

Effect of Kagan Cooperative Learning Structures on Learning Achievement: An Experimental Study

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Abstract— This study aimed to explore the effect of Kagan cooperative learning structures in enhancing the learning achievement of the Bhutanese students in learning chemistry. This was experimental research, pre-test – post-test control group design. A total of 76 higher secondary students from Daga Central School participated in this research. Samples were obtained through purposive sampling. The participants were divided into two groups namely, control group (n = 38) and experimental group (n = 38). The Experimental group was taught using Kagan cooperative learning structures whereas control group was taught using conventional method (lecture method) for four weeks. Achievement test were administered before and after the intervention. Data were analyzed by computing means, standard deviations and t-test. The results of the study showed statistically significant difference in achievement between groups taught using Kagan cooperative learning structures and those taught via conventional method with moderate effect size ($d = 0.63$), suggesting Kagan cooperative learning structures as effective pedagogical approach in learning chemistry in Bhutanese higher secondary schools.

Keywords—learning achievement, chemistry, Kagan cooperative learning structures, Bhutan, middle secondary school

I. Introduction

Over the last one and a half decades, there has been growing concern on quality of education in Bhutan. The study conducted by Royal Education Council revealed that for both basic and advance academic skills students are performing below expectations of their grade level (REC, 2010, as cited in Rabgay, 2018). Additionally, it is also found that students lack basic analytical and communication skills. Similarly, in the report compiled by Bhutan Council for School Examination and Assessment [BCSEA] (2019) of the PISA for Development (PISA-D), it was found that Bhutanese's students have higher success rates in items requiring lower cognitive skills, while there

was significant gap in the performance in more demanding tasks such as, analytical and logical reasoning.

One of the major reasons for the low level of learning is ineffective teaching (REC, 2009). The classroom teaching is mostly one-way communication dominated by teacher (REC, 2009), teachers take the role of a sage on the stage; students were found to be passive learners, relying on teachers to decide what, when and how to learn (Dorji, 2005). Likewise, teaching is largely syllabus oriented and teacher centred (Utha et al, 2016). Inadequate and orthodox pedagogy are plausible reasons for learners being not able to learn meaningfully. The opportunity to communicate among students themselves and with the teacher is limited in teacher centred learning, which sabotages student's communication skills and overall learning. To enhance the communication and overall learning, over the decades cooperative learning has been established as a promising strategy in classroom pedagogy (Johnson & Johnson, 1999; Dotson, 2001; Kagan & Kagan, 2009; Farmer, 2017).

There are various types of cooperative learning strategies practiced over the decades. Kagan Cooperative learning structures (KCLS) are one of many cooperative learning strategies which shares similar root with other cooperative learning principles. KCLS are the structures developed for the effective pedagogy for 21st century by Dr. Spencer Kagan, a renowned author and a professor of psychology and education. KCLS model asserts that cooperativeness of a child is determined by the way in which they are placed, therefore the cooperative structures are necessary and critical part in engaging them (Kagan & Kagan, 2009). The development of the structures is rooted in situationism, a powerful approach to social psychology. If students in small groups discuss a topic with no interaction rules, in an unstructured way, often one or two students dominates the discussion. However, this limitation is mitigated by use of KCLS; equal participation is ensured in structured interaction (Kagan & Kagan, 2009). In attempt to enhance the effectiveness of classroom teaching in Bhutan, Ministry of Education facilitated nationwide workshop on 21st century pedagogy (KCLS) (Wangdi, 2016). However, owing to quiet and introvert behaviour of Bhutanese students, the applicability of the cooperative learning such as KCLS which requires overt communication and participation was questionable. Moreover, KCLS seemed to provide flexibility in generating various opinions, this nature favours teaching of interpretation-based subjects such as English more than facts oriented hardcore subject such as chemistry. Furthermore, the teacher to student ratio was a concern, as there are not less than 30 students in a typical Bhutanese classroom.

