Vol. 3 No. 1 2025

RECOGNIZED IN "Y" CATEGORY BY

Research Consortium Archive

P(ISSN) : 3007-0031

E(ISSN) : 3007-004X

https://rc-archive.com/index.php/Journal/about

Effect Of Concept Mapping Strategy On Elementary Students' Academic Achievement: An Experimental Study

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Publisher : EDUCATION GENIUS SOLUTIONS

ABSTRACT

The purpose of this research was to determine the effect of concept mapping on student academic achievement in general science. For this study, an experimental research design was adopted. A sample of 44 (all) students enrolled in 7th grade from a selected Government girls high school chatter no 2 District Bagh AJK was taken using a simple random sampling technique. The students were divided into two groups: 22 students in experimental group and 22 students for control group. The researcher used only post-tests in the experimental and control groups for this research. The data was obtained using a post-test in order to discover an appropriate method of teaching concept mapping in the elementary science classroom. From 7th grade general science, Azad Kashmir text book board Muzaffarabad designed written MCQS and short answer question type test were constructed. The investigator gathered data using a post-test. Using a t-test independent sample, the researcher analyzed through SPSS. The study's findings indicate that concept mapping had a large and favorable impact on primary learners' achievement. It is determined that concept mapping is helpful for science education at all levels. A brief and informative concept map has been recommended to improve science teaching at elementary level.

Key words: Concept Mapping, Elementary students, Academic Achievement

INTRODUCTION

A technique for visually displaying the structure of information and concepts, as well as their relationships, is concept mapping. Concept mapping can be employed as a successful teaching - learning approach from primary school to university level, according to research studies in the field of scientific education. Learners utilize concept maps as tools for effective learning, evaluation, instructional planning, and identifying alternate concepts or misconceptions (Nesbit,et,al.2006) When compared to other teaching-learning methodologies, concept mapping has a longer-lasting impact on memory, as evidenced by superior performance on delayed post-tests. Additionally, it might be helpful when used in conjunction with other manipulative learning techniques, including experiments (Hilbert & Renkl, 2007).

Concept mapping has been applied to instruction and learning at all levels and in a variety of settings. Concept maps are being used more frequently in scientific classrooms. Concept mapping has received a lot of support and has been applied in a variety of ways in science education. It has been used to assist students in developing and organising their body of knowledge in a particular field or subject. Concept mapping has not only been found useful in promoting pupils' understanding of science concepts, it also facilitates pupils' abilities to solve problems (Zimmerman,et,al.2011) and to answer questions that require application and synthesis of concepts. It has been used to observe change in pupils' understanding of concepts over time. Concept mapping entails a rich social setting in which a student presents and discusses his or her concepts in front of a group or class, which can have a substantial impact on the student's self-concept or self-efficacy. According to research, concept mapping is one innovative instructional method that may help students succeed in and be interested in chemistry (Cheema & Mirza, 2013). Students must actively seek conceptual connections between new concepts and those they already know in order to take control of their knowledge. Simply put, concept mapping is a method of displaying knowledge in networks of concepts or graphs, often known as concept maps (Cheema & Mirza, 2013). Building a graphical representation of subject-matter knowledge for the purpose of understanding concepts in a meaningful way is called concept mapping. For students to work independently or collaboratively to mediate meaning of concepts through linkages, concept mapping approach offers a rich social environment. Its hands-on, activity-based method ensures that all students participate and that their needs, learning preferences, interests, and abilities are met (Cheema & Mirza, 2013).

Concept mapping has its origin in the constructivism which holds that prior knowledge is used as a framework for understanding and learning new concepts. It is based on the belief that no concepts exists in isolation but are interrelated with others to make meaning. Concept mapping helps to strengthen the connecting contiguity among concepts and consequently ensure an improvement in performance and interest in a subject. Concept mapping is the development of constructed and reconstructed knowledge represented graphically. It facilitates active learning, encourages student-discovery while learning (Caputi & Blach, 2008), and reflects students' experiences, beliefs and biases in addition to an understanding of a topic. Through the process of creating a map, related concepts are linked in a meaningful way that serves as a tool for assessing depth and breadth comprehension and knowledge and for reviewing of previously covered material (Croasdell, Freeman, & Urbaczewski, 2003).

