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# The effective role of inductive method in teaching, learning mathematics in secondary school level

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**Abstract:** The effects of inductive teaching method student's cognitive and affective characteristics and learning style on student's performance are measured, performance is measured by the scores on test base on trade concept and exercises in an introductory course in mathematics. Results suggest that inductive teaching increases student's performance and that teaching is enhanced if inductive teaching is done prior to presenting general theories.

In this regard inductive method of teaching is one of the important, useful and effective method in mathematics education.

This study helps to introduce of inductive method in mathematics is to be helpful to math teacher, students, researchers and education planners to understand the principles of mathematics and also to find the effectiveness of inductive teaching method at school level and useful for the teacher with appropriate teaching pedagogies.

**Key-words:** Inductive, pedagogies, traditional rote-memory, critical thinking, deductive.

## Introduction:

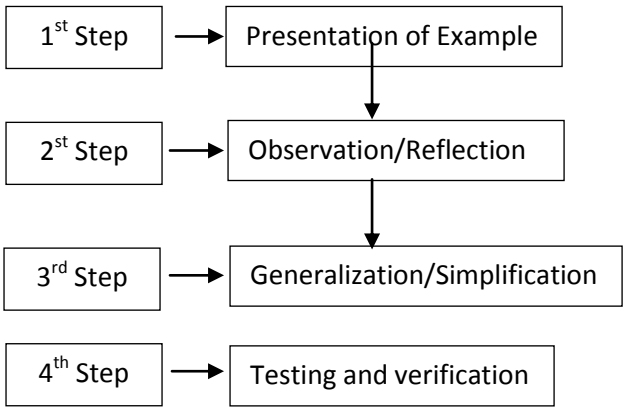
Mathematics plays an important role for the development of the society. The words 'mathematics' which means "to learn". Mathematics helps people understand and interpret different quantitative as well as quantitative aspects of natural phenomena. Mathematics is process of learning and it is an expression of human mind, concerned chiefly with ideas, process and reasoning. It is the way of thinking, a way of organizing a logical proof.

Mathematics is an essential part of school education. It is one of the core subjects at all level of school. It is essential for everyday life as well as for higher study in the field of science and technology. It is also related to logic science, social studies, arts, music and literature. Students apply mathematical concepts, skills and logical reasoning to solve different kind of problems in their life. Thus the ultimate goals of learning mathematics is to enable student to solve problems in mathematics. Consequently, it is concern of both student and teachers to make the teaching of mathematics effective to increase understanding of mathematics better for better achievement in mathematics.

The teaching method is essential in teaching mathematics. Mathematics teacher use variety of methods and technique in their daily classroom teaching in order to make their class more interactive and co-operative. Teachers and students interact with each other in the school. So, to develop this interaction: an educatoruses new teaching substantial, procedures, strategies and approaches of teaching to make learning pertinent and beneficial. Till now so many methods and techniques have been lunched but mathematics teachers select only most relevant one keeping in view the topic content and need of the learner. To grip of fully command on the content of mathematics it is too much necessary for an education to use various relevant methods in the mathematics class room at secondary level. It has been observed so many times that learners solved so many problems very rapidly by using adifferent methods, technique or formula to which they have already leant in the class room but unfortunately they have no idea about the basic logic that how this problem have done. Initially there was only the deductive approach of Aristotle to find a solution for a problem but later is the inductive reasoning of Francis bacon was introduced to solve the mathematics problems.

Introduction means to offer a general truth by showing that if it is true for a particular case, it is true for all such case. Inductive approach is psychological in nature. This method develops the curiosity with the individual which is need of the day. Inductive method is sponsored by Pestalozzi and Francis Bacon. Inductive approach is based on the process of induction in teaching learning process. In the world of mathematics, it is a method of constructing a formula with the help of a sufficient numbers of concrete, actual and real examples. By using this method of teaching mathematics the students follow the content with great interest and understanding at various level of schools. Inductive method is more useful in algebra, geometry, trigonometry and arithmetic teaching and learning this method proceeds from particular examples to general rules of formula concrete illustration to abstract rules, known to unknown and simple to complex.

The steps of inductive method is as follows.




In this 1st step of inductive method teacher shows lot of examples of same type and solution of all those specific examples are obtained with the help of the students.