In addition, as use of KCLS emphasizes on providing more opportunity to interact, the likelihood of compromising the coverage of the syllabus was another concern as Bhutanese curriculum has substantial syllabus to be covered. For those sceptical reasons, KCLS are rarely used in learning science-oriented subjects in Bhutan. Moreover, there is no published paper ascertaining the effectiveness of KCLS in learning chemistry in Bhutanese classroom situation in the public domain. Thus, this study aimed to address this gap. The study addresses this gap by properly exploring the working mechanism of the KCLS and its theoretical underpinning through comprehensive literature review. Additionally, the study also provided statistical evidence of positive impact of KCLS on learning achievement of students in chemistry.

Research Objective(S)

To assess the learning achievement of grade IX students using KCLS in classroom teaching.

Research Question(S)

What is the effect of KCLS on grade IX student's learning achievement in chemistry?

II. Literature Review

This section presents the review of literature which includes the definition of the KCLS, principles of KCLS, theories underlying KCLS and the effects of KCLS.

A. Kagan cooperative learning structures

The KCLS is the structural approach to cooperative learning. Structures redefines teaching, as structures maximize student's interaction with each other and engagement with academic content (Davoudi & Mahinpo, 2012; Kagan & Kagan, 2009). Kagan and Kagan (2009) assert that KCLS serves three main purposes:

- (i) Organizes Classroom Instructions: a structure is an instructional strategy that describes how the teachers and students interact with the curriculum.
- (ii) Is Content-free and Repeatable: Structures are used to explore the curriculum, but are not tied to any specific curriculum. They can be used repeatedly with different curriculum, creating new learning experiences.
- (iii) Implements the Basic Principles of Cooperative Learning: Cooperative Learning Structures have basic principles of cooperative learning built in. The inclusion of the basic principles of cooperative learning is what makes cooperative learning truly effective.

The KCLS were born of cooperative learning theory and research. However, their approaches differ; traditional forms of cooperative learning use cooperative lessons whereas KCLS uses structures. Structure based approach are superior to lesson-based approach is time consuming (both planning and executing) and laborious (Kagan & Kagan, 2009).

B. Principles of Kagan Cooperative Learning Structures

According to Kagan and Kagan (2009), KCLS are based on four major principles abbreviated as PIES:

1. Positive interdependence (p): Positive interdependence connotes to two distinct conditions that promotes cooperation: (1) a positive correlation of outcomes, and (2) interdependence. Positive correlation refers to positive correlation among outcomes, when the gain of one is benefit for other in a team, either they swim or drown together, this encourages teamwork and assures cooperation within a team. To ensure positive interdependence, teacher should ask the central question, “Do students feel they are on the same side?” (Kagan & Kagan, 2009, p.12.4). Second condition is positive interdependence. The word interdependence refers to how the task is structured. If a task is structured so that no individual can do it alone; but can be done by working together, then there is interdependence. The objective of interdependence can be fulfilled by asking a question, “Does the task require working together?” (Kagan & Kagan, 2009, p.12.4).

2. Individual Accountability (i): Individual accountability connotes to how individual takes ownership of learning in achieving a collective goal. Kagan and Kagan (2009) outlines three necessary components to ensure individual accountability: individual, public and requirement. Firstly, unit of learning is individual not the team in the classroom; teams projects and products are not benchmark for individual achievement. Therefore, individual should engage and take active participation in given task. Secondly, accountability is reinforced by public performance. Individuals tends to put concerted effort when they are made to display their knowledge publicly. Thirdly, individual contribution should be made compulsory not voluntary; assuring that the individual public performance is required. The individual accountability can be addressed by asking central question, “Is individual, public performance required?” (Kagan & Kagan, 2009, p.12.9).

3. Equal Participation (e): The KCLS optimizes equal participation (Hinson, 2015; Kagan & Kagan, 2009). Participation is vital in learning process. Students learn by interacting with the

content and with fellow students. For equitable educational outcomes, we need participation to be relatively equal. Linked between participation and achievement is observed (Kagan & Kagan, 2009). It is observed that Participation has benefits for those who need and receive help, as well as for those who offer help. Equal participation is optimized in KCLS by Turn Taking (Kagan & Kagan, 2009). Turn allocation is effective way to equalize participation. With turn allocation, everyone gets a turn. In the traditional whole-class structure, turn allocation is too time-consuming and impractical to use. With cooperative learning structures, turn allocation is relatively easy. The equal participation can be achieved by asking key question, “Is participation approximately equal?” (Kagan & Kagan, 2009, p.12.16).