An important function of the map is to help make explicit complex topics where students may display a fragmentary understanding and are unable to integrate all the components to form a meaningful overview or conceptual framework (Kinchin, Cabot & Hay, 2008). Additional benefits of concept maps include suitability to all learning styles and being an effective method to convey large amounts of information in a limited time (Burgess & Yaoyuneyong, 2010), improve students' academic achievement, increase information recall and retention, and reduce cognitive overload. All the above studies were carried out in all over the world.

Learning is a purposeful, conscious and complex process of the human mind. Compared to maturation it brings a relatively permanent change in knowledge, behaviour, skills or attitude. An important feature of learning is that it involves a complex interactive system including environmental, social, motivational, emotional and cognitive factors. Emotions and cognition of a learner cannot be separated.

According to Nelson (2007), Concept Mapping is a nonlinear, graphic representation of unstable domains, depicting major concept nodes and the interrelationships of those nodes. It is a learning strategy identified as having a significant impact on retention and retrieval of information, with continued processing of data over time. Unfortunately no literature is found in Pakistan especially in Azad Jammu and Kashmir. Therefore, the researcher intends to carry out the present research

A concept map's unique quality is its effective display of the most information possible in the fewest possible words. Concept maps make the teaching-learning process easier, more clear-cut, and effective, which helps to boost students' comprehension ability. Concept maps can be used as a method for knowledge integration to find intriguing links between ideas, generate fresh ideas, and evaluate competing theories. In Azad Jammu and Kashmir teachers mostly teach with traditional method. Hence, study was an effort to find out the effect of concept mapping as a learning strategy on the academic achievement of students at elementary level in the subject of General Science of grade 7th.

OBJECTIVES OF THE STUDY

The objectives of the study

1. To find out the effect of concept mapping as a teaching strategy on the academic achievement of students of 7^{th} grade in the subject of General Science (Experimental Group).
2. To find out the academic achievement of students teaching without concept mapping strategy of 7th grade students in the subject of General Science. (Control Group traditional method).
3. To compare the academic achievement of Experimental and Control Groups

LITERATURE REVIEW

A concept map is an effective teaching and learning tool because it provides a visual representation of the students' acquired knowledge as well as other benefits during the learning process (Stocia, Moraru, & Miron, 2011). It shows the deep interrelationships among several concepts in a particular learning area. To improve the learning environment, concept maps can be linked with various learning techniques such as dialogue, cooperation, discussion, and feedback. Previous research has shown that using concept maps in a variety of learning contexts can result in higher learning outcomes than using a basic learning method. (Joshi & Vyas 2018) Not only are concept maps effective, but the tasks involved in creating them also enable students improve their critical thinking skills (Tseng 2020), despite the fact that some students suffer with concept mapping during their studies (Machado and Carvalho, 2020) Concept maps have been found to develop deeper, higher-level cognitive processing (Wu et al. 2016), as well as meaningful learning, in addition to promoting learning progress and assessment of students' knowledge (Prasetya 2020).

Teachers can use concept maps to assess their teaching and find misconceptions and missing concepts in their learners (Stoica et al. 2011). Kit-Build is an example of a learning framework that includes concept map recomposition as a key learning activity for evaluating students' comprehension. In his book Learning How to Learn, Novak created the concept map Students should be able to understand the content offered by the teacher and engage in meaningful learning as a result of using concept maps (Tee et al., 2014).

Tony Buzan's model concept map includes the type of network tree concept map (Tee et al., 2014), which defines that concept maps of this type are arranged using photos or images placed in the centre of a horizontal paper. After that, the primary branches are linked to the main image, which then links the second and third level branches to levels one and two, and so on. Concept maps are a tool that students use for effective learning, assessment, and lesson planning, and discovering other concepts or misconceptions (Novak & Camas, 2006a, 2006b;)

When compared to other teaching learning methodologies, concept mapping has a long lasting influence on memory, as seen by superior delayed post-test outcomes. It can also be used in connection with other interactive learning techniques such as experiments. (Hilbert & Renkl ,2007) A concept map is a node-link diagram that depicts the semantic connections between concepts. "Concept mapping" is the term for the process of creating concept maps. Nodes, arrows as connecting lines, and linking sentences that express the relationship between nodes create a concept map. A proposition is a set of nodes connected by an arrow with a label. Concept maps are dynamic graphic organizers that may represent a wide range of concepts and their relationships. Linking phrases can express the relationship between concepts, such as" is inside of" (spatial), "follows" (temporal), "leads to" (causal), "consists of" (part-whole), "increases" (quantified), or "is different from" (comparison). A semantic network of propositions is formed by nodes (mostly nouns) and linking phrases.

