

Mathematics achievement through a visual mapping program

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ABSTRACT

Mathematics is considered one of the most important subjects in the school curriculum. Mathematics achievement refers to the scores, proficiency level, or grade achieved by a student in a subject. The present study is based on mathematics achievement through the visual mapping program of 9th std. class students of Bengali medium West Bengal board of secondary education school of Howrah district, West Bengal state. A single group pre and post-test design were adopted and hypotheses were tested between 0.05 & 0.01 levels of significance. The sample of the study was made of 52 students for the experimental group from class 9th std in 2022 from Islampur high school of Howrah district, West Bengal. The researcher made two standardized pre & post-achievement tests used for collecting data. Some learning designs were prepared by the researcher for the visual mapping program. The self-made achievement test was validated by 4 experts in mathematics subjects & the reliability coefficient was found to be 0.89 & 0.91 respectively (Pearson correlation coefficient). For data interpretation researcher used a t-test. The findings difference between the pre & post-achievement tests of the experimental group was found. Thus, it can be concluded that mathematics achievement is increased through a visual mapping program.

Keywords: Mathematics achievement, Visual mapping, program

INTRODUCTION

Education is a process in which the knowledge, character, and behaviour of the young are given a strong foothold. It is conceived to be the adjustment of meaning to his environment to the end that the most enduring satisfaction may accrue to the individual and the society. Hence it is to be given in accordance which the needs and talents of the individuals. Education of a man does not begin at school, it begins at birth, and it ends, not when he graduates from the university, but at his death.

In contemporary education mathematics education is the practice of teaching and learning mathematics along with the associated scholarly research. Researchers in mathematics education are primarily concerned with the tools, methods, and approaches that facilitate practice or study of practice. Mathematics is a core subject and also the backbone of prosperity in every field of our life. Without mathematics, we can't exist.

Secondary education is the foundation that prepares students for the challenges of the future. Mathematics is a compulsory subject in secondary education. Mathematics achievement is an essential part of the academic achievement of the students by which they can show their competency in the subject.

Visual means relating to sight or to things that you can see, and mapping means a matching process where the points of one set are matched against the point of another set. But Visual mapping is the technique used for displaying complex information visually. It is a graphical organization and presentation of information. Some types of visual maps are concept maps, mind maps, and thinking maps.

Visual mapping in the form of mind and concept mapping was found to be an effective learning tool for meaningful learning [5]. Also, it enhances learning and critical thinking skills[6]. Novak concept mapping was more effective than the traditional method in the teaching of mathematical concepts[9]. There is a high positive correlation between mind mapping and achievement in mathematics of students[10]. Thinking maps help students to organize ideas and information and arrange and find the relationship between them for active contribution to the process of learning and

has an impact on the achievement of mathematics[1].

Need and Importance of the study:

Researchers want to make a visual road map between the teacher and students during the teaching-learning process and try to make more understanding and visualize this mathematics subject. So much research has been done on concept maps, mind maps & thinking maps separately but this is combined research where the researcher used these all maps in learning design for teachers in the classroom teaching process for helping students to improve their critical thinking, creative thinking, conceptual understanding, and developing good mathematical achievement. So, this research needed to develop an effective strategy to overcome their difficulties and increase their mathematics achievement.

Statement of the problem:

Developed a visual mapping program and studied the effectiveness of the visual mapping program on mathematics achievement of class 9th std. of west Bengal board of secondary education in Bengali Medium high school students of Howrah district in West Bengal.

Operational definition:

Mathematics achievement:

Mathematics achievement is the competency shown by the student in the subject. Its measure is the score on an achievement test in mathematics.

Visual mapping:

Visual mapping is a visual aid to an image that can guide the memory journey and provide easy editing of facts and ideas that can be used as an alternative to understanding and solving mathematical problems (Astrid Brinkman)

Program:

A set of related measures or activities with a particular long-term aim(Dictionary)

The present research program refers to the list of activities implemented while teaching mathematics using visual Mapping that included the learning design, visual maps, and the achievement test.

Objectives:

1. To develop researcher-made visual maps and learning design
2. To study the effectiveness of the visual mapping program on mathematics achievement.