4. Simultaneous Interaction (s): Active engagement increases student learning (Kagan, 1994). Simultaneous interaction is the powerful tool to enhance active engagement. Simultaneous interaction actively engages a high percent of students at once. KCLS transforms the initiation, response, evaluation (IRE) pattern of interaction into an initiation, interaction (II) pattern. The overt interaction produces better academic achievement, compare to learning time and time spent on task (Hinson, 2015; Kagan & Kagan, 2009). In KCLS the simultaneity is created by Teams and Pairs, simultaneous interaction is achieved by breaking down the traditional whole-class unit into smaller learning teams and pairs. Without teams or pairs, learning is necessarily either whole class or independent. When there is teams and pairs, it makes learning simultaneous because interaction is occurring simultaneously in each group. The simultaneous interaction can be addressed by asking key question, “What percent of students are overtly interacting at once?” (Kagan & Kagan, 2009, p.12.21).

C. Theoretical Underpinning

The KCLS have its root from theories such as: social interdependency theory, social learning theory, cognitive and constructive theories. The relation with the aforementioned theories and KCLS is outlined in succeeding paragraphs.

1. Social interdependence theory: The social interdependence exists when individuals share common goals and each individual’s outcomes are affected by the actions of the others (Deutsch, 1949; Johnson, 2003). In KCLS individuals are made to work in pair or in team. Thus, the success of the individuals depends on the success of the pair or team mates. Possibly there can be three kinds of social interdependence: positive, negative and none. Positive social interdependence occurs when

individuals work cooperatively to attain their shared goals, and it may be negative when individuals compete to claim who attained the goals. There is no interdependence when there is no correlation among individuals' goal achievements. Thus, in this theory, how goals are structured determines how individuals interact, and interaction patterns determines outcome. Positive interdependence may result in promotive interaction, negative interdependence may result in oppositional interaction, and no interdependence may result in no interaction (Johnson, 2003).

2. Social learning theory: Social learning theory applies when individuals learn from their peers, either from their pair partner or teammates as it is organized in KCLS classroom. Much of the learning is said to occur by observing, modelling and imitating models (Bandura, 1977; 1986), This theory emphasizes that understanding personality through observing others' behaviours, attitudes and reactions can influence one's learning. Thus, according to social learning theory, most learning takes place in a social environment, in which learners obtain knowledge, rules, skills, strategies, beliefs, and attitudes by observing others (Tran, 2013). Therefore, social behaviour and the actions of effective students in the cooperative learning groups are to be modelled and adopted by other students (Tran, 2013).

3. Cognitive perspectives: Cognitive development perspective is relatable with KCLS, as the individual learn in pairs and teams, their interaction enhances their cognitive development by promoting their zone of proximal development (ZPD) by assisting each other. Vygotsky defines the ZPD as: "The distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p.86). Vygotsky emphasizes the importance of cooperative activities and argues that the development of children is promoted by cooperative activities. In his view, cooperative activities among children promotes growth because children of the same age work in one another's ZPD and model behaviours, which is more effective than children working individually (Tran, 2013).

4. Constructive learning theory: Constructive learning theory is relatable to KCLS as students in KCLS are encouraged to play the role of active constructor of knowledge. Students learn more when they are in control of constructing their own meaningful knowledge through reciprocal interaction among students (in pairs or teams) on interactive learning tasks. Since cooperative learning (KCLS) is a student-centred learning method; therefore, it ties outcomes with the

constructivist learning theory in which “learners are in control of constructing their own meaning in an active way” (Almala, 2005, p.10).

D. Effects of Kagan Cooperative learning structures

Majority of the studies of cooperative learning in general showed improvement in both interpersonal relationships and achievement of students. In 67 separate studies conducted to investigate achievement effects of cooperative learning, 61% affirms cooperative as more effective than traditionally taught control group. Positive effects were found in all grade levels irrespective of subjects (major subjects), school location (urban, rural and suburban), and nature of students (high, average and low achiever) (Slavin, 1991).

