Research Article

Effectiveness of Concept Mapping and Branching Programming Learning Material on Achievement in Economics

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Abstract

The title of the research was "Effectiveness of Concept Mapping and Branching Programming Learning Material on Achievement in Economics". The objectives of the study were (i) To compare the mean ranks of gain scores of the Traditional lecture group and Concept Mapping group and (ii) To compare the mean ranks of gain scores of the Traditional lecture group and the Branching Programming Learning Material group. (iii) To compare the mean rank of gain scores for the Concept Mapping group and Branching Programming Learning Material group. A purposive sampling technique was used by the researcher in which the sample size was 67, from which 25 students were from experimental group 1 (Concept Mapping group), 25 students were from experimental group 2 (Branching Programming Learning Material group), and 17 students were from the Traditional lecture group, for data collection self-made Achievement test was used. The non-equivalent control group design was used for this study, and data was collected from two schools in Indore. The treatment was given to experimental groups for 9 days, including administration of pre and post-tests. The Mann-Whitney U test was used to analyze the objectives. The findings of the research were that (i) The mean ranks of the Concept Mapping group were significantly higher than those of the traditional lecture group, (ii) The mean ranks of the Branching Programming Learning Material group were significantly higher than those of the traditional lecture group, (iii) The mean ranks of Branching Programming Learning Material group was significantly higher than Concept Mapping group.

Keywords: Achievement in Economics, Branching Programming Learning Material, Concept Mapping

Introduction

Learning is a purposeful, conscious and complex process. An important feature of learning is that it involves a complex interactive system that includes environmental, social, motivational, emotional, and cognitive factors (Cheema & Mirza, 2013). In the traditional learning process, the teacher transmits the facts and assumes students as passive receptors of knowledge. This passive learning prevents the students from constructing their knowledge and understanding the concepts to apply them in their day-to-day lives. Nowadays, various teaching-learning strategies have been developed to accelerate students' learning process. The curriculum demands teaching-learning strategies that may involve students in their own knowledge construction, placing them as the centre of learning activity and

the teacher as a facilitator. This strategy involved Mind mapping, Topic mapping, Concept mapping, programmed learning, etc. Concept mapping is one of the teaching-learning strategies under constructivism having its orientation in David Ausubel's Assimilation theory 1968 of cognitive learning which aims at fostering meaningful learning by students. Concept map is a tool that is used to illicit students' knowledge and helps the learner in learning of concepts.

Concept Mapping

The techniques of Concept mapping were developed by Joseph Novak of Cornell University in the 1970s as a means of demonstrating the developing science knowledge of students. Concept maps have been used as a tool to upturn important learning in Science and other subjects as well as to characterize the expert knowledge of individuals in education. Concepts are defined as abstract ideas. It is a generally accepted and understoo d collection of meaning and characteristics associated with certain events, objects, conditions, situations, people or behaviour. Concepts are denoted by names, symbols or signs of our language. A concept Map or conceptual diagram is a diagram that describes suggested connections between concepts. It typically denotes ideas and information as boxes or circles, which it links with labelled arrows, often in a downward branching hierarchical structure but also in free-form maps. According to Novak and Gowin (2010), "Concept maps are constructed to represent visually meaningful relationships among concepts in the form of propositions".

Branching Programming Learning Material (BPLM)

Norman A. Crowder, an American psychologist, is credited for developing Branching Programming Learning. Branched or intrinsic programming is one which adapts to the needs of the learner. In this type, each frame is of a relatively bigger size and may contain two or three ideas related to the sequence. A single question, usually of the multiple-choice type, is asked at the end. The learner selects the response. If the learner chooses correctly, he is taken to the next frame in the main teaching sequence. If his response is wrong, he is diverted (Branched) to a remedial frame where his mistake is explained, and the topic under consideration is further explained, perhaps using some more examples. After remedial work, he is directed to the original frame to make another attempt at choosing the right answer. The learner moves forward if he answers correctly but is diverted (Branched) to one or more remedial frames if he does not. This cycle goes on till the learner passes through the whole instructional material.