Hypothesis:

1. There is no significant difference in pre & post mathematics achievement test results of the experimentalgroup.
2. There is no significant difference in pre & post mathematics achievement test results of the experimentalgroup boys and experimental group girls.

Variables:

Types	Name
Independent	Visual mapping program
Dependent	Mathematics achievement
Extraneous	Medium of instruction, age, sex, topics, etc.

Research at a Glance:

Method	Experimental
Design	One group pre-tests post-test experimental design
Nature of the school	West Bengal Board of Secondary Education (WBBSE) in Bengali medium high school students of Howrah district in West Bengal.
Grade Level	High school students of class 9 th std.
Subject	Mathematics
Population	All students are studying in class 9th std. of West Bengal Board of Secondary Education of Howrah district.
Sample	52 students are studying in class 9th std. of islampur Adarsha School of Howrah district in West Bengal.
Research tools	Visual mapping program and learning design (developed by theresearcher) 2. Pre & post-achievement tests in mathematics subjects.(Developed and standardized)
Statistical tools	Mean, S.D., t-test

Review of related literature:

Héctor C. Santiago, OD, Ph.D., FAAO(2011) in this study 'Visual Mapping to enhance Learning and Critical Thinking Skills' focused that visual mapping allowing the reader to visualize, analyze, compile and share ideas. This paper reviews mapping tools that are useful for discussing and photographing a thought process (mind map), exploring knowledge structure (concept map), developing environments, arguments, conclusions about conflict (argument maps), and assessing student thinking. process (@Thinking Maps), seeks the relationship between dynamics (general systems thinking) and the development of simulation models (system dynamic). This paper also provides evidence of the effectiveness of these tools in promoting memory, comprehension, and critical thinking skills in general.

Sonali G. Choudhari, Abhay M. Gaidhane, Priti Desai, Tripti Srivastava, Vedprakash Mishra & Syed QaziZahiruddin(2021) in their study focusing on „Applying visual mapping techniques to promote learning in community-based medical education activities“ was conducted to assess the effectiveness of Visual mapping techniques as a learning tool in a CBME program for the subject Community Medicine and thereby assist medical undergraduate students in overcoming identified learning challenges. Methodology: An interventional study was conducted where medical undergraduates were randomly assigned to two different groups (each group = 30). After sensitization, a broad theme was taught to both groups as a part of community-based teaching (CBT), each week for a month. The students in the intervention group were given the assignment to draw visual maps using the mind mapping & concept mapping techniques, after each CBT session, while the control group had a Question-Answer session with built-in discussion (Conventional method) by an equally qualified, experienced faculty with no mapping assignments. A surprise written examination was conducted on the topics taught, and the scores of both groups were compared. Feedback was obtained from the intervention group. The mean score of the examination by the intervention group (29.85 ± 3.22) was significantly higher than that of the control group (23.06 ± 4.09) ($t = 7.14$ and $p < 0.05$). The students shared that the assignment of drawing minds and concept maps for topics taught helped in attempting questions of the written examination by facilitating easy recall of the information learned. Visual mapping“ in the form of Mind and Concept mapping was found to be an effective learning tool for multifaceted CBME especially in promoting meaningful learning and facilitating rational thinking by medical undergraduates.

Shinder Kaur and Jasleen Kaur(2014) in their study „Effect of concept mapping on achievement in mathematics at secondary level focused on the effect of concept mapping on achievement in mathematics at the secondary level for district Ludhiana. A purposeful sample of 30 pupils of the ninth grade was taken and divided into two groups i.e. A and B comprising 15 students. Group A was taught concepts of mathematics with the help of Concept Mapping (CM) and Group B was taught with the traditional method. While comparing these strategies, it was found that Group “A” achieved more than Group “B”. It means that Novak's concept mapping was more effective than the traditional method in the teaching of Mathematical concepts. The study also revealed that both males and females improved through Novak's concept mapping as well as the traditional method.

