few weeks (e.g. report writing, group project, carrying out laboratory work).

In formal cooperative learning groups instructors have to define learning outcomes of the learning session, specify the group size, and assign participants to groups. They describe the group task and promotive interaction. They keep under observation and assess students’ learning. They promote learners’ interpersonal skills, and provide process assistance to group members to rate the quality of their groups’ functions.

2.8.2 Informal Cooperative Learning

Cooperative learning approach becomes informal cooperative learning when the learners toil together to obtain common instructional goals within a session of few minutes to one schooling period. Instructors use direct teaching strategy (demonstration, motion picture etc.) in such sort of cooperative learning. Participants probably, concentrate on the learning content, and work in an environment helpful to learning. They decide on expectancies of what could be taken in during a session, whether students assimilate the learning content cognitively and avail closure to a schooling session.

2.8.3 Cooperative base Group
When learners toil together in a mixed ability groups, for at least one to several years with long lasting fellowship to obtain common instructional goals. Then cooperative group takes the form of cooperative base group. They are destined to back up, assist, motivate and boost the teammates to promote their learning growth and enhance cognitive and social capabilities of individuals in wholesome ways (Johnson et al., 2008).

2.9 METHODS OF COOPERATIVE LEARNING

Research studies have been traced back to 1970s on use of cooperative learning methods in classroom. Presently, researchers are also investigating the principles and theories to facilitate the use of cooperative learning approaches in educational fields. As a result of these efforts wide range of cooperative learning techniques are accessible for practice in every subject, in all kinds of schools, at all grade levels throughout the world. (Slavin, 1995) divided these methods in the following sections;

2.9.1 Students Team Learning Methods

These cooperative learning approaches are investigated and refined by experts and researchers of John Hopkins University America. These techniques are entailed in majority studies of cooperative learning approaches.

In cooperative learning methods learners have to participate in group work to reinforce their personal learning and promote teammates’ learning too. All group’s members may obtain instructional objectives, when emphases are made on the use of group goals for ensuring group success in all methods of students team learning. These methods provide opportunities to learners to avail learning as group.

All learners’ group learning techniques emphasize cooperative learning elements like team rewards, individual accountability, and equal chances for attainment of goals. Group can win group awards and other incentives through achievement of
above mentioned measures. Groups probably involve in competition to fulfil the planned measures in a granted week instead of winning scarce group awards. Individual accountability, group rewards and equal chances for success ascertain that all mixed ability group members are equally persuaded to perform their functions effectively, and that the role play of all groupmates are highly rated.

Researchers improved and refined five main pupil team learning techniques through research processes. STAD (Students Team Achievement Division), TGT (Teams Games Tournaments) and Jigsaw II are most common cooperative learning techniques and are being use broadly, at all grade levels for all subjects. CIRC (Cooperative Integrated Reading and Composition) and TAI (Team Accelerated Instruction) are exhaustive curricula methods that are developed for application in specific scheme of studies at specific educational levels. Three popular cooperative group techniques are described below:

2.9.1.1 STAD

Students Team Achievement Division was introduced by Slavin. In this method, learners work in mixed ability groups usually having four members of different races and localities. In STAD instructors ensure lesson presentation as usual in classroom, and learners toil together in groups to reinforce their learning. They discuss and assist with each other in group to ascertain that teammates have learned the material effectively. Instructors give individuals quizzes to students on the learning content at a times of competition among groups. Group score is added by individuals’ scores. An individual gains points if student quiz score exceeds his /her base score and that points are accumulated to the group points (Slavin, 1995). STAD has been considered appropriate for a variety of subjects and grade levels. Teacher presentation, group
reinforcement activities, and test are basic elements of STAD cycle, usually requires maximum four schooling periods.

2.9.1.2 TGT (Teams Games Tournaments)

TGT was the first of the cooperative methods developed by D. Devries and his colleagues at John Hopkin University and like STAD makes use of instructor presentation, distribution of work sheet, team work, individual quizzes and group reward. However, weekly tournaments are held among the teams in place of quizzes. In the tournaments, individuals add points to their group scores through playing academic games with other groups’ participants. They participate in “tournament tables” of three person games with members of other groups having parallel previous academic achievements. High performing representative of the group earns reward for whole team. Although, tournament table composition changes weekly and groups are held responsible to study together for six weeks.

2.9.1.3 Jigsaw II

That cooperative learning technique has been made by Slavin through modification of pre-existing Jigsaw technique of E. Aronson (1978). In this cooperative learning technique, like STAD and TGT learners work in mixed ability groups of four members. Text material is distributed among group members and a particular portion of a topic is assigned to each one individual in group for learning. Then they learn the assigned material and team members with similar portion of topic form expert groups. They reinforce their learning in expert groups and go back to present learned material to their original group members. Then they are assessed through quizzes, e.g. in chemistry periods, on the topic of chemical bonding, text material is handed over to the participants. Particular portion of instructional material is assigned to group members (chemical bonding, ionic bond, covalent bond, coordinate covalent, metallic bond etc.).
They learn the material, then team members with similar part of the topic e.g. covalent bonding, form expert groups and thoroughly learn the material relevant to covalent bonding. Then “experts” re-joined their parental group to share their learned material with group members. At last, students are assessed through quizzes on the assigned text.

2.9.2 Other Cooperative Learning Methods

2.9.2.1 Circles of learning

Johnson et al. (1994, 1984) developed cooperative learning methods collectively called learning together, at university of Minnesota stressing on cooperative learning elements. In all cooperative learning methods, participants carry out their learning activities in mixed ability groups on assigned material. Each group works on single sheet, and gets recognition and awards on the basis of group outcome. Learning together approach needs to ensure social interaction and group discussion before the practical group working on given assignment.

2.9.2.2 Jigsaw

Jigsaw is cooperative learning approach that facilitates students to work in group and reinforce their learning material in class room. In this method students have to become an expert of particular portion of a topic. Then they have to present their learned content to members of their group. Students are assessed through individual quizzes and grades are awarded on the basis of individual quiz outcome. (Aronson et.al 1978 and Clarke, 1999).

2.9.2.3 Group Investigation

This method, originated by Herbert Thelen and later on Shlomo and Y. Sharan (1992) improved it through research studies. Group Investigation is a common cooperative instructional approach that provides opportunities to learners to take part in
group work effectively. They have to plan, investigate, discuss and work on projects jointly in cooperative learning group. In this method cooperative learning groups are based on specific topic of common interest. The topics are selected by teams from a lesson taught to whole class, these topics are classified into individual tasks, relevant activities are put into practice and group reports are prepared. Then students and instructors both evaluate the report presented by each group in the class at a specified period of time. Six stages of GI implementation are suggested by Sharan (1999). These stages are outlined as under:

- Groups formation and selection of the topic
- Planning of learning task
- Investigation conduction
- Final report preparation
- Final report presentation to entire class
- Achievement evaluation

2.9.2.4 Complex Instruction

This is an instructional approach in which students carry out group learning activities using cooperative inquiry-based projects, particularly in mathematics and science classes. Students have different abilities and capabilities and complex instruction requires different roles and skills. Group members share their skills and capabilities with others that aim to mature group success. In this method participants collaboratively work on science project in group to discover scientific facts and principles. Implementation of this learning style in bilingual classes showed positive outcomes. Details are ready to be used, in English and other international languages. Hence multilingual learners may toil jointly in cooperative learning groups (Slavin, 1995).
2.9.2.5 Team Accelerated Instruction

This method has introduced to be used for teaching mathematics to elementary classes or senior students reluctant of algebra course. In this method students can utilize both cooperative and individualistic efforts to achieve instructional objectives. They need to assist groupmates and assess each other’s work, so that they can learn instructional material. Students encourage and support their group members to participate successively in group work, because they have strong desire of their teams’ success. TAI emphasizes individual accountability and each one in the group is to learn instructional material. Individual final tests are given to students and they are not allowed to support others during the final test. All students are placed according to their prior knowledge, so that they may avail similar chances of their success (Slavin, 1995).

2.9.2.6 Cooperative Integrated reading and Composition

Madden et al. (1986) stated that CIRC is planned scheme which may employ to promote basic comprehension skills at elementary level schooling. In CIRC learners make pairs and cooperatively do practice on reading, sum up narratives to group members, write response to narratives, and re-inforce vocabulary in their respective groups. They also participate in group learning activities to grasp central concept and develop other comprehension skills. Learners’ motivation is ensured through use of cooperative reward structure so that they effectively, involve in pairs’ work on these learning strategies and would get certificates or awards on basis of whole team members’ performance.

2.9.2.7 Structured dyadic methods

It is an organized instructional method that facilitates students’ working in pairs on teaching, to one another. They work as tutor and tutee to understand course of action
or grasp important points of assigned material. Students may increase their learning through effective implementation of this method (Dansereau, 1988). It is a simple and comprehensive study program of peer tutoring. In this method instructors ask questions from their learners. If they answer accurately, the learners obtain points. If not, instructors tell correct answers and learner has to note it and do learning practice several times. Instructors and learners change their roles after each ten minutes. Pairs obtaining maximums points are appreciated on daily basis in class. (Green Wood, Deluadri & Hall, 1989).
2.9.3 Informal Learning Methods

Baloche (1998), described important informal cooperative learning methods as under:

2.9.3.1 Spontaneous group discussion

It is structured cooperative learning technique which adds to in a way that improves group learning and conventional teaching and may be lasting for a few minutes to one class session. Team work makes it easier to discuss with students in a session of presentation that what is meant by something, why something is functioning or what’s the solution of certain problem (Slavin, 1995).

2.9.3.2 Number Heads Together

Kagan (1992), claimed that number had allotted to each one in the group. Students knew that instructor might be asked only one group member to represent the group. The instructor presents questions to students in class and asks them to work together on finding the answers. That way they would receive a point, no matter which number was called. It is basically a variant of group discussion and twist is that teacher randomly selects one student to answer. That twist insures individual accountability and participation of all the students in group activities.

2.9.3.3 Team Product

In Team Product method, participants work together in groups on team product like essay writing, picture drawing, and worksheet completion. They ensure a presentation to the class, create better administration, share information to find out possible solution to a group conflicts and interpret a poem. Instructor ascertains individual accountability by giving individual particular roles or responsibility to group members (Slavin, 1995).
2.9.3.4 Think-Pair Share

This is simple and useful cooperative learning method in which students work in small groups of four members and involve in thinking about questions presented by instructor. Then they are called in front of the class to answer the questions. In this method, four measures are involved. i. Instructor poses a question in class and students carefully pay attention to it. ii. Students have a time to ponder of question and write their answers. iii. Students analyze and talk about their responses in pairs. iv. Instructor asks some students to share their opinions and views with whole class. Science teachers and students have hypothetical construct about effectiveness of that approach in classroom. Hence it would be more beneficial in science class and laboratory work. (Lyman, 1981).

2.9.3.5 Round Table

This is simple and effective cooperative learning strategy that facilitates students’ working together in small groups to study more subject matter, increase courage and determination, and develop their writing skills. In the round table strategy, three measures are ensured to it. i. Question having multiple choice answers is presented by instructor in the class. ii. In every team, opening member enlists one option on a paper and gives a chance to the next teammate in clock wise direction. iii. Appreciation certificate is awarded to the team with maximum true options. Science teachers may be employed round table cooperative learning approach effectively in the science class and laboratory work.

2.9.3.6 Round Robin Brain Storming/Rally Robin

It is simple and interesting cooperative learning method in which students work in mixed ability groups of approximately four members including one record keeper. The Instructor raises a question of multiple answers and students have to reflect on the
best option in a specified time. Then students in each group, discuss the answers with their mates in round-robin way. All the responses of teammates are recorded by record keeper. The learner next to the record keeper presents his response and record keeper puts in writing it. After that every member of group gives an answer in clock wise order till time is over. Actually it is slightly different rearrangement of round tables. The shifting is that in this technique, the record keeper is responsible for maintaining the records of each member in group.

2.9.3.7 Cooperative Review

It is an effective cooperative learning technique that facilitates learner groups to prepare review questions before the tests. They have to enquire the other groups through imploring questions by taking turns. Group gains points on the basis of question asking activities. Initiative taking group gains a point if it gives an accurate response. After that another group may contribute relevant facts to the response and can gain a point (Slavin, 1995).

2.9.3.8 Laboratories and projects

Students toil together in group to work on assigned projects in said method more effectively. Project work may be distributed amongst group members. Instructor has to ensure that every participant needs to accomplish assigned portion of project work. Instructor assesses the project report, presented by student at the end of academic session. A group leader is necessary for projects, but instructor should emphasize that leaner’s job is to ascertain collaborative participation of each group member in project work and do not allow free rider to occur. Group members would not be ready to participate completely if they do not realize personal liability for the team out-come (Slavin, 1995).
2.10 IMPLEMENTATION OF COOPERATIVE LEARNING
(STAD) IN THE CLASSROOM

According to Slavin (1995), STAD is the most widely research based and applicable form of cooperative learning. It has been implemented for a variety of subjects and has been considered favorable to use in primary schooling through higher secondary level. The teachers who have less information of cooperative learning techniques may implement STAD as an effective learning tool in class for, it is plain, basic and most beneficial learning technique. It is common procedure of coordinating learning activities in the class-room and can be utilized to teach all subjects at all educational levels. Teachers usually take advantage of traditional method (lecture discussion) to present their lessons. They have to organize five important learning strategies (i.e preparation, presentation, group practice, quizzes, individual improvement score and group appreciation) to complete STAD cycle.

2.10.1 Preparation

2.10.1.1 Class room arrangement

Basically cooperative learning is group work under certain conditions and needs groups’ formation. Therefore, instructor divided the entire class in mixed ability groups of four members per group in practice session. Students were assigned to groups according to criteria mentioned by (Shafqat, 2008).