With regard to Kagan Cooperative learning structures, several studies showed positive engagement and achievement gains. In the field of language education: Fanolong et al. (2016) and Sabbah (2016) found Kagan Cooperative learning structures effective in improving students reading ability. Fanolong et al. (2016) found that Numbered Heads Together (NHT) structure was successful in improving students’ reading ability as an increment in students’ mean reading scores has increased from 65% in the first test to 80.3% in the second test. Similarly, Sabbah (2016) used a quasi-experimental research design to investigate the effect of using jigsaw cooperative strategy (KCLS) on ESL students’ achievement in reading comprehension. The statistical analysis of the acquired data showed a positive effect of jigsaw strategy on ESL students’ reading achievement. Furthermore, Singay (2020), reported significant improvement in oral communication of Bhutanese students after use of Kagan Cooperatives learning model.

In the field of math and reading: Winter (2013), Heusman and Moenich (2003) found KCLS to be effective in improving math and reading ability. Winter (2013) in his study found that before use of KCLS only 52% and 49% of students passed whereas after use of Kagan Structures 75% and 71% passed math and reading respectively in AIMS (Arizona’s Instrument to Measure Standard Scores). Similarly, study by Heusman and Moenich (2003) also found that math and reading scores increased over the years with use of Kagan Cooperative learning Structures. Moreover, Farmer (2017), tested the effectiveness of Kagan structures in learning math and it was found that the students test gains on three different tests ranging from 10.85% to 32.03% with an average gain of all three tests of 21.20%. He also asserts that more engaged the students are more gain was there in their result, which was facilitated by KCLS.

In the field of science: Burkich (2006) affirmed that the test score in science increased from 82.29% to 97.65 % with use of KCLS over span of two years. Furthermore, in chemistry subject, Mele and Kagan (2001) in their study titled “Kagan Cooperative learning creates explosive result in High School Chemistry” reported increased in the grades of chemistry from 75% to 80%. However, Ragusa (2013) did not find consistent increase in the test scores over three years, she found mix results with average scores in some topics increased over the years and some decreased over the years with minimal percentage of increase and decrease. She used four KCLS namely: RoundRobin, RallyCoach, quiz-quiz-trade, and Timed-pair-share, she observed that KCLS increases the student’s engagement and their attitudes towards learning chemistry.

Statement Of Hypothesis

Previous studies which investigated the effects of KCLS in science (Buekich, 2006; Mele & Kagan, 2001) in improving the learning achievement of students suggest that use of KCLS have positive results. Therefore, based on the assumption stated above, the following hypothesis will be investigated in the present study. The use of KCLS in chemistry lesson will help class IX students to perform better in their learning achievement tests (exams).

III. Methodology

A. Research Design

The study employed pre-test – post-test control group design; involving two groups i.e., control and experimental groups (see Table 1).

Table-1 Pre-test-Post-test Control Group Design

| | | | |
|--------------------|----------------|----------------|----------------|
| Experimental group | O ₁ | X ₁ | O ₂ |
| Control group | O ₃ | X ₂ | O ₄ |

Note: O1: pre-test in the experimental class, O2: post-test in the experimental class, O3: pre-test in the control class, O4: post-test in the control class, X1: KCLS incorporated learning, and X2: Conventional learning (Nursyamsi & Aloysius, 2016, p.51).

B. Sampling

Researcher adopted purposive sampling technique to select 76 grade IX students i.e., two sections. The grade IX students are chosen as sample for the study due to the fact that they are studying chemistry as a separate subject for the first time. If KCLS is effective in teaching students who are inducted to chemistry lesson separately for first time, the result would indicate that it is quite plausible that KCLS will be effective in teaching the other higher grades in the high school. The students were divided into two sections by looking at their previous test scores, making sure that both the sections have equally able students. One section of grade IX students was taught using KCLS (experimental group) and another section (control group) was taught using conventional method (see figure 1).