After solving so many specific examples the students detect and observe these and try to reach some conclusion.

After the second step mean observing presented examples, the educator and students resolve some common rules, laws, formula or principle by logical mutual discussion and in the fourth step student test and prove the law, rule or principle with the help of other suitable specific examples. So in this way students logically achieve the knowledge of inductive method by following above given steps.

Inductive method makes use of student "perceiving". In this method the teacher presents students with many examples showing how the concept is used.

The most commonly used inductive teaching and learning methods inquire learning, problem-based learning, project-based learning, case-based teaching, discovery learning as just-in-time teaching (Prince,J.M, Felder, R.M (2006). The investigations according to Kopka, j. (2004) is possible to consider as a method of the first category. The inquiry learning means that students are presented with questions to be answered, problem to be solved or a set of observation to be explained (Bateman, W (1990). If the method is implemented effectively, the student should learn to formulate good questions, identify and collect appropriate evidence present result systematically, analyze and interpret results, formulate conclusions and evaluate the worth and importance those conclusions. (Lee, V.S. (2001).

In Nepal, studies have shown that mathematics education was largely managed and imparted through traditional lecture approach, vote memorization and cramming. Many students have the habit of only memorizing factual information from their test book without thinking "why"? Worst of all, the student merely copy what the teachers have written on the blackboard and then memorize only that information while even neglecting their text books. It is not only painful for the students to engage in such note memory. It also takes the long period time to do this work.

Nowadays, various methods techniques of teaching have been developed by the pedagogies. Now traditional methods of teaching are criticized and replaced by newer methods through researches. Teachers need to have exposure of the developed methods to bring in to use of classroom teaching. Traditional methods are taken as expository method. This method assumes that learning is possible through the activities of teacher's explanation and student's memorization. At present, this process of learning is claimed not as the meaningful learning.

The genesis of inductive and deductive method is credited to British philosopher Francis Bacon (1562 1626 AD) and the Greek Philosopher Aristotle (322-384) respectively. Aristotle and his followers studied patterns of correct and incorrect reasoning.

The concept of inductive method explained on Mathematics dictionary (1988) is "Inductive methods lead from concrete to abstract, particulars to generals and examples to formula". It is the method of constructing formula with the help of sufficient number of examples. It is based on induction which means providing a universal truth by showing that if it is true for all such cases. A formula or generalization is thus arrived through a convincing process of reasoning and solving s problem. After a number of concrete cases have been understood, student successfully attempts the generalization (Acharya U.P).

The inductive method is deeply entrenched in mathematics education. Traditionally mathematics courses were taught deductively with the teacher teaching the students the facts and theory, then moving to textbook exercises and finally application. Using the inductive to deductive method, the teacher presents the students with a specific challenge or problem that occurred in real life situation, such as an experiment that need

to be interpreted or a real-world problem that needs to be solved. The student must then use their base knowledge to investigate, test, analyze and come to their own conclusion or solution in the form of generalization. The inductive to deductive method which is commonly interpreted in school as the scientific method is widely used as a guide for observation and enquiry based learning.

Using the inductive method, the Banu Secondary School, DaDaBajar, Dhankuta presents the student with a specific challenge or problem that occurred in real life situation. Thus the use of inductive method in teaching mathematics is seen important. So the researcher has realized to investigate its effectiveness on student's achievements in measurement.

## **Literature review**:

Researcher found the variety of sources to provide the foundation of the effectiveness of inductiveness of inductive teaching approach in mathematics. The literature guided the formation of research. Related books, articles, research report, documents and other booklets are found that were concern with curriculum teaching, instructional materials classroom management, physical facilities and so on. The researcher tried to find out the literature on the topic that is related to effectiveness of inductive method is teaching measurement at basic level.

Inductive method is based on principle of induction. Induction means to establish a universal truth by showing that if it is true for a particular case and is further true for a reasonably adequate number of cases then it is true for all such cases. Thus in this method at first stage problem is solved on the basis of previous knowledge, thinking, reasoning and insight of the learner. In this method students do not know about any formula, principle or method for solving the given [problems. It is a method of constructing a formula with the help of adequate number of concrete examples. Thus the inductive method of teaching leads us from concrete to abstract, specific to general and example to formula.