The concept mapping theoretical framework is based on David Ausubel's assimilation theory of learning, which emphasises the role of existing cognitive structures in learning new concepts. In the 1970s, Joseph D. Novak and his research team at Cornell University created concept mapping as a method of graphical representation of concepts based on their research on comprehending changes in people's knowledge of science. Since it focuses a heavy emphasis on actively involving students in eliciting and connecting both old and new concepts, concept mapping is regarded to be consistent with constructivist epistemology. By displaying concepts and relationships as node-link diagrams, concept map exercises can help elicit existing and lacking concepts and connections. (Schwendimann,2014)

Concept maps can be created by hand with paper and pencil, flashcards, and post-its, or with computer software (examples include the shareware application C-map). According to research, concept mapping software can help with the creation, editing, and inclusion of hyperlinks and multimedia. As a "focus question," a concept map might provide a how or why question to describe the purpose of a concept map and drive concept map construction. Concept maps can take many different shapes, ranging from open-ended to almost confine. With a few restrictions, concept mapping exercises can provide students with a focus topic still allowing them select their own concepts and relationships. Although learners can choose which concepts to connect from pre-made lists of topics or medium-constrained forms of linking sentences, Learners can use highly restrictive concept maps to obtain a basic network structure and ready-made lists of concepts or connecting words to fill in the structure's gaps. It is determined that concept mapping is beneficial for science instruction at all levels. A brief and informative concept map has been recommended to improve science teaching at this level (Nesbit & Adesope 2006).

Another way to think of concept mapping is as the first stage in the development of ontology, and it can be used to convey formal arguments in a variety of ways. Concept maps have been investigated as lesson planning aids, enhanced organizers for learning such as knowledge management interfaces, evaluation tools, and online navigation interfaces. Concept maps have been examined as learning tools in a range of science areas, for solitary or collaborative learning, with young children through adults (including chemistry, biology, earth science, ecology, astronomy, and medicine). Concept maps have a moderately beneficial impact on student achievement and a significant positive impact on students' attitudes, according to meta-analyses (Nesbit and Adesope (2006) It has been demonstrated that concept maps, particularly more condensed versions, are effective and reliable assessment tools for conceptual change in scientific concepts. Research comparing concept maps to multiple choice questions reveals that concept maps assess a variety of knowledge kinds (for example, propositional and hierarchical). By displaying links between ideas from various levels, concept clusters, hierarchical levels, and cross-links between them, concept maps can illustrate how pupils organise their information. Cross-links are particularly interesting since they can reveal the knowledge producer's creative leaps.

Concept Map is one of the innovative teaching strategies that enables students to link all of the information in their thoughts. It has been strongly endorsed in science education since it improves students' ability to recall and comprehend information both visually and audibly (Cheema & Mirza, 2013). Additionally, it is a method of instruction that helps pupils understand difficult subjects and clarifies ambiguous connections between them (Shamsudin, 2015). Concept Map are frequently built in response to a focal question, which is a specific question we want to answer. Humans organise and transmit information through the process of developing visual representations of knowledge. It is a general and engaging teaching-learning strategy that may be used to help any person or group express themselves graphically. This way of portraying ideas is used to establish a connection between and among concepts, as well as to determine how they relate to one another (Schwendimann, 2015). A concept map serves as a model or framework to help group and arrange information. As soon as teachers understand how to read and create Concept Maps, they will be able to quickly identify students' prior knowledge as well as any misconceptions and use it as an assessment approach (Cook, 2017).Educational concept maps are useful tools that can be utilised in a variety of educational contexts, including knowledge production, meaningful learning, evaluating students' comprehension and misunderstandings, and lesson preparation. Students actively participated in their education in the concept map-based teaching and learning technique by identifying important concept about the subject from the text, participating in discussions about the topics, and developing links between concepts by creating their own concept maps. In this environment, students became more engaged and interactive in their learning, delving deeply into the topics at hand during conversations, and applying prior knowledge. Students were able to capture and keep more concepts in their cognitive framework as a result of these opportunities, and they performed better on tests and had a better comprehension of photosynthetic concepts