R.Manikandan, P.Murugaraju& A. Edward William Benjamin(2020) in their study „Mind mapping and achievement mathematics of higher secondary school students the primary goal of teaching and learning mathematics is to encourage and enable students to recognize that mathematics is an interesting subject. The present study aims to find out the relationship between mind mapping and achievement in mathematics of higher secondary students. Fifty-five higher secondary students were randomly selected as a sample. A survey method was adopted for the study. The data was collected using a test on the mind mapping method. The interpretation was drawn based on the findings. The mind mapping ability of the higher secondary students was found to be average and there was a high positive correlation between mind mapping and achievement in mathematics.

Mudrika Salih Abdullah (2019) in his research „The Effect of Thinking Maps in The Achievement of Mathematics for The Fourth Scientific Grade Female Students and Their Beliefs Toward Mathematics“ aimed to identify the effect of teaching using thinking maps in the achievement of mathematics for the fourth scientific grade female students and their beliefs toward mathematics. The study sample consisted of (54) students distributed in two divisions, one of which was randomly selected to represent the experimental group that was taught using the thinking maps, while the other group represented the control group and was taught by the usual method. The design of the two equivalent groups with the post-test was used. The researcher prepared two tools, the first was a test to measure the achievement consisting of (25) paragraphs (13 objectivity items of multiple-choice type with four alternatives, and 12 subjectivity items) and the second tool was a beliefs scale similar to the fifth Likert scale where it contains (30) items, the sincerity, and reliability of each tool has been verified. The results were treated using the t-test equation for two independent samples. The results showed that there was a statistically significant difference at (0.05) level of significance between the mean performance of the experimental group and the control group in favor of the experimental group in each tool.

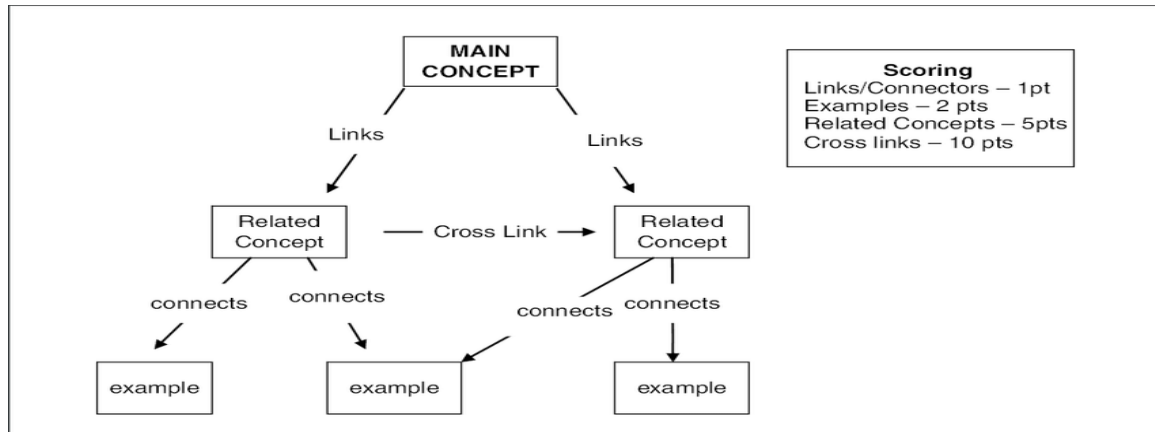
Development of visual mapping program:

Here researcher used 3 types of visual maps

Concept maps:

There are 5 steps to creating concept maps:

Create the main concept Identify the key concept Subordinate concepts Organize shapes and lines Compare representation to the text researchgate.net



Note:

Nodes: Nodes are individual concepts, typically represented by a circle or box with a word in the middle that encompasses the idea.

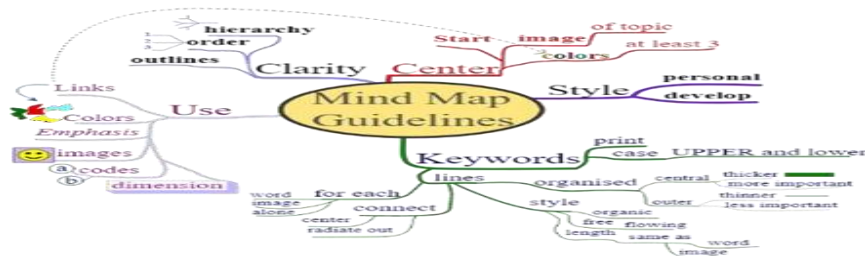
Cross-links: You can show the relationship between two different nodes by connecting them with a line or other visual representation, called a cross-link.