The researcher has reviewed some related literature such as, Amatya (1978) write on his research entitled "A study of effectiveness of teaching mathematics with and without the use of instructional materials" with the aims to find out whether instructional materials are helpful to develop the mathematical concepts and to measure the difference in concept development among students in the experiment and control group of grade third. He concluded that the performance of students taught with the use of instructional materials was significantly improved when compared with the performance of the students taught without the use of instructional material.

Katuwal (2011) write on his research "Effectiveness of inductive method in teaching measurement at secondary level". He concluded that the inductive method can be more effective than the deductive method in teaching Measurement at secondary level. From the result of the study concluded that consequently better result in achievement test over deductive method.

Shaffer (1989) to check the effect of inductive deductive method in teaching, investigator select three hundred and nine pupils of various level from three various American high schools who were taught French and Spanish. In the light of this study, eight classes were separated in to two groups of even language ability. From these groups, one group was instructed using the deductive method of teaching and other group using the inductive method of teaching. Investigator developed material and a close test were the instruments used for the purpose of this research study. Shaffer concluded that an inductive method was much better than the deductive approach to all ability levels.

Silas (2012) inductive method of teaching model is found to be more effective for teaching circle geometry and trigonometry than Transmitter of knowledge teaching model, considering the results obtained. So, it is recommended that inductive method of teaching model should be used in the teaching of circle geometry and trigonometry (P.33-46), Landmark College (2005). Deductive method of teaching is much less constructivist and is based on the idea that a highly structured presentation of content creates optimal learning for students as compared to inductive method of teaching which is more suitable in the teaching learning process.

Shoaib (2010) the deductive method is used in a large classroom setting while the inductive method is effective is effective when used on small groups or numbers of students. The deductive method is traditional, structured and predictable while the inductive method is personalized and the concept are easily remembered and understood. The deductive method is a method of verification and comes from a source while the inductive method is an approach of discovery and relies on a student's perspective or understanding of a concept.

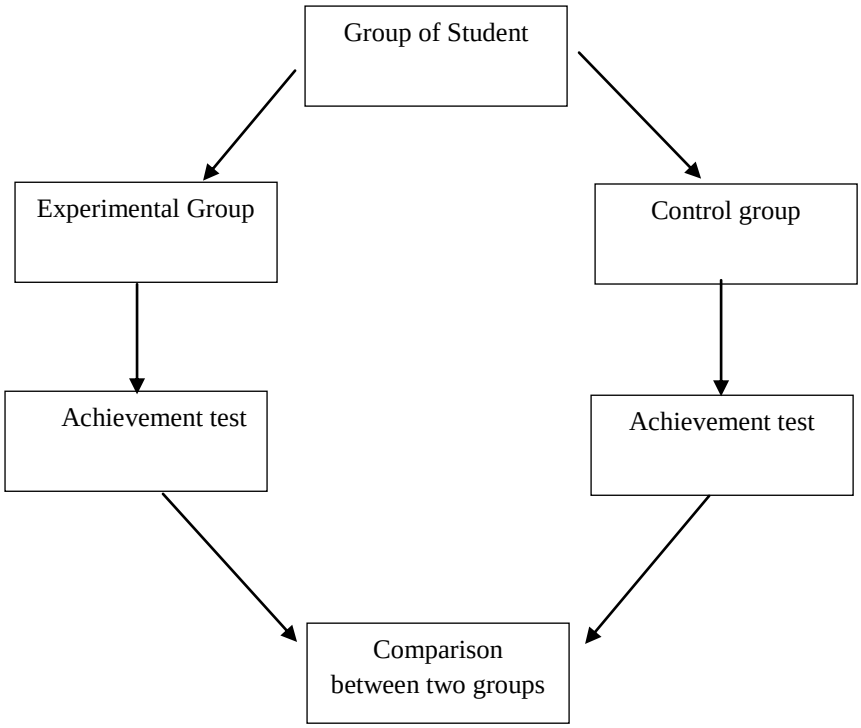
Nicole (2007) Inductive method of teaching is appreciated to recognize design patterns form within the practice, but deductive method of teaching support the pronunciation of outlines. By using deductive method of teaching we cannot develop the thinking of the student but in the use of inductive method of teaching we can develop the thinking and curiosity of the student. Nejla (2000) regarding this research this research study the main purpose of the researcher was to compare the effectiveness of inductive-deductive method of teaching on student chemistry achievement attitude towards chemistry and academic self-concept. The result of this research

study shows that inductive method of teaching play very important role as compared to deductive regarding student's achievement and attitude (Malik Amer Atta).