2.10.1.2 Teams

Students were assigned to various groups by employing the following measures.

a. Students ranking

Class students were arranged in descending order on paper sheet on the basis of previous performance. Pre-test scores were used as previous performance to rank the students properly. However, grades and instructor’s own judgment might be used to do
that. Exact students ranking was hard and needing much skill, but instructor did the best he could.

b. **Number of teams**

Slavin (1995), proposed that group having four learners was ideal for cooperative learning approach. The total number of students in treatment group was divided by four to estimate the number of teams. In this empirical study, the total frequency of cooperative class was twenty one, which is odd number. As quotient were five and remainder one. Then four member teams were four in number and fifth team consisted of five members.

c. **Balancing teams**

Teams may be balanced so that mixed ability groups could be formed and it has been ensured on the basis of teams mean performance that all the teams are approximately equal. Instructor has used student list, arranged in descending order to give alphabetical symbol to every student through team letters. In this study of five-team class instructor made use of first five alphabets, A to E. He initiated with letter A at the top of his list and kept non-stop lettering toward the middle. When he got to the last team letter, then assigned letters in reverse order. As instructor was using the letters A-E, so he assigned fifth and sixth students to team E, the seventh to team D, the eight to C, ninth to B, and tenth to A. Then repeated the lettering from the bottom up, again starting and ending with the letter A.
Table 2: Students allocation to teams

<table>
<thead>
<tr>
<th>Intelligence Level</th>
<th>Rank</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher Achievers</td>
<td>1</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>E</td>
</tr>
<tr>
<td>Average Achievers</td>
<td>6</td>
<td>E</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>E</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Low Achievers</td>
<td>17</td>
<td>E</td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>21</td>
<td>A</td>
</tr>
</tbody>
</table>

d. **Initial base score**

Base score refers to student’s average score on previous performance. Base score calculation is necessary for STAD implementation. Pre-test scores were used as base scores in this experimental study. However students’ final grades based on past performance might be used as base score.

e. **Schedule of activities:**

The following learning activities were arranged to complete STAD cycle.

i. Presentation

ii. Team practice

iii. Individual quizzes

iv. Team recognition
2.10.2 Presentations
Instructor presented his own lesson as usual in class by employing lecture discussion approach. Instructor may ensure the effectiveness of his presentations through purposeful use of AV-aids.

2.10.3 Teams practice
Students were situated to work in mixed ability groups of four members per group. Each team contained one higher achiever, two mediocre and one low ability student. Group work aims to reinforce the learning of assigned material, and assure preparation of each team member to perform better on test. Later than instructor presentation, worksheets were handed over to the learners to study the instructional material. Learners discussed the hard areas of material together, compared their answers and rectified wrong interpretation of team members in practice session.

2.10.4 Quizzes
When teacher presented his lesson and students made team practice. Then individual quizzes were given to students. To ensure individual accountability for students to learn the assigned lesson, they were not allowed to assist one another during the quizzes.

2.10.5 Individual improvement scores
This scoring criterion provides opportunity to students for contributing points to their groups. Base score is computed for every student on the basis of his average score on past performance. If students quiz scores surpass their base scores then they get points for their groups.

2.10.6 Team recognition
Individual improvement scores contribute to team scores. Instructors evaluate that scores and rank the groups as the excellent, great and good teams.
2.10.6.1 Improvement points

Students are awarded points for their teams if their quiz scores surpass their base scores. Team scores, are calculated by adding improvement points of each team and dividing by the number of participants in team.

2.10.6.2 Recognizing team accomplishment

Teams are awarded on the basis of team performance, which are stated as under: The team was announced as “Good Team” having 15 average score, the team who have average score as 20 marks, was awarded as “Great Team”, and the team who have average score as 25, was awarded as “Super team”.

2.11 STUDIES RELATED TO COOPERATIVE LEARNING

Enormous research studies have been carried out to determine the effects of cooperative learning approach verses conventional method regarding the variables of academic achievement, social relations and psychological norms. Most of studies results advocated the validity of cooperative learning approach on the above mentioned variables. A concise description of the studies on the effectiveness of cooperative learning has been discussed as under: Slavin (1995) and Johnson & Johnson (1989) conducted two significant and fundamental meta-analyses on the literature of cooperative learning respectively. They concluded that cooperative strategies had indicated more positive impact on learners’ attainment than traditional methodology.

They assessed the impact of cooperative learning on learners’ attainment. In these two studies they applied vote counting and effect size as measuring parameters to provide empirical support to their studies. Vote counting refers to reckon the extent of inclusive treatment effect of cooperative learning based on the calculation of
studies proportion. Findings of both analyses indicated positive effect, no effect, and negative effect of treatment on achievements (Hedges & Olkin, 1985; Jackson, 1980).

According to Gravetter & Wallnau (2004), effect size refers to compute the mean difference between the treatment and control groups. Johnson and Johnson (1989) and Slavín (1995) used Cohen’s criteria for limitations of effect size measures. Cohen (1988), proposed that study which have an effect size as 0.20 has average effect, the study which have an effect size as 0.80 or has greater significant effect. Gall et.al (1996), proposed that study which have an effect size as 0.33 has significant effect.

Notable research synthesis was carried out by Johnson and Johnson (1989). Totally, 539 studies were analyzed by them and covered 93 years research work appeared on research horizon between 1898 and 1990. 367 studies included in the review had been conducted in previous 29 years. 458 studies were experimental in nature, incorporating variety of subjects at various educational levels. 528 studies were organized in American countries with 178 studies at elementary level, 113 at secondary level, 216 at college level and only 27 on adults. The mean effect sizes were located between .52 and .89 and whole mean was .73, indicating that cooperative learning was found to be more fruitful methodology than traditional way of teaching. The vote counting also favored supremacy of cooperative learning, with 323 numbers of studies showed positive effects, 172 showed no effects, and 43 showed negative effects.

Slavín (1995) also carried out important research review to search out the effects of cooperative learning verses conventional learning. The results of that review indicated that cooperative learning was more effective approach than traditional learning. This research review employed various techniques of cooperative learning
and lasted for (20 hours) or more duration. Total ninety qualified, major studies were analyzed by Slavin in his review. These studies had been conducted between 1973 and 1995 covering the duration of 24 years. Slavin (1995), concluded on basis of studies analyzed that cooperative group work had showed more fruitful performance than traditional teaching. In the meta-analyses firstly, he classified ninety qualified studies in nine categories based on cooperative learning techniques. After that he computed mean effect size for each technique to find out the effectiveness of cooperative learning. Table 3 reflects the classification of effect sizes based on cooperative techniques. This research review also presented the effectiveness of different cooperative learning elements, regarding learners’ attainment through comparison of vote counting and mean effect sizes outcomes.

Table 3: Classification of effect sizes regarding cooperative techniques, percentage of studies

<table>
<thead>
<tr>
<th>Methods</th>
<th>Mean Effect Size</th>
<th>Positive Effect</th>
<th>No Effect</th>
<th>Negative Effect</th>
<th>Summation</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAD</td>
<td>.31</td>
<td>68.5</td>
<td>30.5</td>
<td>Nil</td>
<td>29</td>
</tr>
<tr>
<td>TGT</td>
<td>.36</td>
<td>75.5</td>
<td>25.5</td>
<td>Nil</td>
<td>12</td>
</tr>
<tr>
<td>TAI</td>
<td>.14</td>
<td>100</td>
<td>Nil</td>
<td>Nil</td>
<td>6</td>
</tr>
<tr>
<td>CIRC</td>
<td>.28</td>
<td>100</td>
<td>Nil</td>
<td>Nil</td>
<td>8</td>
</tr>
<tr>
<td>All SIL</td>
<td>.33</td>
<td>77</td>
<td>24</td>
<td>Nil</td>
<td>55</td>
</tr>
<tr>
<td>Jigsaw</td>
<td>.13</td>
<td>30</td>
<td>45</td>
<td>23</td>
<td>12</td>
</tr>
<tr>
<td>Learning together</td>
<td>.03</td>
<td>43</td>
<td>41</td>
<td>17</td>
<td>13</td>
</tr>
<tr>
<td>Group investigation</td>
<td>.07</td>
<td>49</td>
<td>51</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Structured dyads</td>
<td>.83</td>
<td>100</td>
<td>Nil</td>
<td>Nil</td>
<td>6</td>
</tr>
<tr>
<td>Other</td>
<td>.11</td>
<td>30</td>
<td>70.5</td>
<td>Nil</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>.26</td>
<td>64</td>
<td>31</td>
<td>5</td>
<td>99</td>
</tr>
</tbody>
</table>

Table 4: Classification of effect sizes regarding features of cooperative techniques, percentage of studies

<table>
<thead>
<tr>
<th>Both goals and individual accountability</th>
<th>Mean Effect Size</th>
<th>Positive Effect</th>
<th>No Effect</th>
<th>Negative Effect</th>
<th>Summation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.33</td>
<td>78.5</td>
<td>23</td>
<td>Nil</td>
<td>64</td>
</tr>
<tr>
<td>Only goals</td>
<td>.06</td>
<td>(9)</td>
<td>21.5</td>
<td>(2)</td>
<td>55</td>
</tr>
<tr>
<td>---------------</td>
<td>------</td>
<td>-----</td>
<td>------</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>Only Individuals accountability</td>
<td>.08</td>
<td>(12)</td>
<td>35.5</td>
<td>(6)</td>
<td>46.5</td>
</tr>
<tr>
<td>Without goals and individual accountability</td>
<td>.17</td>
<td>(4)</td>
<td>55.5</td>
<td>(5)</td>
<td>44.5</td>
</tr>
<tr>
<td>Total</td>
<td>.26</td>
<td>(77)</td>
<td>64</td>
<td>(63)</td>
<td>31</td>
</tr>
</tbody>
</table>

(Both tables adapted from Slavin, 1995)

The majority of studies, which qualified for Slavin’s research review (1995), had been carried out in American educational setting at all educational levels. However, very few studies were also conducted in European, and African countries. Nevertheless the effectiveness of Johnson and Johnson’s synthesis (1989), was more significant than Slavin’s synthesis based on Cohen’s d measures of effect sizes. The results of both reviews favored the effectiveness of cooperative learning approach on the variable of learners’ attainment. Forty-six studies were analyzed by Qin, S. et al. (1995) to explore the effect of cooperative strategies on learners’ attainment at all the schooling levels. They found that results of cooperative learners were far better than competitive learners belonging to treatment and control groups respectively. The cooperative group average performance was 71 percent more effective than competitive learning outcomes.

An experimental study was carried out by Bayraktar (2001) to determine the effect of cooperative learning approach on students’ attainments in health and physical education at university level. The results of study showed that performance of treatment group was significantly, satisfactory than control group in sports activities session on the variables academic attainment, learning attitude and personal skills practices. In Singapore an empirical study was carried out by Christine et al. (2002) to determine the effect of cooperative learning on learners’ performance in social studies regarding diverse contexts. This study results showed that low and
average achievers of treatment group were performed better and benefited more of cooperative learning approach than learners of control group. Yamarik (2007) conducted a research study to find out the effect of cooperative group work on learners’ attainment in the subject of economics. The result indicated that cooperative learners obtained better test scores than traditional learners.

Rocio et al. (2011) carried out a study on use of cooperative learning in professional institutions and found that cooperative learning promoted instructional procedure of technical education. As cooperative learning creates a situation in which learners can participate actively in cooperative group activities to reinforce their learning. Hence it might be used effectively, as an alternative method in the field of engineering education. Arbab (2003) designed an empirical study to search out the effectiveness of cooperative group work verses conventional approach at secondary level on variable of students’ test scores of general science. Learners were classified into treatment and control groups using pretest scores. Fifteen days treatment was given to the experimental group by employing cooperative learning strategy. On the basis of findings she explored that the mean score of treatment group was significantly greater than control group. Parveen, Mahmood and Mahmood, (2001) carried out an experimental study aimed at, was to examine the effect of cooperative learning verses traditional approach on variable of students’ tests scores, in social studies at elementary level. They stated that they had not found any significant relationship between cooperative learning and conventional method of teaching. Al-Badavi (2008) conducted a study aimed at, was to find out comparative effectiveness of cooperative learning strategy Jigsaw II on variables of learners performance in the form of reading, tests scores and motivation in English as foreign language (EFL). The experimental group was given Jigsaw II treatment for two months duration. The
findings of the study indicated that he had not found any significant relationship between cooperative strategy “Jigsaw II” and conventional method of teaching.

Jalilifar (2010) examined the effect of GI (Group Investigation) and STAD (Student team achievement division) by giving treatment of GI and STAD cooperative learning techniques to both experimental groups on learners’ performance in form of reading and attainment of EFL students. The control group was taught by employing traditional method. After treatment, data were collected by using posttest as data collecting instrument. Collected data were analyzed through statistical parameters like One-way ANOVA and post hoc Scheffe test. He concluded that STAD technique had showed most significant positive outcomes than GI and Conventional method. Iqbal (2004) investigated the impact of STAD on student’s mathematics achievements scores. The experimental group was given treatment for seventy five days duration by employing cooperative learning “STAD” technique. Conventional methodology was employed to teach the students in control group. The result of study indicated that cooperative learners of treatment group had obtained larger academic scores than students of control group. He furtherly, stated that low achieving students had benefited more than high achieving students from cooperative learning.

Kosar, (2003) evaluated the effectiveness of cooperative learning technique verses conventional learning on higher elementary students’ test scores in social studies. Previous annual examination scores in the subject of social studies were used to classify the sample of forty students into treatment and control groups. The experimental group was treated through cooperative learning activities for fifteen days duration. Posttest was used to determine the academic achievements of both groups after treatment, aimed at, comparing their outcomes. The findings of study indicated
that cooperative learners in the treatment group showed better performance in terms of test scores than control group’s learners. Ghaith et al. (2001, 2002, 2003 and 2004) evaluated the comparative effectiveness of different cooperative learning techniques on EFL students. In these studies serious attention was given to all the scientific research measures to ascertain the validity of research processes. They examined the impact of cooperative learning techniques like Jigsaw II, learning together, and (STAD) on the variables of achievements, reading comprehension, motivation and attitude towards group work. Questionnaires and investigator arranged tests were used to collect relevant data.

