CHAPTER III

RESEARCH METHODOLOGY

This chapter presents the methodology which is used in the research. It consists of subject of the study, experimental design, research design, research instrument, data collection and data analysis. Each of the items is explained below:

Subject of the study

The study population was the sixth grade students (n=46) of mendrelgang Primary school in Bhutan. The sample was collected through purposive sampling in which class VI A (n=23) as experimental group and VI B (n=23) as control group because the background of the students was same. The respective class was supposed to contain the students of all three levels (high average and low achievers). In order to make sure that the background of both the groups was same the researcher compared the pre-test of experimental group and control group. Researcher found that there was no significant difference in the mathematics achievement of pre-test of experimental group (M=13.09, SD=2.778) and control group (M=13.22, SD=2.255; t(44)=-.175, p=.862) which clearly indicated that both the groups were of same background.

Experimental design

Quasi experimental design was administered where by the present study was non randomized control group pretest- posttest design. According to Hossain and Tarmizi [117] the quasi experimental design can be seen as shown below:

$$Gr_1: O_1 \xrightarrow{\ X\ } O_2$$

$$Gr_2: O_1 \xrightarrow{\ D\ } O_2$$

where

Gr_1: group 1 (experimental group)

Gr_2: group 2 (control group)

X: treatment (cooperative learning)

D: direct instruction method

O_1: pre-test observations

O_2: post-test observations

In this design, Pre-test was conducted before the application of the experimental treatment. Post-test was conducted at the end of the treatment period. Various techniques and activities of cooperative learning such as think pair share, team accelerated instruction, jig saw, three minutes review, group investigation, STAD and round robin brainstorming was used as treatment to teach the content fraction and decimal.

Research instruments

1. Characteristics of the instruments

1.1 Achievement test was used as pre-test and post-test to compare the mathematics achievement of experimental group, before and after cooperative learning, and also to compare the post-test of experimental and control group. The achievement test was developed by the researcher in the following steps:

1.1.1 Researcher framed 50 questions on the topic fraction and decimal which was a whole unit of the sixth grade's mathematics syllabus in Bhutan.

1.1.2 The items composed in the achievement test directly reflected the learning outcome of fraction and decimal. All of the items in the test were multiple choice formats; each item had 4 alternative choices for the most correct answer. The questions (items) were framed based on the paper setting style (construct of the paper) of Bhutan that is blooms taxonomy as shown below:

Table 8 Blue print of achievement test before IOC test

Content	Construct (6 levels of blooms taxonomy)						
	Remembering	Understanding	Application	Analysis	Evaluation	Creating	Total questions
Chapter 1 Relating fraction							
1. Relating mixes number to improper fraction	2	3	2	-	1	-	8
2. Comparing and ordering fraction	3	2	2	2	-	-	9
3. Adding fraction	-	1	1	1	-	-	3
4. Fraction between fraction	2	2	1	1	-	-	6
5. Subtracting fraction	2	2	1	-	-	-	5
Chapter 2 Relating fraction with decimal							
6. Naming fraction as decimal	3	1	1	1	-	2	8
7. Naming fraction as decimal	3	1	2	2	3	-	11
Total questions	**15**	**12**	**10**	**7**	**4**	**2**	**50**

1.1.3 Then these entire questions were assessed by 3 respective experts namely Assistant Professor Dr.Pakorn Prachanban, Assistant Professor Dr.Kijti Rodtes and Dr.Wanintorn Supap, to maintain the quality of the achievement test. The IOC test was conducted for each item. Only 30 questions were validated by the experts for achievement test (see appendix A). These are the items having IOC value more than 0.05. These 30 questions were administered as both pre-test and post test by the students, but the arrangement of the questions in the post-test was different. There were many changes after validation in both number and level of the questions. For example, the question that was considered in remembering level became understanding level after validation process, and some of the questions which were not fulfilled as good questions were also removed. Following are the valid 30 questions:

Table 9 Blue print of achievement test after IOC test

Content	Construct (6 levels of blooms taxonomy)						
	Remembering	Understanding	Application	Analysis	Evaluation	Creating	Total questions
Chapter 1 Relating fraction							
1. Relating mixes number to improper fraction	3	1		1		1	6
2. Comparing and ordering fraction		1	4				5
3. Adding fraction		1		2			3
4. Fraction between fraction	1	1				1	3
5. Subtracting fraction					1		1
Chapter 2 Relating fraction with decimal							
6. Naming fraction as decimal	3	1	1		2		7
7. Naming fraction as decimal	1	2		1	1	-	5
Total questions	**8**	**7**	**5**	**4**	**4**	**2**	**30**

1.2 Lesson plans were designed by Researcher. Researcher designed 24 lesson plans based on the indicators of cooperative learning (see appendix B). The lesson plans was also designed in such a way that, the lesson plans consist of all the lesson components such as lesson objective, lesson introduction, lesson development, lesson activity/ties, monitoring, follow up activity and closure. These are the lesson component that a lesson plan must contain in Bhutan. Different techniques of cooperative learning were used for different lesson plan as per the suitability of technique and the topics. Some time one topic was taught through one or more lesson as shown below:

Table 10 Lesson plans with various techniques of cooperative learning

SI No.	Cooperative learning Techniques	Topic or content	Lesson number	Process and principle in application.
1	Think pair share	Numerator denominator and quotient	Lesson 1	Because these topics are not so difficult, individual can think of solution if not can get the view of pair. But in case if their pair cannot solve the problem then they can get the view of their class mate.
		Problem on equivalent fraction with same numerator	Lesson 6	
		How to use fraction stripe	lesson10	
		Adding fraction with same denominator	lesson12	
		Writing fraction as decimal	Lesson 19 Lesson 23	
2	Team accelerated instruction (TAI)	Changing mix number to improper fraction	Lesson 2	This is the topic which requires bit higher level of thinking, whereby they need to know the concept. Therefore with TAI high achiever can assist the low achiever to get the concept.

Table 10 (cont.)

SI No.	Cooperative learning Techniques	Topic or content	Lesson number	Process and principle in application.
3	Jig saw	Changing improper fraction to mix number.	Lesson 3	These are the topics which are bit challenging. Through jig saw it can be easily learned as each people are going to expertise in the particular topic (problem) and they also helps their friends to learn thoroughly so that they earn good group grade. Large number of topic can be easily covered with this technique within short period of time.
		Equivalent fraction with same numerator.	Lesson 16	
		Subtracting fraction with different denominator	Lesson 9	
		Decimal as fraction	Lesson 18	
		Relating fraction with decimal	Lesson 20	
		Fraction as decimal	Lesson 22	
		Problems on relating fraction as decimal	Lesson 24	
4	Three minutes review	Comparing and ordering fraction by relating to half	Lesson 4 Lesson 5 Lesson 8	With this technique firstly teacher can check how attentive they are in the class. Secondly teacher can check the understanding. Some low achievers who does not understand when teacher is teaching, will get opportunity to clear their doubts.
		Meaning of subtracting fraction	Lesson 15	

Table 10 (cont.)

SI No.	Cooperative learning Techniques	Topic or content	Lesson number	Process and principle in application.
5	Group investigation	Solving problem on comparing fraction using equivalent fraction	Lesson 7 lesson 13	With this technique the problem on the respective topics requiring, higher order of thinking skill can be solved
		Naming fraction as decimal	Lesson 17 Lesson21	
6	STAD	Adding fraction using fraction stripe	Lesson 11	With this technique each member will be able to know how to use fraction stripe as they will be tested individually and also the whole group will be working hard, helping each other to learn the content as team earn certificate or reorganization based on the degree to which all team members have progressed over the past record.
7	Round robin brainstorming	Fraction between fraction	Lesson 14	It is implemented to the content which can have many possible answer, fraction between fraction is only the topic which is suitable (many possible answers).

Each lesson plan was for 45 minutes as per the school's schedule (Mendrelgang Primary School). Then the lesson plan was given to the respective experts namely Assistant Professor Dr.Pakorn Prachanban, Assistant Professor Dr. Kijti Rodtes and Dr.Wanintorn Supap, to check the appropriateness and effectiveness of the lessons. The feedbacks, comments and suggestion were strictly taken into consideration for the improvement of the lesson plans (see appendix C).