Basnet (2016) explained on his research "The effectiveness of inductive in teaching measurement" with aim to compare the achievement of students taught by traditional method. He found in his study that the students taught by inductive method were better than the student taught through traditional method. Thus this study concluded that the inductive method is more effective than traditional in teaching measurement.

In this study, inductive method was more suitable for teaching measurement which provided clear and meaningful concept. Thus inductive approach on one that begins with observation and develop the final result. This method allows us to gather ideas in the different types of mathematical problems. Use of inductive method as teaching tool to guide students through critical thinking, awareness, and evaluation of what theory observe and drawing conclusion and explanation is universally accepted in math education.

Fig: The conceptual Framework of the study




This framework shows the group of student in school. All the grade IX student of Dhankuta district was the population of this study. Researcher selected a government school. Bhanu Secondary School, Dhankuta district was selected as a sample for this study. 38 student of grade IX were selected from this school for this research study. Among 21 were girls and 17 were boys. In this study, there were two groups, control group and experimental group and 19 students in each group. The groups were formed by randomization method. In experimental design, the effect of independent variable in a given condition was observed in dependent variables. In this study the independent variable is the inductive method of teaching in measurement at grade IX. In this study achievement score of the student in the test of measurement of grade IX has been compared according to their score.

## **Methodology**:

The present study entitled "Effectiveness of inductive method in teaching and learning mathematics in the secondary level school". It was designed to examine effectiveness of inductive method in teaching mathematics in secondary level. The present study was conducted in Dhankuta district. A short description was made of strategies and process adopted while teaching in the classroom.

In this study there were two groups: (i) Control group and (ii) Experimental group. The experimental group was taught by inductive method whereas the control group was taught by traditional method.

This is an experimental design in which the researcher wants to find the effect of inductive method in teaching at secondary level school. Through the researcher tried this best to form equivalent group through pre-

test. The groups could not be claimed completely equivalent. So researcher used pre-test, post-test, non-equivalent experimental design. The pattern of the study is as follow:

| Groups | Pre-Test | Treatment | Post-Test |
|---|---|---|---|
| Experimental Group | $E_1$ | Individual Method | $E_2$ |
| Control Group | $T_1$ | Traditional Method | $T_2$ |

**Data Analysis and Interpretation:**

The study analyzed the collected data and interpreted the results. It has been designed for analysis of data. It involved pre-test and post-test in non-equivalent group design. Since main objective of this study was to examine whether it increased the achievement level of student by using inductive method on measurement in the comparison of traditional method at secondary level. So, the data were collected before and after the experiment. The tools for collected data were an achievement test and teaching lesson on measurement of grade IX.

This study deals with statistical analysis and interpretation of data obtained from achievement score of the sample students. The data were tabulated and analyzed mean, variance, t-test. The data on achievement test score have been analyzed under the headings: (i) Analysis of mean achievement score of control group and experimental group for pre-test data (ii) Analysis of mean achievement score of control group and experimental group for post-test data.

**Achievement score of control Groups and Experimental Group of pre-test Results**:

The summary and the statistical calculation of student of control group and Experimental groups on pre-test result is presented in the following tables.

Table No.1

| Groups | No. | Mean | S.D | Variation(V) | f | t | Decision |
|---|---|---|---|---|---|---|---|
| $E_1$ | 19 | 17.26 | 6.49 | 49.93 | 1.31 | 3.77 | Group are Homogenous |
| $T_1$ | 15.79 | 15.79 | 5.6 | 31.32 | | | |

Since the calculated value (value of distribution f (f=1.31) was less than tabulated value ($f_{0.o1.18}$=3.08). two sample variance were tested for the homogeneity and it was found that the variance were homogeneous. The t-distribution is used for correlated sample formula was used to find the value of t. the obtained t-value (t=3.77) in the above table is greater than tabulated value ($t_{0.05/2.18}$=2.101). Hence null hypothesis is rejected. So there is significance between the mean achievement score of both control and experiment group.