RESEARCH METHODOLOGY

The current study is purely experimental. An experimental research is a study that tries to determine the cause-and-effect relationship between variables in a controlled environment. Researchers actively regulate and adjust the conditions that define the events of interest in experimental research, then introduce an intervention and measure the impact it has. This study uses an equivalent group design with only post-tests. This is a good way to cut down on the experimental intensity bias. Then, a substantial difference is noted between the experimental and control groups' achievements. This design is one of the most successful at limiting challenges to experimental validity. The experimental and control groups are balanced using randomization. At the end of the experiment, the difference between the mean test scores of the experimental and control groups is subjected to a statistical t-test. In this study, sample was selected through random sampling technique and 44 students participated in it. All of the participants were in the seventh grade and were studying science. The seventh grade science class was divided into two groups (Control and Experimental), each with 22 students. The school in question was chosen for study because it has a big number of students, huge classrooms, and numerous amenities, as well as cooperative staff, students, and management. The procedure of group randomization was used to ensure that the groups were equal. The researcher first chose ten chapters from the Punjab Textbook Board's grade 7th science textbook for constructing achievement tests. The researcher created an MCQS and a short answer question test, as well as a lesson plan for each lesson. For data collection, a composed MCQS type test was created based on Bloom Taxonomy's three levels of cognitive domain (knowledge, comprehension, and application). Every lesson plan had four stages: prior comprehension, stage of presentation, stage of practice, and stage of progress. The investigator used the students to gain access to all of the discussions. Following the completion of all study items, the researcher provided a post-test, lesson plans, and discussion advice to the panel of experts for validation. Every day, the researcher conducted a post-test for both classes after each experiment. Each test took forty minutes to complete. The studies were carried out and accurately recorded. All of the tests were marked and separated by the researcher.

DATA ANALYSIS

For comparing the means of two groups, the t-test was applied. The information gathered was an analysis using SPSS 23. The goal of data gathering and interpretation is to obtain useful and useable information.

Table 1: Overall Post-Test Result

Groups	N	Mean	Std. Deviation	t	df	Sig
Experimental Group	22	87.68	10.17	14.81	42	.00
Control Group	22	42.71	7.73			

Table 1 illustrates the importance of the overall test for the Experimental Group. (M=87.68 SD=10.17) is higher than the value of the control Group (M=42.71, SD=7.73) and t (42) = 14.81, P<.05 Demonstrates how stark the disparities between the two groups are. This difference between the two groups is clear, much as how the experimental groups' means values are higher and more significant than the control groups'. This contradicts the H0 hypothesis, which held that there was a substantial difference between the successes of the Experimental Group and the Control Group. The use of the concept mapping method led to the experimental group's output being highly potent. Concept mapping techniques are effectively used in the classroom to further educational objectives.

Table 2: Result of Overall Knowledge Level Post-Test

Groups	N	Mean	Std. Deviation	t	df	Sig
Experimental Group	22	32.00	5.36	9.95	42	.000
Control Group	22	16.76	3.51			

Table 2 demonstrates that the Experimental Group's value of the overall knowledge test (M=32.00 SD=5.36) is higher than the value of the Control Group (M=16.76, SD=3.51) and t (42) = 9.95, P<.05 shows that the two groups' differences are very apparent. Similar to the knowledge level, the experimental group's mean value is higher and significantly different from the control group's value, showing a definite distinction between the two groups. The H0 hypothesis, which claimed there was a significant difference between the accomplishments of the Experimental group and the Control group, is thus disproved. The experimental group's production was quite powerful as a result of the concept mapping method's utilization. The use of concept mapping methods in the classroom for instructional goals has a net beneficial effect.