Linking words: You can define the cross-link between two nodes by assigning a descriptive phrase.

Mind maps:

There are 4 steps to creating mind maps:

1. start with the main idea
2. put branches in the main idea
3. Explore topics by adding additional branches
4. Add pictures & colors.

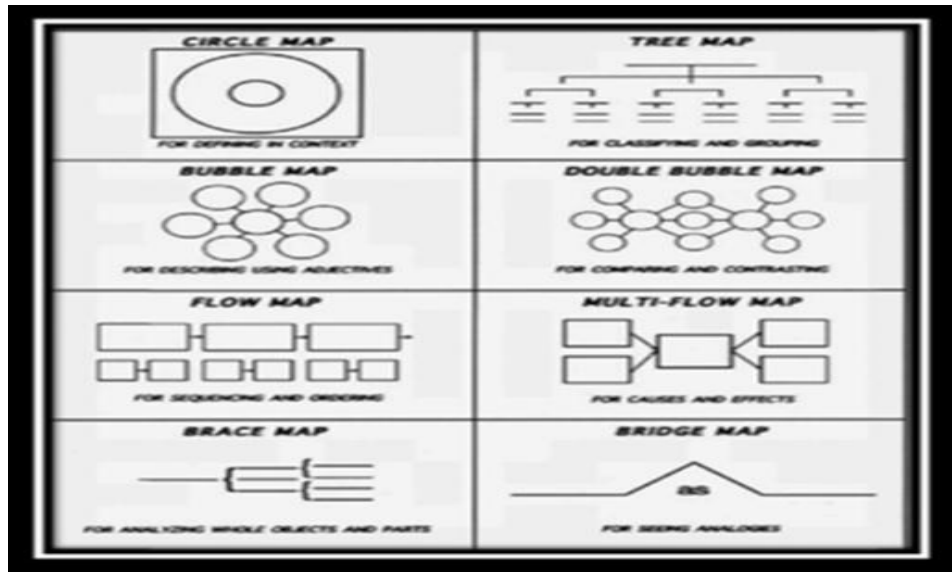


mindmapmaker.org

Thinking maps:

These eight thinking maps are based on the eight basic cognitive processes: -

1. circle-map for defining in context
2. bubble-map for description and characterization
3. double bubble map for comparison and contrast
4. tree-map for the theme, main idea, and details
5. brace-map for physical parts
6. flow-map for sequence
7. multi-flow map for problem-solution and conflict and
8. bridge map- comparison by analogy (Hyerle, 2011).



Implementation: One group was selected based on their prior knowledge and previous achievement test results. The achievement test was used as a pre-test for the experimental group. Several concept maps, mind maps, and thinking maps are available in class 9 mathematics subjects. But the investigator developed new visual maps in 4 chapters of mathematics like „real numbers“, „indices“, „Area of a circle, and „logarithms“ for class 9th students. The investigator taught the experimental group by using the learning design with visual maps of the selected 4 chapters. The students of the experimental group constructed visual mapping individually in groups. After the implementation of the visual mapping program for about 1 week for the experimental group, the post-achievement test was used for the experimental group.

Tools:

The researcher used a self-made pre & post-achievement test which is verified by 4 mathematics experts and the reliability coefficient is 0.89 and 0.91 respectively.

Data analysis & Interpretation:

Table 1: pre & post achievement test results of the experimental group:

Group type	N	Mean(\bar{x})	Std. Deviation	df	t-value	Tabulated value of “t” at 0.05 level	Tabulated value of “t” at 0.01 level
Experimental(pre)	52	35.0192	3.62	102	4.71	1.98	2.58
Experimental(post)	52	38.0762	4.07				

From the above data in Table 1 the value of „t“ is 4.71 which was found to be significant at both 0.05 & 0.01 levels for the degree of freedom 102. The difference was observed between the pre and post-test results of the experimental group. By rejecting the null hypothesis, it claims that students’ scores in the post-achievement test are better than the pre-achievement test.