**Analysis of mean achievement score of Control Group an Experimental Group of Post-Test**:

The summary and statistical calculation for both groups on post-test is given as below:

Table No. 2

| Group | N | Mean | SD | T | Decision |
|---|---|---|---|---|---|
| $E_1$ | 19 | 23.16 | 3.93 | 5.77 | $H_0$ is rejected. |
| $T_1$ | 19 | 17.84 | 7.34 | | |

Two mean achievements of both groups were compared, statically using t-test which two tail test at 0.05 level of significance. The t-distribution for co-related sample formula was used to find the value of t. the obtained t-value (t=5.77) in the above table is greater than tabulated value(t=5.77) in the above table is greater than tabulated value ($t_{0.05/2.18}$=2.101). Hence we conclude that null hypothesis is rejected and alternative hypothesis is accepted. So, there is significance difference between the mean achievement score of both control and experimental groups. Thus from the above table, the researcher concluded that the students who were taught measurement with the use of the inductive method of teaching is proved to be more effective than traditional method of teaching in grade IX.

## Summary of the Study:

This study cleared that the performance of the student of secondary level taught by inductive method affects the mathematics achievement as compared to the performance of them taught by traditional method. For the data collection of the study, the researcher developed and tested the reliability of two achievement test pre-

test and post-test before their administration. Both test consisted of objective multiple choice type items on the whole are of mathematics from grade IX.

A pre-test, post-test equivalent groups design was adopted for the purpose of this study. Grade IX student were for the sampling purpose. Two equivalent groups were established on the basis of the pre-test result. Both experimental and control groups were taught by the researcher himself on the same selected groups. The instruction period was 5 days. A post-test was administered to both the groups providing necessary instruction for usual period on the same groups the t-test was applied to compare the pre-test and post-test result between the two groups. The data was analyzed and interpreted statistically to find the conclusion.

## Findings:

On the basis of analysis of data and interpretation the findings are describe as below:

- From the result, it was concluded that there is significance difference between the mean achievement score of student in control and experimental groups.
- There is significance difference in the achievement score of the student in the experimental and control group which means method of teaching affects the achievement of students in mathematics. Since the mean achievements score of experimental group was higher than that of control group. So it can be concluded that inductive method of teaching may lead the better performance among students in mathematics.
- Inductive method is found more effective in comparison to traditional method of teaching mathematics in grade IX.
- The student, in course of this research investigation were found more comfortable and enjoying while the teacher was using the inductive method.
- The attitude of student towards the traditional method seemed monotonous and repetitive whereas their attitude towards inductive method was more appreciable.
- The teacher's accustomed to the traditional teaching method even though got estranged to the inductive method at the beginning, later on reacted it as a more interesting, effective and fruitful method in the class room.
- The evaluation of the data collected in the research process proved that the experimental group in grade IX inductive method was dramatically high in comparison to deductive method of teaching.

## Conclusion:

Thus it can be concluded that the inductive method of teaching is more appropriate in the comparison of traditional method in measurement in Grade IX. Inductive method of teaching mathematics provides real concept of mathematical knowledge to the student. This method is student-centered method. So, they actively involved in teaching and learning activities in the school. It develops the logical and critical thinking of student. The students of experimental group seem very active and positive towards the uses of inductive method.

## Recommendation:

On the basis of findings of the study, the researcher has recommended some points for the better performance of teaching measurement of grade IX and the mathematic classes of all grades.

- Students should be participated actively in the teaching learning activities in the classroom.
- Inductive method is recommended in teaching measurement in basic level.
- Classroom should be fulfilled with interesting manipulative materials and student should get chance to manipulates themselves to learn.
- Teacher should provide the opportunities to find out answers of the given questions on their own ways.
- Teacher should provide the real ideas, concept of the topical and process for solving problems rather than doing exercises.
- Teachers are recommended to use daily teaching lessons with appropriate teaching materials.
- It is suggested to the math teacher's that ones the teaching techniques is accomplished by learners, the teacher should check their works individually, comment, evaluate, suggest and return back to the learners in time.
- It should be suggested to the math teacher that the mathematics achievement depends upon which teaching method and how it has applied by the teacher.