1.3 Checklist was used by the researcher to know the effect of cooperative learning on students' social skills, the researcher compare the social skills of pre-test and post-test of experimental group. The checklist was administered by the students as pre-test and post-test. The checklist was adapted from the theory provided by Canney and Byrne.

According to Canney and Byrne [30] social skills can be categorized into four levels according to the levels of complexity and interaction as clearly mentioned in the table below:

Table 11 Social skills B

Skill Set	Used for	Examples
Foundation Skills	Basic social interaction	Ability to maintain eye contact, maintain appropriate personal space, understand gestures and facial expressions
Interaction Skills	Skills needed to interact with others	Resolving conflicts, taking turns, learning how to begin and end conversations, determining appropriate topics for conversation, interacting with authority figures
Affective Skills	Skills needed for understanding oneself and others	Identifying one's feelings, recognizing the feelings of others, demonstrating empathy, decoding body language and facial expressions, determining whether someone is trustworthy

Table 11 (cont.)

Skill Set	Used for	Examples
Cognitive Skills	Skills needed to maintain more complex social interactions	Social perception, making choices, self-monitoring, understanding community norms, determining appropriate behavior for different social situations.

In the checklist, from the literature provided by Canney and Byrne [30], the researcher adapted 3 statements from the foundation skills; 5 statements from the interaction skills; 5 statements from the affective skills; and 4 statements from the cognitive skills. Thus researcher adapted 17 statements in total to represent social skills and it was administered as pre-test and post-test by the experimental group.

In the checklist the statements 1, 2, and 3 was adapted by the researcher to represent the foundation skills; statements 4, 5, 6, 7 and 8 was adapted by researcher to represent the interaction skills; statements 9, 10, 11, 12 and 13 was adapted by the researcher to represent the affective skills; and statements 14, 15, 16 and 17 was adapted by the researcher to represent the cognitive skills. All the statements were yes/no statements. Students were supposed to tick either yes or no as per their perception. The quality of the checklist was maintained and strengthened by three experts namely Assistant Professor Dr.Pakorn Prachanban, Assistant Professor Dr.Kijti Rodtes and Dr.Wanintorn Supap. The feedback and the suggestions by experts were strictly followed. IOC test was conducted and the items having IOC value more than 0.5 were finalized for the final checklist the final checklist is as shown below:

Table 12 social skills checklist

Item No.	Items	Responses Yes	No
A	**Foundation skills**		
1.	I maintain eye contact when I talk with my friend/s in the group.		
2.	I can make out whether my friend/s are happy or sad by their gesture/s and facial expression/s.		
3.	I maintain appropriate personal space with my friend/s.		
B	**Interaction skills**		
4.	I solve the conflict/s in a peaceful way by discussing the problem/s.		
5.	I take turn to share my idea/s in the group/s.		
6.	I begin and end conversation/s		
7.	I talk with everyone in the group/s.		
8.	I can talk with my teacher whenever necessary.		
C	**Affective skill**		
9.	I can identify my feeling/s for my friend/s and activities.		
10.	I care that my friend/s are not hurt by my words.		
11.	I feel like helping my friend/s when they are in need.		
12.	I can decode body language and facial expression/s.		
13	I trust my group member.		
D	**Cognitive skills**		
14	I learnt how to choose freely the best choice/s to solve the problem/s.		
15	I could monitor my own learning by following the norms of the activity/ies.		
16	I can discuss the problem/s with my friends.		
17	I try to be active in the activity (group activity).		

2. Construction of the quality of the instruments

2.1 Validity: Content and construct validity of the achievement test was checked and strengthened by the 3 experts. They are Assistant Professor Dr. Pakorn Prachanban, Assistant Professor Dr.Kijti Rodtes and Dr.Wanintorn Supap, Appropriateness and effectiveness of the lesson plan was administered by the 3 experts. They are Associate Professor Bunga Wachirasakmongkol, Assistant Professor Dr.Kijti Rodtes and Dr.Wanintorn Supap before the implementation.