Rationale

Traditional methods or strategies of teaching are teacher-centred. Piaget and Kohlberg are the constructivists who gave more focus on active learning, keeping the child in the centre. Different methods and techniques are used by the teachers to keep the student active and engaged in the classroom by keeping in mind the interests and needs of the individual learner. Economics is a social science, which means it studies society and the relationship between them. Economics is a part of Social Science till class 8, but some parts of Economics may be taught from class 6, including civics. Till class fifth, students already learn something about social science in EVS, but Economics is a new and complex subject for class 6 to 8 students. Economics sometimes deals with some statistical data and technical words, which is sometimes very difficult for students to understand the basic concept, so teachers try to use different

methods for teaching Economics, such as Concept Maps, Project methods, Play-Way methods, Programmed Learning Material, etc.

Few studies on the use of Programming Instruction have been found in India like:

Shah (1968) developed programme material in mathematics on solving equations for class VI students and conducted an experiment for using it. It was found that the group taught by the program alone did significantly better than the traditional lecture method group. Joshi (1972) Developed programmed learning material for first-year degree students in Maharashtra. It was found that learning with programmed learning material was more effective, permanent, and interesting than the traditional method. Chopra (1995) developed the programmed learning material in Home Science on food and nutrition for twelfth-grade students and found it effective for learning. Shihabudeen (2001) found that the group that learnt English through programmed instruction achieved higher mean scores than that of the control group, which learnt through the conventional method of teaching. Ujjainwala (2012) conducted a study to know the effectiveness of computerized branched programme learning material in achievement in chemistry subjects and found that the use of branched programme learning material improved the achievement of students in chemistry. Jain (2017) found that programmed instruction is effective in terms of achievement in English. Sambasivarao (2020) conducted a study on the impact of Programmed Instruction on academic achievement in mathematics. The study found that the use of a programmed instruction strategy improved achievement in mathematics learning.

Novak (1983) found concept mapping is effective for junior high school science students. Pankratius (1990) found that achievement in the Physics of concept mapping group was significantly higher than that of groups that received standard instructions. Ragwalan (1991) studied concept mapping in learning Physical Science and found that the experimental and control groups of boys, girls and Co-educational students had no difference in post-test scholastic performance. Regis and Giorgio (1996) proposed the application of concept maps in Chemistry teaching in high schools. Williams (1998) used concept maps to assess conceptual knowledge and found it effective in terms of mathematical achievement. Gupta (1999) found that the concept mapping model is significantly more effective than the conventional method to foster concept learning in terms of comprehension and application of concepts in chemistry. Ahuja (2007) studied the effectiveness of concept mapping in Science and found positive results. Shailaja (2008) found concept mapping is effective in the achievement of Physics. Dammani (2011) found that the concept mapping strategy was significantly more effective than the concept attainment model in terms of understanding English grammar concepts. Amita (2015) found that the achievement in Biology of class IX students in the concept mapping group was significantly higher than that of the traditional group. Kumuda (2016) developed the concept maps for higher secondary school students in physics and found that the gain scores of students taught through concept mapping are significantly higher than the gain scores of students taught through the lecture method. Anamika (2016) developed the concept maps for IX students in Chemistry and found that concept mapping has a positive effect on cognitive skills and enriches the concept attainment. Besty (2019) found that achievement in Chemistry of higher secondary

students is significantly improved by concept mapping as compared to activity oriented method. Chauhan (2020) found that the understanding in various concepts of Social Science is significantly higher by concept mapping as compared to conventional methods. Jena (2020) found a significant difference in science achievement between the Spider Map Concept Approach and the Hierarchal Concept Map Approach over the Traditional Approach of Teaching. Pandey (2020) found that Concept Mapping is more effective than traditional teaching of Biology. Nausheen (2021) found Concept Mapping is effective in terms of Science achievement.

It is clear from above previous research works that most of the research works have been done regarding concept mapping and Science subject, but no one has done this study in Economics. Thus, in this study researcher wants to study the effect of Concept Map and BPLM on achievement of students in Economics of class VII students.

Statement of Problem

"Effectiveness of concept mapping and branching programming learning material on achievement in economics"

Operational definition of key terms

- **Concept Mapping**: It is a strategy or technique of teaching any topic or concept by dividing the one concept or topic in various different sub- concepts or sub- topics by establishing link or relationship between them.
- **Achievement**: This refers to the marks scored by students in the Economics test related to chapter 7, 'Market Around Us'.
- **BPLM:** It is an MS Office PowerPoint based self-learning material where content is arranged in a logical sequence. In which each slide consists of content after which a question will be asked, on choosing the correct option the learner will move forward to read the next content, if the answer is wrong then the learner will be given remedy and has to re-read that slide.