Table 2: Comparison of experimental group boys & experimental group girls on the result of the post-achievement test:

Group type (Experimental)	N	Mean(\bar{x})	Std. Deviation	df	t-value	Tabulated value of “t” at 0.05 level	Tabulated value of “t” at 0.01 level
Boys	26	38.42	3.7	50	0.6099	2.0	2.66
Girls	26	37.73	4.45				

From the above data in table 2 the value of „t“ is 0.6099 which was found statistically insignificant at both 0.05 & levels for the degree of freedom 50. A very small difference was found in mean scores. It means that the experimental boys & experimental girls are at the same level.

Findings:

1. Post-achievement test results are better than the pre-achievement test result of the experimental group.
2. Post-achievement test results of experimental boys & girls are similar.

Discussion:

Null hypotheses are rejected in one case and we can be inferred that the visual mapping program is more effective in mathematics achievement than traditional teaching in one case the null hypothesis is accepted and then we can infer that boys and girls are at the same level after the implementation of the program.

Education implication:

1. Visual mapping program is more effective to increase students“ mathematics achievement.
2. It helps students and teachers to understand any topic easily.
3. They can construct their own maps for study, note-taking, problem-solving & revision lessons.

CONCLUSION

It can be concluded from the present research that the visual mapping program is more effective in the mathematics achievement of students.

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Appendix:
Learning Design 1

School name:	Subject: Mathematics
Class:	Unit: Real numbers
Time:	Subunit: 1. Rational and irrational numbers
Date:	2. Integers
	3. fraction & Decimal fraction
	4. Number line
Teacher“s name:	Today“s lesson: Subunit 1

1. Learning Goals/ objectives (According to bloom taxonomy): After today“s lesson students will be able to,

Remembering: 1. Define rational and irrational numbers.

Understanding: Explain the concept of rational & irrational numbers.
Applying: solve problems of rational & irrational numbers.
Analyzing: they can classify the properties of rational numbers.
Evaluating: they can interpret rational & irrational numbers.
Creating: they can create their own problems

2. Analyse learners & contexts:

1. What is a number?
2. What is numbers words stand for?
3. Where do you use a number?

3. Develop & select Learning Materials:

1. Textbook
2. Different colour pencils/pens,
3. Blackboard, chalk, duster,

4. Learning Strategies:

Learning Area	Related Strategy
<p>Introduction: A number is a mathematical object used to count, measure, & label. Numbers can be represented in a language called number words and in symbols called numerals. Ex: „5“ is a numeral that represents the number five. The most common numeral system is the Hindu-Arabic numeral system.</p>	<p>The teacher encourages classroom discussion by asking questions about their previous knowledge. Then discuss the concept of numbers & Hindu-Arabic numeral system by drawing a mind map of Hindu Arabic system.</p>
<p>Real numbers: Real numbers are numbers that include both rational and irrational numbers. Rational numbers such as integers (-4,0,2), fractions (1/2,3,5) And irrational numbers such as $\sqrt{3}$, π, etc. all are real numbers.</p>	<p>The teacher draws the first main branch of the mind map (right-hand side) from the central figure, extends the main branch into its sub-branches, and explains the concept of real numbers, rational numbers, and irrational numbers with examples.</p>
<p>Rational numbers(Q): There are real numbers that can be expressed as the quotient/fraction p/q of two integers, a numerator p & a non-zero denominator q i.e., $q \neq 0$</p>	<p>The teacher draws the 1st main branches of the map (right side) into its sub-branches and tells the concept of rational numbers deeply with examples.</p> <p>The teacher draws the 2nd branch of the map (left-hand side) into its sub-branches and explains some solutionsto problems of rational numbers.</p>

Irrational numbers(Q): A real number that is not rational is called irrational. These numbers cannot be expressed as the ratio of two integers.

The teacher draws the 1st branches of main concepts with sub-concepts of irrational numbers with examples and their difference from rational numbers.

The Teacher draws the 2nd branches of properties with sub-branches full of examples of irrational numbers.

The 3rd branch is problem-solving of irrational numbers.

5. Evaluation design:

1. Write one rational number between 2 & 3.
2. Is $\sqrt{225}$ an irrational number?

6. Diagnosing the weaknesses for remedial class (if any):No need.