They found that in certain studies cooperative learners had showed significantly positive outcomes than traditional learners, while in others studies they performed similarly as compare to their counterparts in traditional teaching groups. Gaith, (2003a) planned empirical study to seek out the effect of learning together technique in EFL on secondary school students. He argued that learners of learning together technique achieved higher test scores than learners in traditional class teaching. Ghaith & El-Malak (2004) conducted study to examine effect of Jigsaw II technique on reading comprehension of students in EFL at college level. The findings of the study indicated that the learners in Jigsaw II learning outsore their counterparts in traditional class room teaching.

Furthermore, they reported that cooperative learning had situated the students to receive more academic and social assistance of their group members and instructors. Ghaith (2002, 2003b) conducted studies to examine the effect of cooperative learning on the variables of school alienation, class cohesion and grading fairness. The findings of the studies indicated that cooperative learning strategy had decreased school alienation and promoted the class cohesion and grading fairness respectively.
Ghaith & Bouzeineddine, (2003) argued that low achieving students were benefited more than high achieving students from cooperative learning activities in terms of social and academic assistance. Seller, (2005) conducted a study to explore the effect of cooperative learning co-op-co-op technique on EFL students’ anxiety, motivation and attitude towards group work. He concluded that cooperative learning technique had seemed to increase the motivation, promote the attitude towards group work and decrease the anxiety.

2.12 RESEARCH RELATED TO COOPERATIVE LEARNING AND CHEMISTRY

Researchers were carried out different studies to examine effectiveness of cooperative learning approach verses conventional learning on students’ performance in chemistry. Detail of some studies were stated as under:-

Effects of Group Investigation and Jigsaw techniques on students’ performance in thermos-chemistry in terms of test scores were investigated by Doymus, Karacop and Ada (2009). The findings of the studies indicated that students who received treatment through group investigation achieved high scores in chemistry than those, who worked in Jigsaw groups. The effect of cooperative learning was evaluated by Simsek (2009) on the students understanding of aqueous solution and academic gains in chemistry. The results of study indicated that learners of treatment group had achieved high scores than those, who worked in competitive and individualistic learning setting, as they were involved actively in cooperative group activities and working together to produce new concepts about aqueous solutions.

Effect of cooperative approach on the learners’ performance in terms of tests scores and practical skills attainment in chemistry course of 9th class, was investigated by Okebukula and Ogunniyi (1984), at secondary level schooling in Nigeria. Results of study indicated that cooperative learners had outsored those learners, who
received instruction through conventional methods. Effect of cooperative interaction techniques verses competitive style on higher elementary school students’ achievement was evaluated by Okebukula (1985) in Nigeria. He reported that cooperative learners outscored the competitive learners. An experimental study was designed by Shachar & Fischer (2004) to seek out the effect of Group Investigation Technique on higher secondary school students’ achievement, motivation and understanding of 11th grade chemistry course. The findings of study showed an increase in test scores of low and medium ability students in treatment groups and motivation comparatively, seem to be decrease in cooperative learning groups.

Taran and Acar (2007) estimated the effect of cooperative learning style by undertaking an empirical study on secondary school students’ insight about metallic bonding in 9th class chemistry course. The results indicated that students, whose were taught through cooperative learning approach outperformed the students learning in conventional situations. Cooperative groups’ learners were also active in the learning process and had positive perception about their cooperative work experience. Zisk (1998) carried out a study aimed at, was to explore the effects on tests scores and self-concept of students, whose received treatment by employing cooperative techniques in chemistry course at secondary level. The results indicated positive gains in self-concept and achievements in the student of cooperative group verses conventional classroom students. Hanze and Berger (2007) designed an empirical study to explore impact of Cooperative Learning approach on variables of learners’ academic gains and self-esteem at secondary level. The findings of study indicated that cooperative learning technique had enhanced students’ examination scores and promoted self-esteem of cooperative group students. Low self-esteem, having students particularly, seemed to be gain more confidence and competency from cooperative treatment.
In a study conducted by Jenkins, Antill, and Vadasy (2003) to explore the impact of cooperative learning on students’ outcomes in special education through perception of the science teachers of secondary classes. They argued that cooperative learning had positive impact on students’ performance and self-esteem promotion. Tien, L. T., et al. (2002) initiated a comparative study to determine the impact of peer-led team learning on students’ performance in terms of tests scores, grades and knowledge retention in organic chemistry in a first semester of three years course. The results indicated that learners of peer-led team had performed far better than the learners, whose were taught in traditional setting. Female and minority students particularly, were achieved higher tests scores than their counterparts in conventional group. They reported that workshops’ activities were perceived by students in experimental group as an effective learning agent in organic chemistry course.

Effects of peer-led team learning strategies on students’ achievement, and persistence in organic chemistry class were investigated by Wamsler (2006) and reported that the students in treatment groups had obtained higher average academic scores as compared to their peers, whose were taught through conventional method. Hanson & Wolf Skill (2000) planned study to explore impact of cooperative learning (workshop process) technique on individual test scores, self-confidence, attendance, and attitudes about instruction and tutorial session in chemistry at SUNY-Stony Brook. Students were classified in four members groups to work on cooperative learning activities based on single concept. Students would have to complete these assigned activities in one hour duration. To ensure individual accountability, quizzes were given on chemistry material to students on individual bases. Implementation of this cooperative technique showed positive gains in performances of students in terms of final grades, attendance at tutorial sessions, self-confidence, interest in chemistry
and attitudes towards learning as compared to students, who were taught the course through conventional methods in preceding year.

The conclusions of meta-analysis studies indicated positive outcomes of cooperative learning approaches in chemistry courses at secondary school and college levels. Bowen (2000) carried out an empirical study to explore the effect of cooperative learning setting on learners’ academic performance in chemistry courses. He reported that learners of cooperative groups achieved the 64th percentile, while students in traditional learning environment achieved 50th percentile. Previously, mentioned studies review underlined the usefulness of cooperative learning techniques for chemistry courses at different educational levels. Nevertheless, the researchers still feel the need to assess the use of different cooperative learning strategies to promote learning of chemistry subject across different languages and cultures. Apart from this, it was noticed that majority of students do not like chemistry and they perceive that subject complex to understand (Dori, 1989). Therefore, researcher planned an empirical study to seek out effect of cooperative learning on the academic achievement of secondary school student in chemistry. This study would be helpful and beneficial for not only students and classroom teachers but also for educators and planners.

Chapter 3

METHODOLOGY OF THE STUDY

The purpose of study was to seek out the effect of cooperative learning on the achievement of secondary school students in the subject of chemistry. The independent variable was teaching strategy. An experiment was carried out to assess the effectiveness of cooperative learning by comparing it with traditional method of instruction. The selection of appropriate design was fundamental step in experimental research. The adequacy of experimental designs is examined by the extent to which
they eliminate or minimize threats to experimental validity. The factors affecting internal and external validity of experimental designs may be controlled. As they put adverse effects and may confuse independent variables, dependent variables and experimental treatments effects.

3.1 DESIGN OF THE STUDY

Pretest-Posttest Equivalent-Group Design was in the study (adopted from Farooq, 2001). This design may be symbolically represented as under:

\[
RE = O_1 TO 2 \\
RC = O_3 - O_4 \\
dRe = O_2 - O_1 \\
dRc = O_4 - O_3 \\
D = dRe - dR
\]

C=control group  
O1 and O3 = pre-test observations  
O2 and O4 = post-test observations  
T = treatment

This experimental design is strong and true. However influence of testing and interaction effect with experimental variables may be possible. Post-test equivalent to Pre-test has applied to attain scores of tests for elimination the influence of the effect of testing and the interaction with experimental variable. In this design Control and Experimental groups were equated only on basis of pre-test scores (Farooq, 2001). Pre-test was given before the application of treatment and the post-test after the treatment period.

3.2 POPULATION OF STUDY

Researcher designed a study to explore the effect of cooperative learning on academic achievement of class 9th chemistry students. Hence, all secondary schools science students in Khyber Pakhtunkhwa comprised the population of the study. Secondary level refers to class 9-12.
3.3  SAMPLE
Forty two science students of class 9\textsuperscript{th} in Govt. High School No.1 Nowshera Kalan, Khyber Pakhtunkhwa, Session (2013-2014) was selected as sample of study. Teacher made pre-test scores were used to divide these students into experimental and control group through pair random sampling technique. Both groups were equated on the basis of scores attained through pre-test. The scores of the students in pre-test were ranked accordingly. Matched pair was formed of first two students. Students were allotted to treatment and control groups randomly, of these matched pair members. Students included in sample of study were 13-14 years old. According to the plan of action of cooperative learning, the participants of treatment group in five teams involved in study together. Each team comprised four members. Control group members studied the same material with traditional learning method at the same time. The mean score and mean age of the participants of treatment and control groups were approximately, equivalent.

3.4  RESEARCH INSTRUMENTS
The following instruments were used for data collection.

(i)  Pre-test: To check the academic achievements of students before experiment.

(ii) Post-test: To check the academic achievement of students after experiment

(iii) Retention-test: To check the knowledge retention of students after 4 weeks of experiment.

These tests were used to determine the achievements of forty two participants comprising sample. Firstly, the researcher thoroughly studied the chemistry related chapters and techniques of test construction with the consultation of Dr. Jamila, PhD in chemistry an experienced teacher of chemistry. Then he developed pre-test and post-test. The test covered all the text material included in the related three units.
(structure of atom, periodic table and periodicity of properties, and structure of molecules) of textbook of chemistry for 9th grade published by Khyber Pakhtunkhwa textbook Board 2013. Test was comprised of 100 items focused on students’ chemistry knowledge. Multiple choice format was selected for presentation of items in test. Four alternative options were provided for the correct answer of each item. Total marks of achievement test was 100 for knowledge component. Both tests were equivalent. However, items arrangements had changed in post-test. It was used to measure student’s chemistry knowledge before treatment and after treatment.

3.5 VALIDATION OF TEST
Committee, which was composed of teachers and experts in chemistry subject and education Northern University Nowshera checked and revised content validity of the test. All the items of test covered the text material taught to the participants of sample.

3.6 RELIABILITY OF TEST
The test was piloted at Usmania Public High School Nishterabad Peshawar in the 1st week of June 2014 through forty science students of class 9th. The data obtained from pilot testing was subjected to the split half method of estimating reliability. Using spearman Brow Prophecy formula, the coefficient of reliability ‘r’ of the test was found 0.78. Reliability co-efficient of test using for data collection in research studies should be 0.70 and may be higher (Frankel and Wallen 2003). Thus the test had good reliability and was accepted.

3.7 COLLECTION OF DATA
To investigate the effect of STAD cooperative learning model on the academic performance and knowledge retention in term of test score of class 9th chemistry students. An experiment was planned and carried at Govt. High School No.1 Nowshera Kalan, Nowshera. Two different treatment styles in methods of teaching
were applied during experiment. Two teachers with same qualification and almost same experience were taught to treatment and control groups. Experimental group received treatment in the form of STAD cooperative learning model was received by treatment group and control group received traditional instruction in the classroom. The experiment continued for six weeks. Group formation was based on the pre-test scores in which mix-ability students were chosen for each group. Same chemistry text content was selected for both groups. They were given chemistry instruction for equivalent time interval at morning session and in two separate classrooms during the same period of time table. After the treatment, a post-test was given to the students. Post-test scores were used as data to quantify the performance of participants as outcome of treatment. After a gap of four weeks, the same post-test was given to quantify the knowledge retention of participants comprising the sample. Finally, from 42 participants, twenty one from each group, data were collected. The marks of the tests were arranged and compared by statistical techniques like analysis of variance and t-test.

3.8 ANALYSIS OF DATA

To determine effect of cooperative learning on participants’ educational achievements, relevant data were obtained from pre-test, post-test and retention test. These tests also provided sub-total achievement scores with respect to high achievers, low achievers, urban and rural students. The data were arranged and tabulated for the aim of interpretation and analysis. Means, standard deviations and means difference were calculated for each group to analyze the collected data. Significance of difference between the means of both groups on the variable of pre-test, post-test and retention test scores were treated through t-test at 0.05. To evaluate the treatment effects for urban and rural students as well as higher and lower achievers for the
experimental and control groups, the factorial design (2x2) analysis of variance was used.

Both groups’ participants were split into two halves (higher achievers above the mean score) and (low achievers below the mean score) for application of analysis of variance, pre-test scores was used as basis to ensure this distribution.

Factorial design is illustrated as under:

<table>
<thead>
<tr>
<th></th>
<th>Experimental</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>High achievers</td>
<td>Cell₁</td>
<td>Cell₂</td>
</tr>
<tr>
<td>Low achievers</td>
<td>Cell₃</td>
<td>Cell₄</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Experimental</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban students</td>
<td>Cell₁</td>
<td>Cell₂</td>
</tr>
<tr>
<td>Rural students</td>
<td>Cell₃</td>
<td>Cell₄</td>
</tr>
</tbody>
</table>

For statistical analysis the formulae followed by (R.L Linn & M.D Miller, 2001) were used.

Data were analyzed through application of following formulas.