**On policy level**:

- Government should provide training and equipment for mathematics teaching to the teacher.

- It should be better to study each grade level of school in order to get wider view of inductive method.
- It should be better to collect the attitude and opinion of different levels teacher's in school towards the use of inductive method.
- It is suggested to the mathematics curriculum designer text book writer to include different activities and problems of inductive method.
- Teacher training in different teaching methodologies should be conducted to all mathematics teacher in time to time.

**Further Recommendation**:

- The study can be done in large areas.
- The study can be done in other content area and other grades.
- It is also recommended to explore the psychological effect of inductive method of teaching among students.

**Statistical Formulas and Symbols Under Data Analysis**

1. Homogeneity of variance

$$F = \frac{{s_1}^2(larger\ \ variance\ )}{{s_2}^2(smallest\ \ variance\ )}$$

2.Mean: $\bar{X} = \frac{\sum fx}{N}$

3.Variance of statistics: $(s^2) = \frac{N\sum x^2 - (\sum x)^2}{N}$

4. Standard Deviation of Statistics

$$S = \sqrt{\frac{N\sum x^2 - (\sum x)^2}{N}}$$

5. T-test for correlated Groups

$$t = \frac{x_1 - x_2}{\sqrt{\frac{{S_1}^2}{N_1} + \frac{{S_2}^2}{N^2} - 2r\left(\frac{S_1}{\sqrt{N_1}}\right)\left(\frac{S_2}{\sqrt{N_2}}\right)}}$$

Where, $S_1$ = Standard deviation of Experimental group
$S_2$ = Standard deviation of Control group
$N_1$ = Number of students in Experimental group
$N_2$ = Number of students in in Control group

6. Pearson's product moment co-efficient of co-relation (r)

$$r = \frac{N\sum x_1x_2 - (\sum x_1)(\sum x_2)}{\sqrt{N\sum {x_1}^2 - (\sum x_1)^2}\sqrt{N\sum {x_2}^2 - (\sum x_2)^2}}$$

7. Difficulty level of the Items

$(P\ \%) = \frac{R_U + R_L}{N} * 100\%$

Where, $R_U$ = No. of correct Responses given by upper 27% students
$R_L$ = No. of correct Responses given by Lower 27% students

8. Discrimination Index of item

$$D = \frac{R_U - R_L}{N/_2}$$

**References**:

[1]. Amatya, B.P (1978): A study on the effectiveness of teaching mathematics with and without use of instructional materials.
[2]. Basnet, R (2016): The effectiveness of inductive method in teaching measurement at basic level master degree thesis, T.U. Kirtipur.
[3]. Bateman, W (1990), open to question: The art of teaching and learning by inquiry. Josseey – Bass, Sanfrancisco.
[4]. Katuwal, B (2011): The effectiveness of inductive method in teaching measurement at secondary level, T.U, Kirtipur.
[5]. Kopka, J (2044): The investigation approach in school mathematics, Actauniversitiespurkyniance 40. Mathematics usti and labem, xzech Republic.
[6]. Lee, V.S (2004) Teaching and learning through inquiry, Sterling, V.A: stylns publication.
[7]. Land mark college (2005), Using varied instructional Techniques: Inductive and deductive teaching approach.
[8]. Nejla (2000)" Comparison of inductive and deductive content sequences on student chemistry achievement, attitude and academic self-concept" HACETTEPE University.
[9]. Nicole & Timothy, J.(2007) "Comparing inductive and deductive methodologies for design patterns identification and articulation school of Design, core A the Hong-Kong Polytechnic university, Hung Hum, Hong-Kong sd.nic poly.edu.hk, sdtim@polyu.edu.hk."
[10]. Prince, J.M, Felder, R.M(2006): Inductive teaching and learning method: Definition comparison and Research base. J.Engr Education 95(2) PP 123-138.
[11]. Shoaib,Q.m (2019) "A comparison of inductive and deductive method of teaching mathematics on the educational performance of student at secondary school level".
[12]. Silas, A.I & bright, O. (2012) "Comparative effectiveness of inductive inquiry and transmitter of knowledge models on secondary school student" achievement on circle Geometry and Trigonometry" Bulletin of society of mathematics services and students. ISSN: 2277-8020, vol-1 No. 3 (2012)