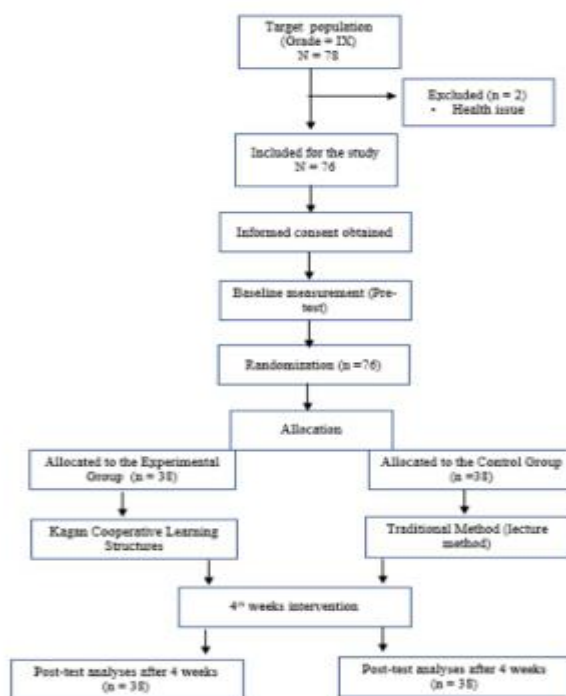


Figure 1 Flow chart showing the experimental design of the study

C. Research Instrument

Achievement test: The pre-test and post-test consisting of 10 true or false and 20 multiple choice questions were O4 developed and administered to compare the achievement level in the experimental and control group before and after the intervention. The pre-test was administered at

the beginning of the study and later was used to compare with the post-tests administered at the end of the intervention.

D. Validity and Reliability of the Research Instrument

The instrument used for this study was validated by three experts who have over five years of experience in teaching science and chemistry particularly for Middle and Higher Secondary Schools in Bhutan. After considering their opinions and suggestions, an index of the Item-Objective Congruence (IOC index) for all the items was determined and found to be more than 0.66 which implied that they were acceptably congruent with the learning objectives and was suitable for the implementation in the study. Moreover, item analysis from the pilot test done with students from one of middle secondary school in Dagana district, showed acceptable difficulty and discrimination index, for both pre test and post-test – difficulty of $p = 0.69$ (for both) were recorded and discrimination of $r = 0.39$ (pre-test) and 0.45 (post-test) were recorded. For the Reliability, Cronbach's alpha of $\alpha = .73$ and $.81$ was recorded for pre-test and post- test respectively.

E. Research Procedures:

After performing satisfactory validity and reliability checks, a pre-test was conducted for both the experimental and control groups. The experimental group students were briefed about the KCLS and their role in operation of those learning structures. In the experimental group as per the recommendation of Kagan and Kagan (2009), heterogeneous groups of four students which contain a low (L), low-medium (LM), medium-high (MH), and high (H) (see Figure 2) ability student in each group was formed based on their unit test performance. The experimental group was taught with the use of KCLS whereas the control group was taught through the conventional method (lecture method). The study used four KCLS namely, RoundTable, RallyTable, RallyRobin, and RoundRobin.

In RoundTable (RoT) incorporated lessons, teacher after teaching the required facts or lesson, asks a question and provides think time and upon teacher's signal students in a group of four takes turns in writing their answers on a piece of paper until the last person in a group completes. Thus, everyone in the group is involved in solving the question in hand. Likewise, in the lesson incorporated with RoundRobin (RoR), only difference is here, they take turn in sharing their answers instead of writing down in the piece of paper. Furthermore, for RallyRobin (RaR) test. Further, in order to understand extent to which KCLS incorporated lessons, teacher asks a question

and provides think time and then upon teacher's signal students in pair was effective in enhancing the learning achievement of students, effect size (Cohen's d) was also computed. either shoulder partner or face partner (see figure 2) as indicated by teacher's instruction, students take turn in sharing their answers to each other. For RallyTable (RaT) incorporated lessons, a pair of students, either face or shoulder partner takes turn in writing their answers in a piece of paper. Whereas conventional method involved mostly lecture method or teacher centred delivery. The treatment was given for four weeks, teaching the topics within the Rate of reaction chapter (refer Table 2). At the end of the intervention, post-tests were conducted for both groups.