Objectives

1. To compare the mean ranks of gain scores of the Traditional lecture group and Concept Mapping group.
2. To compare the mean ranks of gain scores of the Traditional lecture group and Branching Programming Learning Material group.
3. To compare the mean ranks of gain scores of the Concept Mapping group and Branching Programming Learning Material group.

Hypothesis

1. There is no significant difference between the mean ranks of gain scores of the Traditional lecture group and the Concept Mapping group.
2. There is no significant difference between the mean ranks of gain scores of the Traditional lecture group and the Branching Programming Learning Material group.
3. There is no significant difference between the mean ranks of gain scores of the Concept Mapping group and the Branching Programming Learning Material group.

Delimitations

- The study was delimited to only English medium students.

- The Concept Maps and BPLM were developed in Chapter 7, "Market Around Us", of Economics only.
- The study was delimited to Schools affiliated with only the MP Board.

Methodology

The experimental method was used for this research in which the independent variable was teaching strategy, and the dependent variable was an achievement in Economics.

Sample

The present study was conducted in two schools in Indore city. The population comprises all students of class 7th in the session 2022- 2023 in Indore MP Board School. A purposive sampling technique was used to select the schools. The selected schools were Namdev Panjwani Higher Secondary School and Jagdale Higher Secondary School. The selected schools were assigned randomly to two levels of treatment. Namdev Panjwani Higher Secondary School formed the Experimental groups and taught with Concept Mapping and Branching Programming Learning Material, while Jagdale Higher Secondary School formed the Traditional lecture group and taught with traditional strategy. The sample consists of 67 students, out of which 25 students were from Experimental Group 1(Concept mapping group), 25 students were from Experimental Group 2 (Branching Programming Learning Material group), and 17 students were from the Traditional lecture group. The age range was to be 12 to 14 years. The medium of instruction in both schools was English, and both schools belonged to the urban area of the Indore district. The students were from different socio-economic statuses.

Table-1: Group-wise and gender-wise sample

School Name	Group	Gender	Sample
Namdev Panjwani Higher Secondary School	Experimental group 1 (Concept Mapping)	Male	9
		Female	16
	Experimental group 2 (BPLM)	Male	25
Jagdale Higher Secondary School	Traditional lecture group	Male	6
		Female	11
		Total	**67**

Tool: Achievement Test

The achievement test consisted of 20 multiple choice questions related to chapter 7 "Market Around us" of Economics which have 4 alternatives and out of 4 alternatives, one alternative was correct. For one correct answer one mark was given and zero mark was given for a wrong answer. The test was of 30 minutes duration and of 20 marks. The general information was filled by the students such as Name, Class, Gender and School name.

Experimental Design

In the present study non-equivalent control group design was used. Firstly the pre-test was administered on both the traditional and experimental groups and then treatment was given to only experimental groups after that post-test was administered on both the groups. The layout of designs is as follows-

Traditional lecture group	O_1		O_2
Experimental Group 1	O_1	X_1	O_2
Experimental Group 2	O_1	X_2	O_2
Where O_1 stands for pre-test			
O_2 stands for post-test			
X_1 Stands for Concept Mapping			
X_2 stands for Branching Programming Learning Material			
..... Non-equivalency			

Development of Concept Map and Branching Programming Learning Material

To make the concept map, the researcher searched for the different apps through which concept maps can be made very easily and in an interesting manner, along with different images, colours and backgrounds. Thus, the researcher found different apps such as Design Hill, canvas, Get Mind, Nova Mind, Map Tool, etc. The researcher chose the map tool to design a concept map as this tool contains many features like inserting images, colours, background images, and adding different links. Multiple links can be added to each concept to form a dynamic map that opens web pages or local documents.

The Branching Programming Learning Material was developed through the Microsoft PowerPoint application. For creating the presentation, a slide with all the instructions regarding the program was mentioned, and then the homepage was made where the content was displayed. For this, the content analysis was done by dividing the content into major parts. The content was explained in simple language, and for every difficult word, the meaning was provided with the help of a hyperlink so that on hovering over the difficult word, the meaning of the word would appear. For a better understanding of the content, images, graphs and tables were also used. After each content, multiple choice questions related to the content were asked. On choosing the right answer, reinforcement was given with the help of GIFs or images, and for wrong answers, a remedy was given.

Data Collection

First, permission was obtained from the principals of all schools. A good rapport was established between the students. Then pre- test was taken of both the experimental and traditional group on the first day. Then the treatment was given to experimental group for consecutive 7 days. Meanwhile, the traditional group was taught the same topics with traditional method. After giving treatment for 7 days, a post-test was taken from the experimental and traditional groups on the last day.