1. Mean

\[ \bar{X} = \frac{\sum x}{N} \] (Linn & Miller, 2001)

Where \( \bar{X} = \text{Mean} \)

\[ \sum = \text{sum of} \]

\( X = \text{raw score} \)

N = Number of observations

2. Standard Deviation

The formula for standard deviation (SD) is:

\[ SD = \sqrt{\frac{\sum x^2 - (\sum x)^2}{N}} \]

Where

SD = Standard Deviation

\( \sum = \text{Sum of} \)

\( X = \text{any score} \)

N = Number of scores
3. Standard Error of the Difference between two Means

\[ SE_D = \sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}} \]

where \( SE_D = SE_{\bar{x}_1 - \bar{x}_2} \)

SE = Standard Error

\( \bar{x}_1 \) = Experimental group Mean

\( \bar{x}_2 \) = Mean of Control group Mean

\( S_1 \) = Standard deviation of sample one

\( S_2 \) = Standard deviation of sample two

\( n_1 \) = Observations’ number in treatment group

\( n_2 \) = Observations’ number in control group

4. Sampling error of difference between means

\[ |\bar{x}_1 - \bar{x}_2| - (\mu_1 - \mu_2) = \]

\( \bar{x}_1 - x_2 \) = difference of sample means

\( \mu_1 - \mu_2 \) = expected difference of population means

critical ratio = \( \frac{\text{sampling error of difference}}{\text{standard error of difference}} \)

5. Computation of t-value

\[ t = \frac{\bar{x}_1 - \bar{x}_2}{SE_D} \]

6. Analysis of variance

(i) Correction term (c) = \( \frac{(x_1 + x_2)^2}{N_1 + N_2} \)

(ii) SS Total = \( x_1^2 + x_2^2 - c \)

(iii) SS between means = \( (x_1)^2 + (x_2)^2 - c \)

(iv) SS with in groups = SS total – SS between means
7. Factorial design (2×2 analysis of variance)

(i) Correction term (c) = \( \frac{(x-\bar{x})^2}{N} \)

(ii) \( SS_{\text{total}} = x^2 - c \)

(iii) \( SS_{\text{cells}} = N (d_{11}^2 + d_{12}^2 + d_{21}^2 + d_{22}^2) \)

(iv) \( SS_{\text{within cells}} = SS_{\text{total}} - SS_{\text{cells}} \)

(v) \( SS_{\text{treatment}} = N_1 (d_1^2 + d_2^2) \)

(vi) \( SS_{\text{intelligence}} = N_1 (d_1^2 + d_2^2) \)

(vii) \( SS_{\text{interaction}} = SS_{\text{cells}} - SS_{\text{treatment}} - SS_{\text{intelligence}} \)

(viii) Table of ANOVA (2×2)

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>d.f</th>
<th>Sum of squares</th>
<th>Mean squares</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intelligence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interaction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within cells</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
MS-Excel 2007 and statistical package for social sciences (SPSS-17) computer program were used to analyze the collected data.

3.10 SELECTION AND TRAINING OF TEACHER FOR EXPERIMENT

Two teachers with same qualification and almost same experience were selected for teaching chemistry to experimental and control groups. Training of twelve days was provided to a secondary school teacher volunteering for teaching experimental group at GHS No.1 Nowshera Kalan in cooperative learning model, Student Team Achievement divisions (STAD). Preparation and Presentation of class, and Group formation and Quiz were kept under focusing by researcher in training session.

3.11 THE BOOK COOPERATIVE LEARNING

Theory and Research by Slavin (1995, p.50-94) was used as source material to cover the contents. Training was provided to teacher for practical teaching in the classroom for six days according to the following schedule.

3.11.1 First day

The teacher assigned the students to STAD teams under the guidance of researcher and trained students in the area of:

* Cooperative learning
* Seating arrangement for STAD activities
* Quiet Signal
* Classroom rules
* Schedules of STAD activities

3.11.2 Second Day

The teacher revised the activities learnt on first day using question-answer technique. The teacher provided rehearsal to the students to get arrangement in the cooperative teams quickly. After rehearsal the teacher focused on the training of students in following areas of cooperative learning.

- About social skills for group work

lxxxiv
- About how to solve worksheet cooperatively
- About how to solve quiz sheet
- About the scores sheet and rules for gain scores on achievement scores.

3.11.3 Third Day
Teacher provided two worksheets to each group about the previously learned lesson of chemistry and asked the students to solve the worksheets. Students started working on the worksheets, while teacher took round in class and watch the social skills and level of cooperation. The teacher guided the students about these aspects accordingly. The teacher told the students about quiz on next day.

3.11.4 Fourth Day
Students were arranged for test and a quiz sheet was given to students. Students solved the quiz and returned to the teacher.

3.11.5 Fifth Day
Marked answer sheets were returned to each group and each group was provided a blank team score-sheet. Students cooperatively filled sheets. Then, teacher provided rehearsal in the following.
- About achievement scores
- About total achievement scores of the team
- Criteria for supper team, excellent team and good team

3.11.6 Sixth Day
Teacher started unit structure of atom of the experiment according to lesson plan. Provided, guided practice and assigned homework. Thus the treatment continued in sequence instruction with guided practice (one day) STAD practice on work sheet (second day) and quiz (third day).
3.12 TREATMENT

Following steps were ensured to carry on each lesson for treatment group:

On first day, teacher used direct teaching style to present lesson for 40 minutes. On 2nd day teacher provided last day worksheet containing contents of lesson. Participants completed worksheets in their respective teams to comprehend the material for 40 minutes.

Teacher gave individual test to participants in quiz form on 3rd day. Tests were marked to measure team score through criteria of team members’ improvement scores. Winner team received awarded in class for high team score.

While, teacher concerning the control group divided each lesson plan into three sections and employed direct teaching to teach these sections in three days accordingly, in conventional educational environment. Same content material was covered by treatment group and control group.

Three chapters of 9th class chemistry book published by Khyber Pakhtunkhwa Textbook Board, Peshawar 2013-14 was taught, that are listed below:

1- Structure of atom

2- Periodic tables and periodicity of properties

3- Structure of molecules

The chances of mixing of students of both groups were minimized. Furtherly, worksheets given to cooperative groups, were collected after period. A post-test was administered to find out the performance of the participants in term of test scores at the end of experiment.
ANALYSIS AND INTERPRETATION

Intention of study was to evaluate co-operative learning effect on academic achievement of secondary school students in chemistry. Data were obtained through teacher made tests to draw inferences. Pre-test scores in subject of chemistry were used to equate the groups. Significance of difference between the mean scores of treatment and control groups on pre-test, post-test and retention test were determined through application of t-test, analysis of variance and factorial design (2 x 2) analysis of variance. Results and discussion has been classified into three sections.

SECTION-I

This section shows the presentation of the results of experimental and control groups on pre-test scores.

Table 5: Significance of difference between the mean scores on pre-test of experimental and control groups.

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>D.F</th>
<th>Mean</th>
<th>S.D</th>
<th>S.E</th>
<th>T. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calculated Value</td>
</tr>
<tr>
<td>Experimental</td>
<td>21</td>
<td>20</td>
<td>29</td>
<td>4.42</td>
<td>1.62</td>
<td>0.24</td>
</tr>
<tr>
<td>Control</td>
<td>21</td>
<td>20</td>
<td>28.61</td>
<td>5.98</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The critical region is $|t| \geq t_{0.025} (40) = 2.021$

Table-5 indicates that the computed t (0.24) value was found less than the table value at 0.05. Therefore, null hypothesis, “significant difference does not exist between the mean scores of experimental and control groups on pre-tests” was accepted.

Table 6: Significance of difference between the mean score on pre-test of urban students of experimental and control groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>D.F</th>
<th>Mean</th>
<th>S.D</th>
<th>S.E</th>
<th>T. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calculated Value</td>
</tr>
</tbody>
</table>

lxxxvii
The critical region is $|t| \geq t_{0.025(23)} = 2.06$

Table 6 reveals that the computed $t(0.14)$ value was found less than the table value at 0.05. Therefore null hypothesis, “significant difference does not exist between the mean scores of urban students of experimental and control groups on pre-tests” was accepted.

Table 7: Significance of difference between the mean scores on pre-test of rural students of experimental and control groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>D.F</th>
<th>Mean</th>
<th>S.D</th>
<th>S.E</th>
<th>T. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>9</td>
<td>8</td>
<td>29.66</td>
<td>3.50</td>
<td>2.08</td>
<td>- 0.16</td>
</tr>
<tr>
<td>Control</td>
<td>8</td>
<td>7</td>
<td>30.00</td>
<td>4.89</td>
<td></td>
<td>2.16</td>
</tr>
</tbody>
</table>

The critical region is $|t| \geq t_{0.025(15)} = 2.16$

Table 7 indicates that the computed $t(-0.16)$ value was found less than table value at 0.05. Therefore the null hypothesis, “significant difference does not exist between mean scores of rural students of experimental and control groups on pre-tests.” was accepted.
Table 8: Significance of difference between mean scores on pre-test of high achievers of the experimental and control groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>D.F</th>
<th>Mean</th>
<th>S.D</th>
<th>S.E</th>
<th>T. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calculated Value</td>
</tr>
<tr>
<td>Experimental</td>
<td>11</td>
<td>10</td>
<td>32.27</td>
<td>3.31</td>
<td>1.28</td>
<td>0.07</td>
</tr>
<tr>
<td>Control</td>
<td>11</td>
<td>10</td>
<td>32.18</td>
<td>2.68</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The critical region is $|t| \geq t$ to 0.025(20) = 2.086

Table 8 depicts that computed $t$ (0.07) value was found less than table value at 0.05. Therefore null hypothesis, “significant difference does not exist between the mean scores of high achievers of experimental and control groups on pre-tests” was accepted. It means that both the comparison groups on the variable of high achievement level could be treated equal.

Table 9: Significance of difference between the mean scores on pre-test of low achievers of experimental and control groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>D.F</th>
<th>Mean</th>
<th>S.D</th>
<th>S.E</th>
<th>T. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calculated Value</td>
</tr>
<tr>
<td>Experimental</td>
<td>10</td>
<td>9</td>
<td>24.50</td>
<td>7.32</td>
<td>3.38</td>
<td>0.05</td>
</tr>
<tr>
<td>Control</td>
<td>10</td>
<td>9</td>
<td>24.30</td>
<td>7.80</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The critical region is $|t| \geq t$ to 0.025(1) = 2.10

Table 9 indicates that computed $t$ (0.05) value was found less than table value at 0.05. Therefore null hypothesis, “significant difference does not exist between the mean scores of low achievers of experimental and control groups on pre-test” was accepted. It means that both the groups of low achievers could be treated equal.
Table 10: Significance of difference between mean scores of urban and rural students of experimental groups on pre-test

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>D.F</th>
<th>Mean</th>
<th>S.D</th>
<th>S. E</th>
<th>T. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calculated</td>
</tr>
<tr>
<td>Urban</td>
<td>12</td>
<td>11</td>
<td>28.50</td>
<td>5.10</td>
<td>1.87</td>
<td>-0.62</td>
</tr>
<tr>
<td>Rural</td>
<td>9</td>
<td>8</td>
<td>29.66</td>
<td>3.50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The critical region is $|t| \geq t_{0.025(19)} = 2.09$

Table 10 reflects that computed $t (-0.62)$ value was found less than table value at 0.05. Therefore null hypothesis, “significant difference does not exist between the mean scores of urban and rural students of experimental group on pre-test” was accepted.

Table 11: ANOVA showing difference between the means scores on pre-test of urban and rural students of experimental and control groups

<table>
<thead>
<tr>
<th>Mean square variation</th>
<th>D.F</th>
<th>Sum of squares</th>
<th>SD</th>
<th>F-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calculated Value</td>
</tr>
<tr>
<td>Among the means of conditions</td>
<td>3</td>
<td>28.12</td>
<td>9.37</td>
<td>0.48</td>
</tr>
<tr>
<td>Within conditions</td>
<td>38</td>
<td>739.78</td>
<td>19.46</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>41</td>
<td>767.78</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The critical region is $F \geq F_{0.05(3,38)} = 2.23$

It appears from table 11 that obtained value of $F (0.48)$ was found less than table value at 0.05. Therefore null hypothesis, “significant difference does not exist between mean scores of urban and rural students of treatment and control groups on pre-test” was accepted.

**SECTION-II**

This Section deals with the results of post-test of experimental and control groups accordingly.
Table 12: Significations of difference between means scores on post-test of experimental and control group.

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>D.F</th>
<th>Mean</th>
<th>S.D</th>
<th>S.E</th>
<th>T. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calculated Value</td>
</tr>
<tr>
<td>Experimental</td>
<td>21</td>
<td>20</td>
<td>52.80</td>
<td>14.88</td>
<td>3.59</td>
<td>3.59</td>
</tr>
<tr>
<td>Control</td>
<td>21</td>
<td>20</td>
<td>49.42</td>
<td>7.11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The critical region is $|t| \geq t_{0.025(40)} = 2.02$

It is obvious from table 12 that the computed $t$ (3.59) value was found greater than table value at 0.05. Therefore null hypothesis, “significant difference does not exist between mean scores of experimental and control groups on post-test” was rejected. It means that the significant difference was there between mean scores on post-test of both groups after being treated by co-operative learning method and traditional learning method respectively.

Table 13: Significance of difference between mean scores on post-test of urban students of experimental and control groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>D.F</th>
<th>Mean</th>
<th>S.D</th>
<th>S.E</th>
<th>T. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calculated Value</td>
</tr>
<tr>
<td>Experimental</td>
<td>12</td>
<td>11</td>
<td>63.50</td>
<td>18.43</td>
<td>5.60</td>
<td>2.42</td>
</tr>
<tr>
<td>Control</td>
<td>13</td>
<td>12</td>
<td>48.69</td>
<td>6.62</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The critical region is $|t| \geq t_{0.025(18)} = 2.10$

It is clear from table 13 that computed $t$ (2.42) value was found greater than table value at 0.05. Therefore null hypothesis, “significant difference does not exist between mean scores of urban students of treatment and control groups on post-test” was rejected.

Table 14: Significance of difference between mean scores on post-test of rural students of experimental and control groups
<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>D.F</th>
<th>Mean</th>
<th>S.D</th>
<th>S.E</th>
<th>T. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calculated Value</td>
</tr>
<tr>
<td>Experimental</td>
<td>9</td>
<td>11</td>
<td>60.77</td>
<td>9.03</td>
<td>4.17</td>
<td>2.43</td>
</tr>
<tr>
<td>Control</td>
<td>8</td>
<td>12</td>
<td>50.62</td>
<td>8.17</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The critical region is $|t| \geq t$ to 0.025(15) = 2.13

It is evident from table 14 that computed $t$ (2.43) value was found greater than table value at 0.05. Therefore null hypothesis, “significant difference does not exist between mean scores of rural students of treatment and control groups on post-test” was rejected.