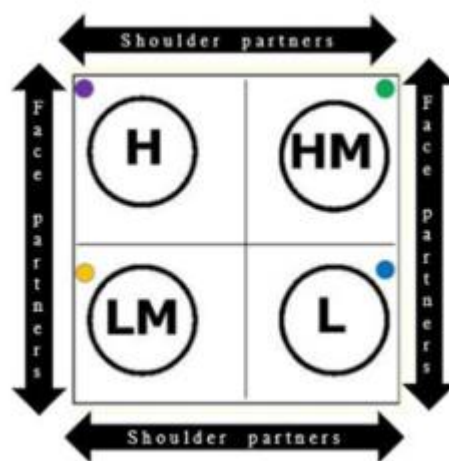


Figure 2 Kagan heterogenous grouping and Kagan management-mat

Table 2 Lesson topics and Kagan cooperative learning structures

| Sl. no. | Topic | Kagan Cooperative Learning Structures |
|---------|--|---------------------------------------|
| 1 | Slow and first reactions | RoT, RoR, RaR and RaT |
| 2 | Collision Theory | RoT, RoR, RaR and RaT |
| 3 | Rate of Chemical Reactions | RoT, RoR, RaR and RaT |
| 4 | Factors affecting the rate of chemical reactions | RoT, RoR, RaR and RaT |
| 5 | Reversible and irreversible chemical reactions | RoT, RoR, RaR and RaT |

F. Data analysis Approach

The data analysis in this study involved the comparison of the means of the two groups using the t-test within subject (Paired Sample t-test) and among subjects (independent test). Further, in order to understand extent to which KCLS , was effective in enhancing the learning achievement of students, effect size (Cohen's d) was also computed.

IV. Result and Discussion

sharing their answers to each other. For RallyTable (RaT) incorporated lessons, a pair of students, either face or shoulder partner takes turn in writing their answers in a piece of paper. Whereas conventional method involved mostly lecture method or teacher centred delivery. The treatment was given for four weeks, teaching the topics within the Rate of reaction chapter (refer Table 2). At the end of the intervention, post-tests were conducted for both groups. For the purpose of comparing students' learning achievement among control and experimental groups, pre test and post-test with the same questions were administered in both the groups at the beginning and end of the study. The questions consisted of 10 true and false question carrying 1 mark each and 20 multiple-choice questions carrying 2 marks each (Full mark = 50). The pre test was administered at the beginning of the study, before any intervention, to assess whether the learning ability and background knowledge of the students in both the groups were similar or not. The post-test was administered in the end to assess the differences in the learning achievement after the intervention. A comparative statistical analysis was done using paired sample t-test within the group (i.e., analysis of pre-test and post-test of both the groups within itself) to determine the difference in the learning achievement within the same group. The comparison of pre-test and post-test scores between the experimental and control group was done by using independent t-test (i.e., analysis of pre-test and post-test between the groups) to find out the difference in the learning achievement of the control and experimental group. The comparisons were done based on mean, standard deviation and inferential statistics t-test with p

A. Comparison of pre-test and post-test result within the group (Paired sample t-test)

Table 3 Comparison of Pre-test and Post-test within the group (Paired sample t test).

| | Control group | | Experimental group | |
|------------------------|------------------------------|-----------|-----------------------------|-----------|
| | Pre-test | Post-test | Pre-test | Post-test |
| Mean | 26.52 | 26.03 | 25.92 | 27.75 |
| SD | 3.34 | 3.18 | 1.26 | 2.24 |
| Mean difference | 26.03 – 26.52 = -0.49 | | 27.75 – 25.92 = 1.83 | |
| Sig. (t-test) | 0.30 | | 0.00 | |

The comparison of pre-test and post-tests within the group was done by comparing the mean, standard deviation and significance level p-value. Table 3 indicates that the mean of the pre-test and the post-test scores of the control group were 26.52 and 26.03 respectively. The mean of the pre test and post-test scores of the experimental group were 25.92 and 27.75 respectively. The mean difference of pre-test and post-test of the control group was – 0.49 and the mean difference of pre-test and post-test of the experimental group was 1.83 resulting to the significance value (p) 0.30 in control group and 0.00 in experimental group respectively, which indicated there was a statistically significant increase in the students’ scores in the post-test in experimental group only.