Data Analysis

In the research study, there are three groups: Concept Mapping, Branching Programming Learning Material group, and Traditional lecture group and group. The sample size was 25, 25, and 17, respectively. In fewer samples, there is a strong chance that any or all assumptions of normality, homogeneity, and outliers will likely be violated. Due to the purposive sampling technique and smaller sample size, Mann Whitney U test was used, and it is also equally powerful, as evidenced by the significant result of the study.

Comparison of mean ranks of gain scores of Traditional lecture group and Concept Mapping Group

The first objective of the research was "To compare the mean ranks of gain scores of traditional lecture group and Concept Mapping group". For analyzing the data Mann-Whitney U test was used, and the results for the treatment effect on achievement were as follows:

Table-2: Summary of Mann-Whitney U test for comparing the mean ranks of gain scores of traditional and concept mapping group

DV	Treatment	N	Mean ranks	Sum of ranks	Mann – Whitney U	Z	P
Ach.	Lecture	17	15.35	261.00	108.00	-2.69	.007*
	Concept Mapping	25	25.68	642.00			

**Significant at 0.01 level*

From the above table, it is clear that the value of Mann-Whitney U for the treatment is 108.00, and the Z value is - 2.69, for which the value of two-tailed significance is 0.007, which is less than 0.01 level of significance. Therefore, the U value is significant at a 0.01 level of significance. In this view, the null hypothesis, "There is no significant difference between the mean ranks of gain scores of traditional lecture group and Concept Mapping group" is rejected. This means that there is a significant difference between the mean rank of gain scores of the traditional lecture group and the concept mapping group.

From the above table, it is also clear that the value of mean rank of Concept Mapping group is 25.68 which is higher than traditional lecture group which is 15.35.Therefore, it is concluded that the treatment of Concept Mapping is found to be significantly higher to the traditional method for teaching Economics.

Comparison of mean ranks of gain scores of Traditional lecture group and Branching Programming Learning Material Group

The second objective of the research was "To compare the mean ranks of gain scores of traditional lecture group and Branching Programming Learning Material group. For analyzing the data, Mann Whitney U test was used, and the results for the treatment effect on achievement were as follows:

Table-3: Summary of Mann-Whitney U test for comparing the mean ranks of gain scores of the Traditional group and Branching Programming Learning Material group

DV	Treatment	N	Mean ranks	Sum of ranks	Mann – Whitney U	Z	P
Ach.	Lecture	17	11.21	190.5	37.5	-4.5	.000*
	BPLM	25	28.5	712.5			

**Significant at 0.01 level*

From the above table, it is clear that the value of Mann-Whitney U for the treatment is 37.5 and the Z value is –4.5, for which the value of two-tailed significance is 0.000, which is less than 0.01 level of significance. Therefore, the U value is significant at a 0.01 level of significance. In this view, the null hypothesis, "There is no significant difference between the mean ranks of gain scores of the traditional group and Branching Programming Learning Material group", is rejected. This means that there is a significant difference between the mean rank of Gain scores of the traditional group and the branching programming learning material group.

From the above table, it is also clear that the value of mean rank of Branching Programming Learning Material group is 28.5 which are higher than traditional group which is 11.21. Therefore, it is concluded that the treatment of Branching Programming Learning Material is found to be significantly higher to the traditional lecture method for teaching Economics.

Comparison of mean ranks of gain scores of Concept Mapping group and Branching Programming Learning Material Group

The third objective of the research was "To compare the mean ranks of Gain scores of Concept Mapping group and Branching Programming Learning Material group". For analyzing the data, Mann Whitney U test was used, and the results for the treatment effect on achievement were as follows:

Table-4: Summary of Mann-Whitney U test for comparing the mean ranks of gain scores of Concept Mapping group and branching programming learning material group

DV	Treatment	N	Mean ranks	Sum of ranks	Mann - Whitney U	Z	P
Ach	Concept mapping	25	20.86	521.50	196.50	-2.26	.024 *
	BPLM	25	30.14	753.50			

**Significant at 0.05 level*

From the above table, it is clear that the value of Mann-Whitney U for the treatment is 196.50, and the Z value is is-2.26, for which the value of two-tailed significance is 0.024, which is less than 0.05 level of significance. Therefore, the U value is significant at a 0.05 level of significance. In this view, the null hypothesis, "there is no significant difference between the mean ranks of gain scores of Concept Mapping group and Branching Programming Learning Material group", is rejected. This means that there is a significant difference between the mean rank of Gain scores for the Concept Mapping group and the Branching Programming Learning Material group.