Table 15: Significance of difference between the scores on post-test of higher achievers of experimental and control groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>D.F</th>
<th>Mean</th>
<th>S.D</th>
<th>S.E</th>
<th>T. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calculated Value</td>
</tr>
<tr>
<td>Experimental</td>
<td>11</td>
<td>10</td>
<td>65.81</td>
<td>16.40</td>
<td>4.00</td>
<td>2.70</td>
</tr>
<tr>
<td>Control</td>
<td>11</td>
<td>10</td>
<td>55.00</td>
<td>4.04</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The critical region is $|t| \geq t$ to 0.025(20) = 2.08

It is apparent from table 15 that computed $t$ (2.70) value was found greater than table value at 0.05. Therefore null hypothesis, “significant difference does not exist between mean scores of high achievers of treatment and control groups on post-test” was rejected, and we may conclude that high achievers of treatment group performed better than control group.
Table 16: Significance of difference between mean scores on post-test of low achievers of experimental and control groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>D.F</th>
<th>Mean</th>
<th>S.D</th>
<th>S.E</th>
<th>T. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calculated Value</td>
</tr>
<tr>
<td>Experimental</td>
<td>10</td>
<td>9</td>
<td>57.80</td>
<td>12.73</td>
<td>4.20</td>
<td>3.61</td>
</tr>
<tr>
<td>Control</td>
<td>10</td>
<td>9</td>
<td>43.30</td>
<td>3.83</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The critical region is |t| ≥ t to 0.025(18) = 2.10

It is visible from table 16 that computed t (3.61) value was found greater than table value at 0.05. Therefore null hypothesis, “significant difference does not exist between mean scores of low achievers of experimental and control groups on post-test” was not accepted, and we may conclude that the difference between mean scores on post-test of low achievers of treatment and control groups was significant in the favor of experimental group.

Table 17: Significance of difference between the mean scores on post-test of urban and rural students of experimental group

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>D.F</th>
<th>Mean</th>
<th>S.D</th>
<th>S.E</th>
<th>T. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calculated Value</td>
</tr>
<tr>
<td>Urban</td>
<td>12</td>
<td>11</td>
<td>63.5</td>
<td>18.43</td>
<td>6.11</td>
<td>0.44</td>
</tr>
<tr>
<td>Rural</td>
<td>9</td>
<td>8</td>
<td>60.77</td>
<td>9.03</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The critical region is |t| ≥ t to 0.025(17) = 2.11

It is clear from table 17 that computed t (0.44) value was less than table value at 0.05. Therefore null hypothesis, “significant difference does not exist between mean scores of urban and rural students of treatment group on post-test” was accepted, and we may conclude that both urban and rural participants of the treatment groups performed equally on the post-test.

Table 18: ANOVA (2 ×2) showing difference between treatment effects for high and low achievers of the experimental and control groups on post-test
Table 18 indicates that the computed F-values obtained in case of “Treatment” and “achievement” level were found greater than table values at 0.05. Therefore null hypothesis, significant difference does not exist between mean scores of high and low achievers of treatment and control groups on post-test were rejected. However the interaction effect between treatment and achievement level was insignificant.

**The interaction effect between treatment and achievement level on post test scores**

![Graph showing achievement level and treatment interaction](image)

<table>
<thead>
<tr>
<th>Low achievers</th>
<th>High achievers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>58.5</td>
</tr>
<tr>
<td>Control</td>
<td>43.3</td>
</tr>
<tr>
<td>Experimental</td>
<td>65.81</td>
</tr>
<tr>
<td>Control</td>
<td>55</td>
</tr>
</tbody>
</table>

Graph shows that both high and low achievers of treatment groups outscored the high and low achievers of control groups.

Table 19: ANOVA (2×2) showing difference between mean scores on post-test of urban and rural students of experimental and control groups

<table>
<thead>
<tr>
<th>Sources of</th>
<th>D.F</th>
<th>Sum of</th>
<th>Mean square</th>
<th>F-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>variation</td>
<td>squares</td>
<td>variation</td>
<td>Calculated Value</td>
<td>Table Value</td>
</tr>
<tr>
<td>---------------</td>
<td>---------</td>
<td>-----------</td>
<td>------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Treatment</td>
<td>1</td>
<td>1748.4</td>
<td>1748.4</td>
<td>$F_1=86.42$</td>
</tr>
<tr>
<td>Locality</td>
<td>1</td>
<td>4672.6</td>
<td>4672.6</td>
<td>$F_2 = 230.97$</td>
</tr>
<tr>
<td>Interaction</td>
<td>1</td>
<td>4.40</td>
<td>4.40</td>
<td>$F_3 = 0.21$</td>
</tr>
<tr>
<td>Within cells</td>
<td>38</td>
<td>768.8</td>
<td>2023</td>
<td>----</td>
</tr>
</tbody>
</table>

**The critical regions are**

(a) $F_1 \geq F_{0.05 (1,38)} = 4.08$

(b) $F_2 \geq F_{0.05 (1,38)} = 4.08$

(c) $F_3 \geq F_{0.5 (1,38)} = 4.08$

Table 19 indicates that the computed value of $F_1$ (86.42) and $F_2$ (230.97) were found greater than tables values at 0.05. Therefore null hypotheses were rejected and we may conclude that both sources of variation (treatment and locality) were significant at 0.05 level. However calculated of $F_3$ (0.21) was found less than table value. Hence null hypothesis with regard to interaction was accepted, it means that interaction effect between treatment and locality was not statistically significant at 0.05.
SECTION-III

This section deals with the results of retention test of experimental and control groups respectively and the data have been presented in tables 20 to 26.

Table 20: Significance of difference between the means scores on retention test of experimental and control groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>D.F</th>
<th>Mean</th>
<th>S.D</th>
<th>S.E</th>
<th>T. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>21</td>
<td>20</td>
<td>49.91</td>
<td>14.61</td>
<td>4.01</td>
<td>2.79</td>
</tr>
<tr>
<td>Control</td>
<td>21</td>
<td>20</td>
<td>38.71</td>
<td>11.16</td>
<td></td>
<td>2.02</td>
</tr>
</tbody>
</table>

The critical region is $|t| \geq t$ to 0.025(40) = 2.02

Table 20 shows that computed $t$ (2.79) value was found larger than table value at 0.05. Therefore null hypothesis, “significant difference does not exist between mean scores of experimental and control groups on retention-test” was rejected, and we may conclude that the difference between means scores on retention test of both groups was statistically, significant in favor of treatment group.

Table 21: Significance of difference between the means scores on retention test of urban students of experimental and control groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>D.F</th>
<th>Mean</th>
<th>S.D</th>
<th>S.E</th>
<th>T. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>12</td>
<td>11</td>
<td>49.25</td>
<td>16.84</td>
<td>5.69</td>
<td>1.08</td>
</tr>
<tr>
<td>Control</td>
<td>13</td>
<td>12</td>
<td>38.15</td>
<td>1.67</td>
<td></td>
<td>2.10</td>
</tr>
</tbody>
</table>

The critical region is $|t| \geq t$ to 0.025(18) = 2.10

Table 21 reflects that computed $t$ (1.08) value was found less than table value at 0.05. Therefore null hypothesis, “significant difference does exist between mean scores of urban students of treatment and control groups on retention-test” was accepted and we may conclude that difference between mean scores on retention test
of urban students of experiential and control groups was insignificant at 0.05. Hence, both the groups performed equally on retention-test.

Table 22: Significance of difference between the means scores on retention test of rural students of experimental and control groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>D.F</th>
<th>Mean</th>
<th>S.D</th>
<th>SE</th>
<th>T. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calculated Value</td>
</tr>
<tr>
<td>Experimental</td>
<td>9</td>
<td>8</td>
<td>49</td>
<td>12.01</td>
<td>5.99</td>
<td>1.56</td>
</tr>
<tr>
<td>Control</td>
<td>8</td>
<td>7</td>
<td>39</td>
<td>12.61</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The critical region is |t| ≥ t to 0.025(15) = 2.13

Table 22 indicates that computed t (1.56) value was found less than table value at 0.05. Therefore null hypothesis, “significant difference does not exist between mean scores of rural students of treatment and control groups on retention-test” was accepted and we may conclude that difference between mean scores on retention-test of rural students of experiential and control groups was not statistically significant at 0.05.

Table 23: Significance of difference between the means scores of high achievers of experimental and control groups on retention test.

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>D.F</th>
<th>Mean</th>
<th>S.D</th>
<th>SE</th>
<th>T. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calculated Value</td>
</tr>
<tr>
<td>Experimental</td>
<td>11</td>
<td>10</td>
<td>48.45</td>
<td>28.42</td>
<td>9.12</td>
<td>0.39</td>
</tr>
<tr>
<td>Control</td>
<td>11</td>
<td>10</td>
<td>44.81</td>
<td>10.37</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The critical region is |t| ≥ t to 0.025(20) = 2.08

Table 23 reveals that computed t (0.39) value was found less than table value at 0.05. Therefore null hypothesis, “significant difference does not exist between mean scores of high achievers of treatment and control groups on retention-test” was
accepted and we may conclude that difference between mean scores on retention test of high achievers of experiential and control groups were not statistically significant at 0.05.

Table 24: Significance of difference between the means scores on retention test of low achievers of experimental and control groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>D.F</th>
<th>Mean</th>
<th>S.D</th>
<th>S.E</th>
<th>T. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calculated Value</td>
</tr>
<tr>
<td>Experimental</td>
<td>10</td>
<td>9</td>
<td>44</td>
<td>13.84</td>
<td>5.03</td>
<td>2.38</td>
</tr>
<tr>
<td>Control</td>
<td>10</td>
<td>9</td>
<td>32</td>
<td>7.85</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The critical region is |t| ≥ t to 0.025(18) = 2.10

Table 24 depicts that computed t (2.38) value was found larger than table value at 0.05. Therefore null hypothesis, “significant difference does not exist between mean scores of low achievers of treatment and control groups on retention-test” was rejected and we may conclude that low achievers of experiential group outscored control group low achievers on retention test scores.

Table 25: Significance of difference between the means scores on retention test of urban and rural students of experimental group

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>D.F</th>
<th>Mean</th>
<th>S.D</th>
<th>S.E</th>
<th>T. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calculated Value</td>
</tr>
<tr>
<td>Urban</td>
<td>12</td>
<td>11</td>
<td>49.25</td>
<td>16.84</td>
<td>6.42</td>
<td>0.038</td>
</tr>
<tr>
<td>Rural</td>
<td>9</td>
<td>8</td>
<td>49</td>
<td>12.61</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The critical region is |t| ≥ t to 0.025(19) = 2.09

Table 25 indicates that computed t (0.038) value was found less than table value at 0.05. Therefore null hypothesis, “significant difference does not exist between mean scores of urban and rural students of treatment group on retention-test”
was accepted and we may conclude that the difference between the mean scores on retention test of urban and rural students of experiential group was not statistically significant at 0.05. It means data did not present sufficient evidence to indicate that treatment affected mean scores.

Table 26: ANOVA (2x2) showing difference between mean scores on retention test of urban and rural of experimental and control groups

<table>
<thead>
<tr>
<th>Sources of variation</th>
<th>D.F</th>
<th>Sum of Squares</th>
<th>Mean Square Variation</th>
<th>F-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Calculated Value</td>
</tr>
<tr>
<td>Treatment</td>
<td>1</td>
<td>1142</td>
<td>1142</td>
<td>F_1 = 10.40</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>F_2 = 23.48</td>
</tr>
<tr>
<td>Locality</td>
<td>1</td>
<td>2577</td>
<td>2577</td>
<td>F_3 = 0.18</td>
</tr>
<tr>
<td>Interaction</td>
<td>1</td>
<td>20</td>
<td>20</td>
<td>F_3 = 0.18</td>
</tr>
<tr>
<td>Within cells</td>
<td>38</td>
<td>4170</td>
<td>109.73</td>
<td>----</td>
</tr>
</tbody>
</table>

The critical regions are (a) \( F_1 \geq F_{0.05} (1,38) = 4.08 \)
(b) \( F_2 \geq F_{0.05} (1,38) = 4.08 \)
(c) \( F_3 \geq F_{0.5} (1,38) = 4.08 \)

Table 26 indicates that computed values of \( F_1 \) (10.4) and \( F_2 \) (23.48) were found greater than tables values at 0.05. Therefore null hypotheses, “significant difference does not exist between mean scores of urban and rural students of treatment and control groups on retention-test” were rejected it means that both sources of variations (treatment and locality) were significant. However calculated value of \( F_3 \) (0.18) was found less than table value. Hence null hypothesis with regard to interaction was accepted.
DISCUSSION

Intention of study was to evaluate the effect of STAD cooperative learning model on students’ academic achievements, comparison between cooperative learning and traditional learning method were made with a pre-test, post-test equivalent group design. The treatment group was treated through Student Team Achievement Division cooperative learning, which ensured integration of peer tutoring, elaborated explanation peer modeling, cognitive elaboration, peer practice, and peer assessment and correction into the instructional strategies. Therefore students played important roles in various types of class activities. The control group was treated by the conventional class instruction involving communication-based class activities that were carried out either whole-class or individually. The treatment remained in practice for six weeks. Results of study favored cooperative learning utility in terms of boosting academic achievement, and knowledge retention. Results based discussion was presented according to the research questions. To address these questions 21 null hypotheses were proposed and tested. Statistical analysis of pre-test scores showed that there no significant relationship existed between the mean scores of experimental and control groups (table 5-11) with respect to pre-test achievement in chemistry, and both groups were almost equal, as t-value obtained was not statistically significant at 0.05. Moreover, comparison between means pre-test scores of urban and rural students of experimental and control groups on academic achievement in chemistry was insignificant at 0.05 (Table 6-7). Hence both groups may be equal before starting the experiment. Similarly, difference between mean scores of high achievers of both groups on pre-test was insignificant at 0.05. It indicates that both the comparison groups on the variables of high achievement level could be treated equal (Table 8). The results based on t-test analysis showed no significant relationship in chemistry pre-test scores between treatment and control
groups on the variable of low achievement level. It means that students of both groups had equivalent academic knowledge in chemistry before experiment (Table 9). Results based on ANOVA analysis showed no significant relationship in chemistry pre-test scores ($f (3.38) = 0.48; p=2.23$) of treatment and control groups on the variables of urban and rural locality. Hence, both comparison groups on could be treated equal (Table 11).