Table 4 Comparison of pre-tests and post-tests between the groups

| | Pre-test | | Post-test | |
|------------------------|-----------------------------|--------------|-----------------------------|--------------|
| | Control | Experimental | Control | Experimental |
| Mean | 26.52 | 25.92 | 26.03 | 27.75 |
| SD | 3.34 | 1.26 | 3.18 | 2.24 |
| Mean difference | 25.92 – 26.52 = -0.6 | | 27.73 – 26.03 = 1.72 | |
| Sig. (t-test) | 0.30 | | 0.00 | |

Significance level: > 0.05 – not significant, <0.05 – significant

B. Comparison of pre-tests and post-tests result between the groups (Independent sample t-test).

Table 4 illustrates the means and the standard deviations of pre-tests and post-tests of both control and experimental groups. The mean difference of pre-tests of the control and experimental groups was -0.6 indicating that the mean score of the experimental group was slightly lower than the

control group. Thus, due to smaller difference (-0.6) of mean scores between the groups the calculated significance value (p) was 0.30, which was greater than significant value $p < 0.05$. This indicated that there was no significant difference in the pre-test scores between the groups. Hence, it can be concluded that the students in both the groups had homogenous learning ability prior to the treatment. The result adheres to the requirement of equal or similar leaning ability in both groups at the beginning of the study.

The mean difference of the post-tests between the control and experimental group was 1.72. The significance value (p) of the post-tests was 0.00, which was lower than the significant value p

The mean difference of the post-tests between the control and experimental group was 1.72. The significance value (p) of the post-tests was 0.00, which was lower than the significant value $p < 0.05$. This indicated there was statistically significant difference in the post-test scores between control and experimental group. The result showed that the students in the experimental group had significantly higher scores than the students in the control group. The result was as anticipated by the researcher - a better performance from the students who were taught using KCLS than the students who were taught using the conventional method.

Figure 3, illustrates the comparison of the scores of the pre-test and the post-test of the control and experimental group. In the control group, lollipop plot is scattered (high standard deviation for both pre-test (SD = 3.34) and post test (SD = 3.18) whereas in experimental group it is concentrated towards the mean (low standard deviation for both pre-test (SD = 1.26) and post-test (SD = 2.24) (see Figure 3). In the control group, scores of the students in post-test was not higher than the pre-test as indicated by the irregular position of black and red dot in the Figure 3. Whereas in the experimental group, majority of scores of the students in pre-test was higher than the pre-test as indicated by the occurrence of red dot towards right hand side. Likewise, the length of the stick indicates the gain in learning achievement of individual students. Generally, the lollipop plot in experimental group has longer length of stick compare to the control group indicating that the students in experimental group had more learning achievement as oppose to control group. This indicated that the use of intervention (use of KCLS) was effective in enhancing the learning achievement of students in chemistry (see Figure 3)

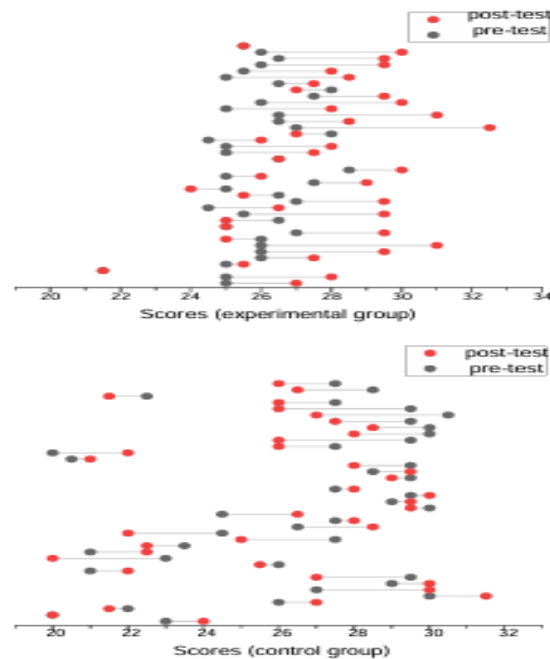


Figure 3 Comparison of pre-test and post-test scores (lollipop plot)