2.2 Reliability: The achievement test was piloted with the 30 mathematics students who have already studied the fraction in the previous year to check the reliability of the instrument. Cronbach's Alpha was used to check the reliability of the achievement test and the achievement test revealed an acceptable reliability coefficient of $\alpha = 0.793$ (see appendix D). Furthermore, the reliability of the checklist was also checked by using Cronbach,s Alpha . The checklist revealed an acceptable reliability coefficient of $\alpha = 0.715$.

Data collection

The experiment was conducted on the sixth grade students studying in Mendrelgang Primary School for the duration of 24 lesson period (one month). From the total number of the sixth grade students which is 46 in numbers, 23 students (class VI A) was assigned as the experimental group, and another 23 students (class VI B) was assigned as control group through purposive sampling method.

Before the treatment, the experimental group was pre-tested. After that experimental group was given a brief orientation on cooperative learning process and then they were divided into 6 groups with 4 members in each group (the researcher made sure there is both male and female and the students of all the ability are present in each group). Experimental group was taught by cooperative learning for 24 lesson period and each lesson period was 45 minutes, then right after the treatment, an achievement test was conducted to obtain the post-test score.

On the other hand the control group was pre-tested before having taught the content. Then they learnt the content (fraction and decimal) as usual (direct instruction) for the same duration (24 lesson periods each period with 45 minutes). As soon as the teaching got over they also did the post test.

Having finished conducting pre test and post test (in experimental group and control group), the result of pretest and post-test of experimental group was compared. Then the post-test of experimental group and control group was also compared.

With regard to social skills, before treatment, the experimental group was given social skills check list as pre-test and again after treatment the same check list was given as post-test to compare the social skills of the experimental group, before and after cooperative learning.

Data analysis

The effect of cooperative learning on students' (sixth grade students studying in Mendrelgang Primary School) mathematics achievement was evaluated by the analysis of the data collected from the mathematics achievement test (on the topic fraction) administered to the 46 sixth grade students of Mendrelgang Primary school who were assigned into experimental group (class six 'A' with 23 students) and control group (class six 'B' with 23 students).

The data was collected in two phases. In the first phase data was collected in the form of pre-test administered by both the groups (experimental group and control group). In the second phase data was collected in the form of post test administered by both the groups.

Then the data of these two tests (pre-test and post-test of experimental group and control group) was analyzed in the following ways:

1. Paired samples t-test was conducted to compare the pre-test and post-test (students' mathematics achievement) of the experimental group. Paired samples t-test was also conducted to compare the social skills of experimental group, before and after cooperative learning.

2. Independent samples t-test was conducted to compare the post-test (mathematics achievement) of control group and experimental group.

The output of the Paired samples t-test was interpreted in the following two steps:

Step 1 Determining overall significance

First sig. (2 tailed) value was determined. If this sig. (2 tailed) value is less than.05, it is concluded that there is significant difference between the two score (pre

test and post score of experimental group). If the sig. (2 tailed) value is more than .05 it is concluded that there is no significant difference between two score (pre test and post score of experimental group).

Step 2 Compare the mean value

Having established that there is a significant difference then mean value was compared (which set of score is higher) [118].

The output of the independent samples t-test was be interpreted in the following three steps:

Step 1 Checking the information

The information about the groups was checked, example number of people in the groups, code used for male or female. Is there any missing data or not was thoroughly checked.

Step 2 Checking assumptions

The first section of the independent sample t-test output box gives the results of Levene's test for equality of variances. This test tests whether, the variance (variation) of the scores for two groups are same or not. The outcome of this test determines which of the t- values that SPSS provides the correct one to use is. If sig. value is larger than .05 then should use first line in the table, which refers to Equal variances assumed. If the significance level of Levene's test is p = .05 or less, this means that variance of two groups are not same. In such case the information in the second line of the t-test table should be used which refers to equal variance not assumed.

Step 3 Assessing differences between the groups

To find out whether there is significant difference between two groups column labeled sig (2-tailed) appeared under the section labeled t-test for equality of means was referred, based on Levene's t-test result. If the value in the sig. (2-tailed) column is equal or less than 0.05, then there is sig. difference in the mean score of the dependent variable for each of the two groups. If the value is above 0.05 then there is no significant difference between the two groups [118].