$Ho_1$: Treatment group performed far better than control group on post-test. Magnitude of the difference in means (Mean difference = 2.38) was statistically significant at 0.05 level (Table 12). Thus null hypothesis that, ”significant difference does not exist between mean scores of the students taught chemistry with CLA and the students taught through tradition method of teaching” was rejected at 0.05 level in favor of experimental group. The results of present study are consistent with previous research findings (Yamarik, 2007; Doymus, 2008a & 2008b; Masood, 2012; Shafqat, 2008; Iqbal, 2004).

$Ho_2$: The f-value attained in case of treatment and locality both as source of variation was significant at 0.05 (Table 18). Thus null hypothesis, “significant difference does not exist between mean scores of urban and rural students of the treatment and control groups on the post-test”, was rejected. Therefore we may conclude that both sources of variation (treatment and locality) were significant at 0.05 in favor of treatment group. However, computed value of F3 (0.21) was found to be insignificant at 0.05 level. Hence hypothesis with regard to interaction was accepted, it means that interaction effect between treatment and locality was not statistically significant at 0.05. Furthermore, the comparison of urban and rural students of experimental group on post-test scores (Table 17) showed that difference
between mean scores of both groups was not significant at 0.05. Hence, both urban and rural students of treatment group performed equally on post-test.

Ho$_3$: Significance difference between mean scores on post-test of high achievers of treatment and control groups depicted that experimental group performed better than control group on post-test (table 15). Hence null hypothesis, “significant difference does not exist between mean scores of treatment and control groups of high achievers on post-test,” was rejected at 0.05 in the favor of treatment group depicted that cooperative learning was an effective strategy for teaching chemistry at secondary level versus traditional learning methodology.

Same lesson from chemistry prescribed book were used in experimental and control groups. Nevertheless, experimental plans facilitate small group interaction and sharing resources amongst group participants. They are actively involved in learning process. Group members try to help one another for clearance of concepts while control group participants toiled individually and shared their answers with the class. They remained passive listener. The results of the study supported findings of previous studies, conducted by Masood (2012) Shachar and Fischer (2004); Iqbal (2004).

Ho$_4$: Experimental group of low achievers performed significantly better than control group on post-test. Significant difference was there between mean scores of two groups at 0.05 (table 16). Therefore null hypothesis, “significant difference does not exist between mean scores of low achievers of experimental and control groups on post-test” was rejected. Cooperative learning is more effective versus conventional learning for heterogeneity of STAD model (Slavin, 1995). Academic performance of low achievers was much better for, strategies of higher achievers were observed by them more keenly.
Low ability learners develop their cognitive dexterities at session of interaction with higher achievers (Vygotsky, 1978). Cooperative group learners avail inspiration and support of their high ability partners. They are present to guide them when they need a typical answer to a question. This provision of explanation leads to gain in achievement. Furthermore the calculated t-value (3.61) on post-test of treatment and control groups for low achievers is greater than t-values (2.70) of high achievers for both groups. Thus the performance of low achievers was significantly better than that of high achievers on post-test. Hence cooperative learning has proved more effective strategy for low achievers. This result supports the findings reported by Iqbal (2004) and Veeman, Kenter and Post (2000) and is in contrast to the findings by Slavin (1996 b);

Ho5: The analysis of variance (2×2) i.e. factorial design) showed that f-values attained for both “treatment” and “locality” as source of variation was significant at 0.05. However, interaction between treatment and locality was insignificant at 0.05 (table 25). Thus the null hypothesis, “significant difference does not exist between the mean scores of urban and rural students of treatment and control groups on retention-test” was not accepted. However the hypothesis with regard to interaction was accepted. Moreover, comparison of mean scores of urban and rural students of experimental group on retention test (Table 24) showed insignificant difference at 0.05. This reveals that performance of urban and rural students of experimental group on retention test was found to be almost equal. This study specially investigated the effect of cooperative learning groups on the academic achievement and retention of urban and rural students and concluded that treatment strategy of cooperative learning had equal effect on the retention of both urban and rural achievers. These findings validate the results of some earlier studies (Johnson & Sahin, 2010). The study reveals
that cooperative learning activities promote student’s personal involvement in learning process, attributed to their gains in achievement on retention test in experimental group. The results of this study are also in agreement with the results of many experimental studies as (Slavin, 2011; Johnson & Johnson, 2008; Webb, 2008; Moore, 2008).

The overall results of the study indicate that cooperative learning boost higher level of achievement and knowledge retention in subject of chemistry at secondary level with higher achievement gains for the groups of low achievers as compared to high achievers. However, urban and rural students both benefit equally from cooperative learning. There is agreement in most of the researches that cooperative learning is more beneficial strategy for low ability learners than high ability learners. For example, Iqbal (2004) and Kenneth and Young (1999) reported cooperative learning more favorable for low achievers. The difference might be attributed to exposure of former group to the useful implementation of cooperative learning that assured active participation in learning process. Based on wiener’s attribute theory (2000), It was assured that STAD cooperative learning model, particularly its equal opportunity aspect, facilitated learners to perceive competence as acquired, which in turn made them believe in the worth of themselves, and constant self-improvement.

The cooperative learners had more time to reflect upon subject matter, raise their awareness, structure and restructure knowledge, differentiate information received, fine tune their thoughts, and expand their knowledge base, as a result of these activities, they were able to learn more effectively, retain information longer, and thus perform better on achievement and knowledge retention (Snowman & Biehler, 2005).

Chapter 5
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS
5.1 SUMMARY

This research study has conducted to assess the “effect of STAD cooperative learning model on secondary school students’ academic performance in chemistry”. Chemistry is a key science subject in the curriculum of Pakistani schools at secondary level. It is a fundamental branch of science that facilitates the medical, engineering, agriculture, and industrial sectors etc. of a country.

It has been observed that students evade chemistry learning and perceive chemistry education more complex as compared to other subjects because of the complicated character of chemistry subject traditional approach being employed by majority of the chemistry instructor in Pakistan. Hence chemistry requires specific teaching-learning methodologies. To overcome these challenges, cooperative learning approach may be employed in educational institutions to convert teacher centered classroom to student centered situation. Objectives of study were stated as:

1) to examine cooperative learning effect as an approach on students’ academic achievement versus conventional learning. 2) to differentiate the treatment effects for higher and low achievers. (3) to differentiate treatment effects for urban and rural students. (4) to determine the effects of cooperative learning on the retention of students in chemistry.

Following null hypotheses were tested to achieve these objectives: (1) Significant difference does exist between the mean scores of students taught chemistry with CLA and without CLA. (2) Significant difference does not exist between the two treatments ‘effects for the students of high and low intelligence. (3) Significant difference does not exist between the mean scores of urban and rural students of treatment and control groups.
This study was conducted in government high school No.1 Nowshera Kalan. Population of the study comprised of secondary schools science students. All 42 students enrolled in 9th grade chemistry were included in the sample.

Sample students were assigned randomly to treatment and control group. Pre-test scores were used to equate treatment and control groups. Each group composed 21 students. Two chemistry teachers having equal qualification, almost same experience, have taught the control and experimental groups. Conventional method was employed to teach the control group and treatment group was treated through (STAD model) of cooperative learning approach the duration of six weeks. Equivalent lesson plans and worksheets were employed along with the direct teaching techniques for control and the experimental groups.

After six weeks treatment, a teacher made post-test was given to sample students in order to examine treatment effect. These tests were aimed to determine the academic scores of students included in the sample of students. Four weeks after completion of treatment, the same post-test was given surprisingly, to determine the retention of students comprising the sample. All 42 participants remained regular throughout the experiment and final data were attained from them

Pre-test and post-test were used as data collecting instruments in the experiment. The purpose of pre-test was to equate treatment and control group. While post-test was given to determine achievement and retention of participants after treatment. Pre-test and post-test were same with different order of test questions. After obtaining the scores, the data were tabulated and the mean, standard deviation, differences between means were calculated.
Validity of test was judged by a committee comprised experts of education and chemistry. Reliability of the test was computed by applying spearman-Brow’s prophecy formula. Reliability co-efficient ‘r’ of post-test was estimated to be 0.78.

Significance of difference between the means scores of experimental and control on variable of these tests was tested at 0.05 by using t-test and ANOVA. Factorial design (2×2) analysis of variance was used to evaluate treatment effect for urban and rural students/ higher and low achievers.

5.2 CONCLUSIONS
The conclusions based on analysis and findings of the study are following.

i. The use of cooperative learning instruction in teaching of chemistry was more beneficial than conventional learning.

ii. Cooperative learning was found to be more useful approach of learning for urban and rural students. Both of them benefited equally from this style of learning.

iii. Cooperative learning was proved to be more effectual learning means for both high achievers and low achievers. Low achievers benefited more from cooperative model than high achievers in conventional setting.

iv. Urban students taught chemistry with cooperative learning or conventional approach, retain equivalent knowledge of learnt material.

v. Rural students learnt chemistry by cooperative learning also retain same material to rural students taught by conventional method.

vi. Low achievers of cooperative group have superiority in retaining the learnt chemistry material over the students learning by traditional teaching method. Therefore cooperative learning is very useful method for teaching chemistry to low ability students.
vii. High achievers of cooperative group have no obvious supremacy in retention ability over students taught by traditional method.

viii. Cooperative learning has proved to be applicable and lends itself to the instructions, we want for learning chemistry at secondary level without any major shift in classroom arrangement and time table. It maximizes student learning.

ix. The utilization of cooperative learning in school is warranted through close relationship between the goals of citizenship education and social skills promoted by this learning strategy.

x. Cooperative learning assures students’ active participation in the teaching learning process owes a great deal for better students achievement.

5.3 **RECOMMENDATIONS**
Recommendations based on findings and conclusions of the study are following:

i. The study reported a range of positive outcomes during implementation of cooperative learning. Therefore, science teachers may use cooperative learning to improve the academic achievement of participants.

ii. This study was conducted in boys’ school in Pakistan. Furthermore, conducting similar study in girls’ school would worth presenting.

iii. The present empirical study was carried to examine the effect of cooperative learning strategy in teaching chemistry. Such studies are needed to be conducted in other subject’s area such as physics, mathematics and social sciences.
iv. Studies on cooperative learning provide an extensive field of research if we examine the relative effectiveness of different cooperative learning methods. Thus researchers should also consider this aspect of research.

v. It is recommended that teachers may be established high level of interaction through questioning as it promotes involvement enhances learning and motivates students.

vi. This study evaluated only the pupils’ further study may be necessary to discover the utility of cooperative learning for other dependent variables e.g. attitude towards subjects, self-esteem, peer relations, social skills and academic motivation for various subjects.

vii. It is recommended that teachers and students should own cooperative learning to get maximum benefits from this innovation. Teachers training institutes may make cooperative learning as a part of their curriculum content and teacher educators may be trained in different model of cooperative learning.

viii. Training may be provided through refresher courses to in-service teachers to instruct them in application of cooperative learning, so that they can implement useful approach of cooperative learning instruction.

ix. Further training programs are required to plan and develop for both teachers and their pupils, not just in cooperative learning methods but also in other teaching methods including e-learning, CAI, and personalized learning to study these innovations in practice.

x. The sample of study is delimited to only 42 students. Further studies may be conducted with larger sample to explore more evidences on the effects of cooperative learning.
BIBLIOGRAPHY


MULTIPLE CHOICE QUESTIONS TEST
Atomic Structure, Periodic Table & Structure of Molecules

Q.1) Choose the correct option from the given choices (i.e.A,B,C,D) and insert into the relevant box.