Furthermore, the statistical significance of the study was further validated by testing the effect size. The p-value indicated that the intervention worked. However, it doesn't convey how well it worked, therefore reporting effect size is important as it conveys how well it worked (Mcleod, 2019). The study recorded moderate (see the Table 5 for criteria of interpretation) effect size ($d = 0.63$). This indicated that the difference in the mean of control and experimental groups were medium and the intervention (use of KCLS) was effective in producing the change in the than 69% of the control group test scores was below the experimental group test scores (see Table 5). This indicated that Kagan cooperative learning structures was moderately effective in enhancing the achievement scores of students.

Examination of this result demonstrated that the integration of KCLS in teaching was better than the conventional approach. The finding of this study was similar to the finding of Heusman and Moenich (2003), Burkich (2006), Winter (2013), Farmer (2017) and Singay (2020), who concluded that cooperative learning structures had positive effect on students' learning achievement. Specifically, the result also supports the conclusion made by Mele and Kagan (2001) on the

effectiveness of KCLS in improving the learning achievement of students in High School Chemistry.

This study showed that KCLS had positive effect on learning of chemistry in Bhutanese classroom situation rejecting the null hypothesis. This study statistically affirmed that the use of KCLS is effective despite the inhibiting classroom situation (large number of students in the class). Since the statistically significant enhancement in the learning achievement is recorded in learning chemistry this study debunks the myth around whether the KCLS can be applicable to learning of hardcore sciences such as chemistry. Thus, inferring that KCLS are not subject oriented as purported by Dr. Kagan.

Table 5 Criteria for Interpretation of effect size (Mcleod, 2019)

| Relative size. | Effect size | % of the control group below the mean of experimental group |
|----------------|-------------|---|
| | 0.0 | 50% |
| Small | 0.2 | 58% |
| Medium | 0.5 | 69% |
| Large | 0.8 | 79% |
| | 1.4 | 92% |

V. Conclusion

Provided that the KCLS is implemented correctly, applying all its four principles effectively KCLS can optimize student's engagement in the classroom and improve student's both interpersonal skills and learning achievement. The use of KCLS facilitates transitioning of the focus from the teacher to student. In KCLS incorporated classes, teachers take the role of facilitator, provides the guidance and platform for learning while students take the role of active learners, playing active role by engaging themselves in acquisition of the content knowledge and communication skills. The result of the study indicated that the use of KCLS in classroom teaching has inherent potential to transform the learning paradigm; from students being passive learners to active potent learners.

The result of this study revealed that the students in the experimental group taught using KCLS performed better than those students in the control group taught via conventional method. Thus, this finding correlates with the available researches on the use of KCLS in improving student's learning

achievement. This study provided evidence that despite inhibiting classroom situations in Bhutan, KCLS can be effective in enhancing learning achievement in chemistry. The study also discussed in great length the theoretical underpinning of the KCLS and its working principle. The study indicated KCLS as viable strategy to maximize engagement of students; involving students in creative thinking and collaborative working. This study supports and urges the need of Bhutanese education system to transition from teacher centred to student centred pedagogy. Since, the study revealed KCLS effectiveness in enhancing student's achievement in chemistry; it is logical to recommend the use of KCLS in teaching chemistry to enhance student's learning achievement. As this research is conducted in the real classroom situation, it has direct implication for pedagogical practice.

However, as the study was limited to grade IX students of only one school and the intervention period was only for four weeks. The study result cannot be generalized to whole population. So, future studies on KCLS can include investigation of KCLS's effectiveness in teaching chemistry in multiple schools in Bhutan and in more than one grade level. Future researchers may also explore on KCLS's effectiveness in other science subjects. Additionally, future studies can also be done to investigate effectiveness of different types of KCLS apart from the four structures studied in this research.

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