From the above table, it is also clear that the value of mean rank of Branching Programming Learning Material group is 30.14 which are higher than Concept Mapping group which is 20.86. Therefore, it is concluded that the treatment of Branching Programming Learning Material is found to be significantly higher to the Concept Mapping for teaching Economics.

Findings

1. Concept Mapping is more effective as compared to the traditional lecture methods in terms of the achievement of students.

2. Branching Programming Learning Material is more effective as compared to traditional lecture method in terms of achievement of students.
3. Branching Programming Learning Material is more effective as compared to Concept Mapping in terms of achievement of students.

Discussion

Novak (1983), Pankratius (1990), and Shailaja (2008) demonstrated its success in improving science and Physics performance. Similarly, Regis and Giorgio (1996) and Gupta (1999) confirmed its efficacy in Chemistry, while Williams (1998) found it beneficial for Mathematics. Ahuja (2007) and Dammani (2011) supported the method's positive impact on science and English grammar learning, respectively. Studies by Amita (2015), Kumuda (2016), and Besty (2019) reaffirmed that concept mapping led to significantly higher achievement in Biology, Physics, and Chemistry when compared to traditional methods. Research by Chauhan (2020), Jena (2020), and Pandey (2020) further emphasized its superiority over conventional teaching approaches in Social Science and Science. Overall, the findings show that concept mapping not only enhances comprehension but also fosters deeper understanding, making it more effective than traditional methods in improving student achievement across disciplines. Shah (1968) and Joshi (1972) demonstrated that students taught using programmed instruction in mathematics and at the degree level outperformed those taught through traditional methods. Similarly, Chopra (1995) found programmed instruction in Home Science to be more effective for learning. Shihabudeen (2001) and Jain (2017) confirmed the method's success in English, while Ujjainwala (2012) and Sambasivarao (2020) found that computerized and branched programmed learning significantly improved student achievement in Chemistry and Mathematics, respectively. The cumulative findings strongly suggest that programmed instruction, particularly branching programming, offers individualized learning that enhances comprehension, retention, and engagement. Therefore, applying branching programmed learning material in teaching Economics is expected to result in better student achievement compared to traditional methods, as it allows students to learn at their own pace and grasp complex ideas more effectively.

Conclusion

The discussion shows that both concept mapping and programmed instruction are more effective than traditional teaching methods across various subjects. Concept mapping improves student achievement in Science, Mathematics, Chemistry, Social Science, and English by enhancing comprehension and fostering deeper understanding. Similarly, programmed instruction, especially branching programming, proves superior in improving student performance in subjects like Mathematics, English, Home Science, and Chemistry by offering individualized, self-paced learning. In conclusion, both methods significantly enhance student achievement, making them valuable alternatives to conventional teaching strategies. Their application in subjects like Economics is likely to yield similar positive outcomes.

Implications

The findings have implications for the teachers, students, parents and content developers, which are as follows:-

Teachers- Concept mapping strategy proved to be very useful for teachers

as they can make their teaching very effective by using concept maps in teaching various concepts of economics. Further, the teachers also use Branching Programming Learning Material to divide the whole content into small chunks and give a chance to students to learn at their own pace. Also, the teachers are being exposed to the concept map; there is a need to stress that the content given in the syllabus should be analyzed in sequences, and appropriate concepts should be identified by teachers so as to make their teaching effective.

Students- Concept maps and Branching Programming Learning Material is very useful for students to make their learning very effective. The student should understand each and every concept thoroughly which will help in meaningful learning and which in turn enhance their achievement also students can make their own concept maps on their own understanding which will help them to remember the concept for a lifetime.

Parents- Concept maps and Branching Programming Learning Material are equal important for parents as it will help them to teach their child at home and helps their child in doing the revision of the ideas during their exams.

Content developers- Concept maps and Branching Programming Learning Materials serve as tools for content developers. Building and using a concept map representing the entire study programme is beneficial for different stakeholders involved in the content development. Concept map and BPLM is a guide for the sequencing of topics throughout the curriculum. The use of concept maps and BPLM allows identifying missing linkages, inconsistencies, false assumptions and previously unrecognized relationships.

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