(1) Which one of following is found in Liquid state at room temperature ……..
   (A) Mg           (B) He           (C) Hg           (D) Fe

(2) Another name for the period (Lanthanides) is ………
   (A) Rare Earth     (B) Alkaline Earth   (C) Alkali Metals   (D) All Of Them

(3) An element has 8 electrons in its valence shell. It is ………
   (A) Inert gas     (B) Halogen     (C) Coinage metal     (D) Alkali metal

(4) According to Mendeleev’s periodic law, the physical and chemical properties of elements are the periodic function of their ………
   (A) Atomic number     (B) Atomic masses   (C) Atomic Radii  (D) Atomic volumes

(5) Decrease in force of attraction between the valence electrons and nucleus occurs due to………
   (A) Screening effect     (B) Rays emitting     (C) Light absorbing     (D) All of them

(6) The least electronegative element of the periodic table is ………
   (A) Cs           (B) Na           (C) K           (D) Ca

(7) Which of the following is a normal/ representative element …………
   (A) Cr          (B) Co          (C) Cu          (D) Cl

(8) Electron affinity is measured in ………
   (A) KJ/mole      (B) K mole/J (C) mole / KJ     (D) J/K mole

(9) The lanthanide and actinide series are called………
   (A) s-block elements (B) d-block elements (C) p-block elements (D) f-block elements

(10) The numbers of shells of period-IV elements are ………
    (A) 7          (B) 6          (C) 5          (D) 4

(11) The elements of group-VIII are …………
    (A) Metal       (B) Metalloid   (C) Gasses      (D) Transition
(12) The longest period in long form periodic table is …..  
(A) 4th  (B) 5th  (C) 6th  (D) 7th

(13) Atomic size of the atom in a periodic table from left to right…..  
(A) Increases  (B) Decreases  (C) Remains Constant  (D) None of them

(14) The ionization energy in group from top to bottom……..  
(A) Increases  (B) Decreases  (C) Remains Constant  (D) None of them

(15) The values of electron affinity in period from left to right …..  
(A) Decreases  (B) Remains Constant  (C) Increases  (D) None of them

(16) Atomic Radii are measured in units of ……..  
(A) Nano meter  (B) Micro meter  (C) Milli meter  (D) Pico meter

(17) The most electronegative element of the periodic table is……..  
(A) Cl  (B) Br  (C) F  (D) I

(18) The elements with atomic number 58-71 are called ……..  
(A) Actinide  (B) Lanthanide  (C) Transition  (D) Normal

(19) Numbers of groups in modern periodic table are ……..  
(A) Seven  (B) Eight  (C) Ten  (D) Eleven

(20) The numbers of valence electrons of group-III elements are ……..  
(A) 3  (B) 6  (C) 9  (D) 12

(21) All s and p-block elements are called ……..  
(A) Transition elements  (B) Representative elements  (C) Lanthanide  (D) Actinide

(22) Modern periodic law is based on the concept of atomic number introduced by……..  
(A) Lothar Meyer  (B) Mendeleev  (C) Newland  (D) Mosley

(23) The numbers of valence electrons of group-IV elements are ……..  
(A) 4  (B) 6  (C) 8  (D) 10

(24) Molecules with partial charges on atoms are called …..  
(A) Non-polar  (B) Polar  (C) Metallic  (D) Ionic

(25) J.W Dobcreiner classified chemically similar elements in group of three on the bases of their..  
(A) Atomic densities  (B) Atomic number  (C) Atomic masses  (D) Atomic volumes
(26) The first attempt to classify the elements was made by………
   (A) Dobereiner  (B) Mosley  (C) Newlands  (D) Mendeleev

(27) According to the law of triad, the atomic mass of the middle elements is approximately to the arithmetic mean of atomic masses of ……
   (A) 1st and 3rd  (B) 1st and 2nd  (C) 2nd and 3rd  (D) None of them

(28) Law of octaves was presented by………..
   (A) Lothar Meyer  (B) Mosley  (C) Dobereiner  (D) Newlands

(29) According to Mendeleev, all the properties of the elements depend on their ……..
   (A) Atomic masses  (B) Atomic radii  (C) Atomic number  (D) Atomic volumes

(30) Another name for group-1 is ………
   (A) Noble gases  (B) Halogen  (C) Alkaline earth  (D) Alkali metals

(31) The horizontal rows of elements in the periodic are called……..
   (A) Periods  (B) Groups  (C) Classes  (D) None of them

(32) H₂O₂ is an example of ……
   (A) Monoatomic molecules  (B) Diatomic molecules  (C) Triatomic molecules  (D) Tetra-atomic molecules

(33) Chlorine is member of ……
   (A) Boron family  (B) Halogen family  (C) Zero group  (D) Oxygen family

(34) Numbers of carbon isotopes exist in nature are ……..
   (A) 2  (B) 3  (C) 4  (D) 5

(35) Iodine-131 is used for the treatment of ……
   (A) Goiter  (B) Beriberi  (C) Hemophilia  (D) None of them

(36) The half-life of carbon – 14 is ……..
   (A) 37000 years  (B) 47000 years  (C) 57000 years  (D) 67000 years

(37) The most abundant isotope of hydrogen is …………..
   (A) Tritium  (B) Deuterium  (C) Protium  (D) All of them

(38) The source of alpha particle used in Rutherford experiment is ……..
   (A) Barium  (B) Gallium  (C) Radium  (D) Indium

(39) Rutherford used zinc sulphide plate as α-particles………..
   (A) Detector  (B) Emitter  (C) Absorber  (D) None of them
(40) Each alpha particle has a mass equal to …….
   (A) 2a. m. u    (B) 4a. m. u    (C) 6a. m. u    (D) 8a. m. u

(41) Isotopes of an element exhibit similar chemical properties because of same …….
   (A) Atomic number    (B) Mass number    (C) Number of neutrons    (D) all of them

(42) Electron can reside ……….
   (A) Between the orbits    (B) In the orbit    (C) Above the orbit    (D) Below the orbit

(43) S is one of the orbitals which stand for ……….
   (A) Specific    (B) Special    (C) Shrill    (D) Sharp

(44) Only a few high energy α-particles bounced back after striking the metal foil in Rutherford experiment due to presence of ……….
   (A) Electron    (B) Neutron    (C) Nucleus    (D) All of them

(45) Duplet rule applies to ……….
   (A) Na    (B) Cl    (C) H    (D) Ne

(46) Co-60 is used for treatment of ……….
   (A) Heart attack    (B) Cancer    (C) Aids    (D) Anemia

(47) The ionic reactions is aqueous solutions are ……….
   (A) Very fast    (B) Fast    (C) Very slow    (D) Slow

(48) Water is a typical polar molecule with a ……….
   (A) V-shape    (B) L-shape    (C) Linear shape    (D) Tetrahedral shape

(49) Dative bond is always ……….
   (A) Ionic    (B) Polar    (C) Non-polar    (D) Metallic

(50) Dipole-dipole forces are about one percent in strength to that of ……….
   (A) Ionic bond    (B) Metallic bond    (C) Covalent bond    (D) Dative bond

(51) The energy of an electron in the same level is ……….
   (A) Increased    (B) Decreased    (C) Fixed    (D) None of them

(52) The valence electrons in metals are……..
   (A) Shared between atoms    (B) Transferred between atoms    (C) Pooled between atoms    (D) None of them

(53) The bond which never results in compound formation is……..
   (A) Dative bond    (B) Covalent bond    (C) Ionic bond    (D) Metallic bond
(54) Identify that compound which is formed by three types of bonds………
   (A) H₂O   (B) CO₂   (C) NaCl   (D) NH₄Cl
(55) Octet rule always applies to which of the following pairs of elements in compound formation..
   (A) Cl & N   (B) Na & P   (C) CI & Ca   (D) S & H
(56) The tendency of atoms to attain two electrons in their outer most shell by gaining, losing or sharing of electrons is known as………
   (A) Octet rule   (B) Triplet rule   (C) Duplet rule   (D) None of them
(57) Hydrogen bonding is shown by …………
   (A) Bar   (B) Arrow   (C) Dotted line   (D) Curved line
(58) The bond formed by sharing of electrons between dissimilar atoms is called …………
   (A) Ionic bond   (B) Polar covalent bond   (C) Non-polar covalent bond   (D) Co-ordinate covalent bond
(59) Metals conduct heat and electricity because of the presence of …………
   (A) Free electrons   (B) Fixed electrons   (C) Free protons   (D) Fixed protons
(60) The force of attraction between the positive ions and mobile sea of electrons is called …………
   (A) Ionic bond   (B) Polar bond   (C) Metallic bond   (D) Covalent bond
(61) All of the following are Wander Wall’s forces except………
   (A) Dipole dipole forces   (B) H-bonding   (C) Covalent bond   (D) Dispersion forces
(62) The geometrical shape of NH₃ is………
   (A) Pyramidal   (B) Tetrahedral   (C) Triangular   (D) Linear
(63) The pair of compounds ionizes completely in water is………
   (A) NH₃ & HCl   (B) CH₃OOH & K₂CO₃   (C) NaBr & CO₂   (D) NaCl & HCL
(64) The bond in hydrogen molecules is………
   (A) Single Covalent bond   (B) Double covalent bond   (C) Triple Covalent bond   (D) Ionic bond
(65) The bond in oxygen molecule is …………
   (A) Single Covalent bond   (B) Double covalent bond   (C) Triple Covalent bond   (D) Ionic bond
(66) H₂O is a good example of …………
   (A) Ionic bond   (B) Pure Covalent bond   (C) Polar Covalent bond   (D) None of them
(67) The number of electrons in the valence shall of Chloride ion (Cl⁻) is …………
   (A) 8   (B) 7   (C) 2   (D) 1
(68) The bond in the table salt is………
   (A) Covalent bond   (B) Ionic bond
   (C) Co-ordinate covalent bond   (D) Polar covalent bond

(69) The smallest particle of compound that exits independently is called ………
   (A) Molecule   (B) Atom   (C) Trivalent   (D) Monovalent

(70) AlCl₃ is an example of ………
   (A) Metallic bond   (B) Covalent bond   (C) Ionic bond   (D) Co-ordinate Covalent bond

(71) All are correct about ionic compounds except…..
   (A) They conduct electricity in all states   (B) They are soluble in polar compound
   (C) They do not form molecules   (D) They have high density in sold crystals

(72) Cat-ion formation by the atoms results in ………
   (A) Increase in size
   (B) Decrease in size
   (C) Decrease in number of electrons
   (D) Increase in number of electrons

(73) The isotope of oxygen forms ozone (O₃) is ………
   (A) $^{16}_{8}$O   (B) $^{17}_{8}$O   (C) $^{18}_{8}$O   (D) $^{19}_{8}$O

(74) The force which holds atoms together in molecules or crystal is………
   (A) Chemical bond   (B) Covalent bond   (C) Ionic bond   (D) Co-ordinate covalent bond

(75) The number of valence electrons in an element determines it’s ………
   (A) Stability   (B) Reactivity   (C) Conductivity   (D) All of them

(76) Electrostatic attractive force which holds together the oppositely charged species is called ………
   (A) Covalent bond   (B) Ionic bond   (C) Dative bond   (D) All of them

(77) The bond formed by sharing of electrons is ………
   (A) Ionic bond   (B) Metallic bond   (C) Covalent bond   (D) Co-ordinate Covalent bond

(78) The gases like oxygen, nitrogen, are the result of ………
   (A) Metallic bond   (B) Covalent bond   (C) Ionic bond   (D) Co-ordinate Covalent bond
(79) The nature of Ca atom in the formation of CaCl₂ is ……..
   (A) Tetravalent  (B) Divalent  (C) Trivalent  (D) Monovalent
(80) Isotopes have different number of ……..
   (A) Electrons  (B) Protons  (C) Neutrons  (D) None of them
(81) Which one of following particles take part in the chemical reaction…..
   (A) Proton  (B) Electron  (C) Neutron  (D) All of them
(82) The formula to find out maximum number of electrons in a particular orbit is ……..
   (A) n²  (B) 2n  (C) 2n²  (D) None of them
(83) When principle Q.No = 4 the maximum electrons in this shell will be……..
   (A) 8  (B) 18  (C) 26  (D) 32
(84) The shape of p-orbital is………
   (A) Sphere  (B) Square  (C) Dumbbell  (D) Oval
(85) When an electron revolves in an orbit, it angular momentum (mvr) is equal to ……..
   (A) \( n\left(\frac{h}{2\pi}\right) \)  (B) \( n\left(\frac{2\pi}{h}\right) \)  (C) \( n\left(\frac{2h}{\pi}\right) \)  (D) \( \pi\left(\frac{h}{2n}\right) \)
(86) The correct statement to find the number of neutrons in an atom is ……
   (A) A = Z – N  (B) A = N – Z  (C) A = Z + N  (D) None of them
(87) \(^{92}\text{U}_{234}, ^{92}\text{U}_{235}, ^{92}\text{U}_{238}\) are …………
   (A) Isobars  (B) Isomers  (C) Isotopes  (D) Allotropes
(88) The heaviest one among the following is …….
   (A) Proton  (B) Electron  (C) Hydrogen atom  (D) Alpha particle
(89) Rutherford observed that most of the \( \alpha \)-particles passed through the foil un-deflected due presence of ……..
   (A) Nucleus  (B) Empty Space  (C) Protons  (D) Neutrons
(90) The correct equation for energy change of electron on going from one orbit to another is
   (A) \( E_2 + E_1 = hv \)  (B) \( E_2 - E_1 = hv \)  (C) \( E_2/E_1 = hv \)  (D) \( E_2 \times E_1 = hv \)
(91) Na atom has………
   (A) 11 Electrons  (B) 11 Protons  (C) 12 Neutrons  (D) All of them
(92) Mass number of an atom is = ………
(A) Protons + Electrons (B) Protons + Electrons (C) Electrons + Neutrons (D) Number of Neutrons

(93) Atomic number of an atom = ………
(A) Protons + Electrons (B) Protons + Electrons (C) Electrons + Neutrons (D) Number of Neutrons

(94) The first formal atomic theory was presented by……..
(A) Democritus (B) Neil Bohr (C) Rutherford (D) John Dalton

(95) The postulate “Matter is composed of small indivisible particles called” was proposed by….
(A) Muslims (B) Romans (C) Greeks (D) Egyptians

(96) Rutherford bombarded a gold foil by…….
(A) Alpha particles (B) Beta particles (C) Gamma particles (D) Helium atoms

(97) Alpha particles are ………
(A) Negatively Charged (B) Neutral (C) Double Positively Charged (D) Protons

(98) The L-shell can accommodate maximum number of electrons………
(A) 2 (B) 8 (C) 12 (D) 18

(99) Electron in its stable or ground state does not…..
(A) Emit energy (B) Revolve (C) Spin (D) Reside in its orbit

(100) The number of sub shells in third orbit is ………
(A) 2 (B) 3 (C) 4 (D) 5
MULTIPLE CHOICE QUESTIONS TEST

Atomic Structure, Periodic Table & Structure of Molecules

Q.1) Choose the correct option from the given choices (i.e. A, B, C, D) and insert into the relevant box.

(1) The first formal atomic theory was presented by………
   (A) Democritus   (B) Neil Bohr   (C) Rutherford   (D) John Dalton

(2) The postulate “Matter is composed of small indivisible particles called” was proposed by…
   (A) Muslims   (B) Romans   (C) Greeks   (D) Egyptians

(3) Rutherford bombarded a gold foil by………
   (A) Alpha particles   (B) Beta particles   (C) Gamma particles   (D) Helium atoms

(4) Alpha particles are ………
   (A) Negatively Charged   (B) Neutral   (C) Double Positively Charged   (D) Protons

(5) The L-shell can accommodate maximum number of electrons………
   (A) 2   (B) 8   (C) 12   (D) 18

(6) Electron in its stable or ground state does not…..
   (A) Emit energy   (B) Revolve   (C) Spin   (D) Reside in its orbit

(7) The number of sub shells in third orbit is ………
   (A) 2   (B) 3   (C) 4   (D) 5

(8) $^{92}\text{U}_{234}$, $^{92}\text{U}_{235}$, $^{92}\text{U}_{238}$ are ………
   (A) Isobars   (B) Isomers   (C) Isotopes   (D) Allotropes

(9) The heaviest one among the following is ……
   (A) Proton   (B) Electron   (C) Hydrogen atom   (D) Alpha particle

(10) Rutherford observed that most of the α-particles passed through the foil un-deflected due presence of ………
    (A) Nucleus   (B) Empty Space   (C) Protons   (D) Neutrons

(11) The correct equation for energy change of electron on going from one orbit to another is
    (A) $E_2 + E_1 = hv$   (B) $E_2 - E_1 = hv$   (C) $E_2/E_1 = hv$   (D) $E_2 \times E_1 = hv$

(12) Na atom has………
    (A) 11 Electrons   (B) 11 Protons   (C) 12 Neutrons   (D) All of them

(13) Mass number of an atom is = ………
    (A) Protons + Electrons   (B) Protons + Neutrons   (C) Electrons + Neutrons   (D) Number of Neutrons

(14) Atomic number of ant atom = ………
(A) Protons + (B) Protons + (C) Electrons + (D) Number of
Electrons Electrons Neutrons Neutrons

(15) Isotopes have different number of ……
(A) Electrons (B) Protons (C) Neutrons (D) None of them

(16) Which one of following particles take part in the chemical reaction……
(A) Proton (B) Electron (C) Neutron (D) All of them

(17) The formula to find out maximum number of electrons in a particular orbit is ……
(A) n² (B) 2n (C) 2n² (D) None of them

(18) When principle Q.No = 4 the maximum electrons in this shell will be……
(A) 8 (B) 18 (C) 26 (D) 32

(19) The shape of p-orbital is……
(A) Sphere (B) Square (C) Dumbbell (D) Oval

(20) When an electron revolves in an orbit, it angular momentum (mvr) is equal to
………. 
(A) \(\frac{nh}{2\pi}\) (B) \(\frac{2\pi}{h}\) (C) \(\frac{2h}{\pi}\) (D) \(\frac{\pi}{2n}\)

(21) The correct statement to find the number of neutrons in an atom is ……
(A) A = Z – N (B) A = N – Z (C) A = Z + N (D) None of them

(22) The isotope of oxygen forms ozone (O₃) is……
(A) \(^{16}\)O (B) \(^{17}\)O (C) \(^{18}\)O (D) \(^{19}\)O

(23) The number of valence electrons in an element determines it’s ……
(A) Stability (B) Reactivity (C) Conductivity (D) All of them

(24) Electrostatic attractive force which holds together the oppositely charged species is
called……
(A) Covalent bond (B) Ionic bond (C) Dative bond (D) All of them

(25) The bond formed by sharing of electrons is ……
(A) Ionic bond (B) Metallic bond (C) Covalent bond (D) Co-ordinate Covalent bond

(26) The gases like oxygen, nitrogen, are the result of ……
(A) Metallic bond (B) Covalent bond (C) Ionic bond (D) Co-ordinate Covalent bond

(27) The nature of Ca atom in the formation of CaCl₂ is ……
(A) Tetravalent (B) Divalent (C) Trivalent (D) Monovalent

(28) The smallest particle of compound that exits independently is called ……..
(A) Molecule (B) Atom (C) Trivalent (D) Monovalent

(29) AlCl₃ is an example of ……..
(A) Metallic bond (B) Covalent bond (C) Ionic bond (D) Co-ordinate Covalent bond

(30) All are correct about ionic compounds except…..
(A) They conduct electricity in all states
(B) They are soluble in polar compound
(C) They do not form molecules
(D) They have high density in solid crystals

(32) Cat-ion formation by the atoms results in ........
(A) Increase in size
(B) Decrease in size
(C) Decrease in number of electrons
(D) Increase in number of electrons

(33) The bond in hydrogen molecules is........
(A) Single Covalent bond
(B) Double covalent bond
(C) Triple Covalent bond
(D) Ionic bond

(34) The bond in oxygen molecule is ........
(A) Single Covalent bond
(B) Double covalent bond
(C) Triple Covalent bond
(D) Ionic bond

(35) H₂O is a good example of ........
(A) Ionic bond
(B) Pure Covalent bond
(C) Polar Covalent bond
(D) None of them

(36) The number of electrons in the valence shall of Chloride ion (Cl⁻) is .......
(A) 8
(B) 7
(C) 2
(D) 1

(37) The bond in the table salt is........
(A) Covalent bond
(B) Ionic bond
(C) Co-ordinate covalent bond
(D) Polar covalent bond

(38) The bond formed by sharing of electrons between dissimilar atoms is called ........
(A) Ionic bond
(B) Polar covalent bond
(C) Non-polar covalent bond
(D) Co-ordinate covalent bond

(39) Metals conduct heat and electricity because of the presence of ........
(A) Free electrons
(B) Fixed electrons
(C) Free protons
(D) Fixed protons

(40) The force of attraction between the positive ions and mobile sea of electrons is called ...
(A) Ionic bond
(B) Polar bond
(C) Metallic bond
(D) Covalent bond

(41) All of the following are Wander Wall’s forces except........
(A) Dipole dipole forces
(B) H-bonding
(C) Covalent bond
(D) Dispersion forces

(42) The geometrical shape of NH₃ is........
(A) Pyramidal
(B) Tetrahedral
(C) Triangular
(D) Linear

(43) The pair of compounds ionizes completely in water is........
(A) NH₃ & HCl
(B) CH₃OOH & K₂CO₃
(C) NaBr & CO₂
(D) NaCl & HCl

(44) The valence electrons in metals are........
(A) Shared between atoms
(B) Transferred between atoms
(C) Pooled between atoms
(D) None of them

(45) The bond which never results in compound formation is........
(A) Dative bond
(B) Covalent bond
(C) Ionic bond
(D) Metallic bond

(46) Identify that compound which is formed by three types of bonds........
(A) H₂O
(B) CO₂
(C) NaCl
(D) NH₄Cl

(47) Octet rule always applies to which of the following pairs of elements in compound
formation..
(A) CI & N  (B) Na & P  (C) CI & Ca  (D) S & H

(48) The tendency of atoms to attains two electrons in their outer most shell by gaining, losing or sharing of electrons is known as………
(A) Octet rule  (B) Triplet rule  (C) Duplet rule  (D) None of them

(49) Hydrogen bonding is shown by ………
(A) Bar  (B) Arrow  (C) Dotted line  (D) Curved line

(50) The ionic reactions is aqueous solutions are ………
(A) Very fast  (B) Fast  (C) Very slow  (D) Slow

(51) Water is a typical polar molecule with a ………
(A) V-shape  (B) L-shape  (C) Linear shape  (D) Tetrahedral shape

(52) Dative bond is always ………
(A) Ionic  (B) Polar  (C) Non-polar  (D) Metallic

(53) Dipole-dipole forces are about one percent in strength to that of ………
(A) Ionic bond  (B) Metallic bond  (C) Covalent bond  (D) Dative bond

(54) The energy of an electron in the same level is ………
(A) Increased  (B) Decreased  (C) Fixed  (D) None of them

(55) Electron can reside………..
(A) Between the orbits  (B) In the orbit  (C) Above the orbit  (D) Below the orbit

(56) S is one of the orbitals which stand for ………
(A) Specific  (B) Special  (C) Shrill  (D) Sharp

(57) Only a few high energy α-particles bounced back after striking the metal foil in Rutherford experiment due to presence of ………
(A) Electron  (B) Neutron  (C) Nucleus  (D) All of theme

(58) Dative rule applies to ………
(A) Na  (B) Cl  (C) H  (D) Ne

(59) Co-60 is used for treatment of ………
(A) Heart attack  (B) Cancer  (C) Aids  (D) Anemia

(60) The most abundant isotope of hydrogen is ………
(A) Tritium  (B) Deuterium  (C) Protium  (D) All of theme

(61) The source of alpha particle used in Rutherford experiment is ………
(A) Barium  (B) Gallium  (C) Radium  (D) Indium

(62) Rutherford used zinc sulphide plate as α-particles………
(A) Detector  (B) Emitter  (C) Absorber  (D) None of theme

(63) Each alpha particle has a equal to……
(A) 2a. m. u  (B) 4a. m. u  (C) 6a. m. u  (D) 8a. m. u

(64) Isotopes of an element exhibit similar chemical properties because of same……
(A) Atomic number  (B) Mass number  (C) Number of neutrons  (D) all of them

(65) H₂O₂ is an example of ………
(A) Monoatomic  (B) Diatomic  (C) Triatomic  (D) Tetra-atomic molecules

(66) Chlorine is member of ………
(A) Boron family (B) Halogen family (C) Zero group (D) Oxygen family

(67) Numbers of carbon isotopes exist in nature are ……. 
(A) 2 (B) 3 (C) 4 (D) 5

(68) Iodine-131 is used for the treatment of ….. 
(A) Goiter (B) Beriberi (C) Hemophilia (D) None of them

(69) The half-life of carbon – 14 is ……. 
(A) 37000 years (B) 47000 years (C) 57000 years (D) 67000 years

(70) Molecules with partial charges on atoms are called ……. 
(A) Non-polar (B) Polar (C) Metallic (D) Ionic

(71) J.W Dobcreiner classified chemically similar elements in group of three on the bases of their.. 
(A) Atomic densities (B) Atomic number (C) Atomic masses (D) Atomic volumes

(72) The firs attempt to classify the elements was made by……. 
(A) Dobereiner (B) Mosley (C) Newlands (D) Mendeleev

(73) According to the law of triad, the atomic mass of the middle elements is approximately to the arithmetic mean of atomic masses of ……
(A) 1st and 3rd (B) 1st and 2nd (C) 2nd and 3rd (D) None of them

(74) Law of octaves was presented by…………
(A) Lothar Meyer (B) Mosley (C) Dobereiner (D) Newlands

(75) According to Mendeleev, all the properties of the elements depend on their ……. 
(A) Atomic masses (B) Atomic radii (C) Atomic number (D) Atomic volumes

(76) Another name for group-1 is ……..
(A) Noble gases (B) Halogen (C) Alkaline earth (D) Alkali metals

(77) The horizontal rows of elements in the periodic are called……. 
(A) Periods (B) Groups (C) Classes (D) None of them

(78) The elements with atomic number 58-71 are called ……..
(A) Actinide (B) Lanthanide (C) Transition (D) Normal

(79) Numbers of groups in modern periodic table are ……..
(A) Seven (B) Eight (C) Ten (D) Eleven

(80) The numbers of valence electrons of group-III elements are ……..
(A) 3 (B) 6 (C) 9 (D) 12

(81) All s and p-block elements are called …….. 
(A) Transition elements (B) Representative elements (C) Lanthanide (D) Actinide

(82) Modern periodic law is based on the concept of atomic number introduced by……. 
(A) Lothar Meyer (B) Mendeleev (C) Newland (D) Mosley

(83) The numbers of valence electrons of group-IV elements are ……..
(A) 4 (B) 6 (C) 8 (D) 10

(84) The elements of group-VIII are ……..
(A) Metal (B) Metalloid (C) Gasses (D) Transition
(85) The longest period in long form periodic table is ….. 

(A) 4<sup>th</sup>  (B) 5<sup>th</sup>  (C) 6<sup>th</sup>  (D) 7<sup>th</sup>  

(86) Atomic size of the atom in a periodic table from left to right….. 

(A) Increases  (B) Decreases  (C) Remains Constant  (D) None of them  

(87) The ionization energy in group from top to bottom……. 

(A) Increases  (B) Decreases  (C) Remains Constant  (D) None of them  

(88) The values of electron affinity in period from left to right …….

(A) Decreases  (B) Remains Constant  (C) Increases  (D) None of them  

(89) Atomic Radii are measured in units of ……. 

(A) Nano meter  (B) Micro meter  (C) Milli meter  (D) Pico meter  

(90) The most electronegative element of the periodic table is……. 

(A) Cl  (B) Br  (C) F  (D) I  

(91) The least electronegative element of the periodic table is …….. 

(A) Cs  (B) Na  (C) K  (D) Ca  

(92) Which of the following is a normal/ representative element ………. 

(A) Cr  (B) Co  (C) Cu  (D) Cl  

(93) Electron affinity is measured in …….. 

(A) KJ/mole  (B) K mole/J  (C) mole / KJ  (D) J/K mole  

(94) The lanthanide and actinide series are called………. 

(A) s-block elements  (B) d-block elements  (C) p-block elements (D) f-block elements  

(95) The numbers of shells of period-IV elements are ……. 

(A) 7  (B) 6  (C) 5  (D) 4  

(96) Which one of following is found in Liquid state at room temperature ……. 

(A) Mg  (B) He  (C) Hg  (D) Fe  

(97) Another name for the period (Lanthanides) is ………. 

(A) Rare Earth  (B) Alkaline Earth  (C) Alkali Metals  (D) All Of Them  

(98) An element has 8 electrons in its valence shell. It is ……. 

(A) Inert gas  (B) Halogen  (C) Coinage metal  (D) Alkali metal  

(99) According to Mendeleev’s periodic law, the physical and chemical properties of elements are the periodic function of their ……. 

(A) Atomic number  (B) Atomic masses  (C) Atomic Radii  (D) Atomic volumes  

(100) Decrease in force of attraction between the valence electrons and nucleus occurs due to……. 

(A) Screening effect  (B) Rays emitting  (C) Light absorbing  (D) All of them  

Appendix – III

STATISTICAL DATA

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