Table 3: Result of Overall Comprehension Level Post-Test

Groups	N	Mean	Std. Deviation	t	df	Sig
Experimental Group	22	35.00	4.71	11.7	42	.000
Control Group	22	17.18	4.31			

Table 3 demonstrates that the Experimental Group's value of the overall knowledge test (M=35.0 SD=4.71) is higher than the value of the Control Group (M=17.18, SD=4.31) and t (42) = 11.7, P<.05 shows that the two groups' differences are very apparent. Similar to the knowledge level, the experimental group's mean value is higher and significantly different from the control group's value, showing a definite distinction between the two groups. The H0 hypothesis, which claimed there was a significant difference between the accomplishments of the Experimental group and the Control group, is thus disproved. The experimental group's production was quite powerful as a result of the concept mapping method's utilization. The use of concept mapping methods in the classroom for instructional goals has a net beneficial effect.

Table 4 Result of Overall Application Level Post-Test

Groups	N	Mean	Std. Deviation	t	df	Sig
Experimental Group	22	20.68	2.93	12.42	42	.000

Control Group	22	8.77	2.82

Table 4 demonstrates that the Experimental Group's value of the overall knowledge test (M=20.68 SD=2.93) is higher than the value of the Control Group (M=8.77, SD=2.81) and t (42) = 12.42, P<.05 shows that the two groups' differences are very apparent. Similar to the knowledge level, the experimental group's mean value is higher and significantly different from the control group's value, showing a definite distinction between the two groups. The H0 hypothesis, which claimed there was a significant difference between the accomplishments of the Experimental group and the Control group, is thus disproved. The experimental group's production was quite powerful as a result of the concept mapping method's utilization. The use of concept mapping methods in the classroom for instructional goals has a net beneficial effect.

DISCUSSION

The efficiency of the concept mapping approach versus the traditional method of teaching and understanding some science concepts at the elementary level was examined in this study. The researchers wanted to see if the concept mapping technique may help students perform better in science concepts. Students who were taught using concept mapping performed better than those who were taught using the traditional method. Bunting (2006) discovered that students who participated in tutorials that used concept mapping as a teaching strategy outperformed those who took a regular class or didn't attend any tutorials. This study provides concrete proof of concept mapping's effectiveness in improving students' science proficiency. Similarly, according to Bos and Anders (1990, as reported in Guastello, 2000), such graphic plans or presentations assist pupils in making mental connections. Concept mapping has the potential to enhance teaching and learning in general scientific courses, as evidenced by the significant achievement disparity between the experimental and control groups. Students in the experimental group were better able to understand the subjects they were taught because they could discover links between ideas. As they built, they discussed ideas, and the best ones were used to create their maps; as Anamuah Mensah, Otuka (1996) point out, this idea became public knowledge. Students were also required to create idea maps on their own. They formed their own knowledge as they made connections between concepts. Students also had a visual representation of the concept being discussed by documenting their ideas in a concept map, and the linking phrase made the relationship between concepts obvious (Bunting , 2005). While students worked on their maps (either individually or in groups), the researcher who also served as the lecturer, went around the room and engaged students in conversation and critique of their work. Colour-coded and labeled idea maps were used. Because concept maps provide students with a visual depiction of concepts, they are better able to remember information.

CONCLUSION & RECOMMENDATION

The use of educational concept mapping has a beneficial and critical influence throughout the learning cycle, and current research shows that it has an impact on students' achievement at the fundamental level of the course book as a whole.

It offers students a conducive setting for learning. They can expand their knowledge beyond elementary level general science textbooks. In the current study, the researcher discovered that elementary students are enthusiastic about using educational concept mapping in general scientific reading material. At first, they were to participate as though it were a completely new experience for them, but they showed less interest in learning, eventually becoming active members of the trial. They were enthralled by all of the chapters completed by the specialist while encouraging general science at the elementary level in class 7th. It was discovered in their general post-test results that the cognitive domain's three phases had each grown (getting, information, application). According to the first objective, the results of the current study showed that the experiment group's performance was outstanding when compared to the control group, which was evidence of the beneficial and substantial effects of using educational concept mapping method in elementary level general science teaching in the Bagh Azad region of Jammu and Kashmir. It has been demonstrated that using educational concept mapping for instructional purposes in the classroom has a generally favorable and significant impact. According to the second objective current study's findings, students in the experimental group who were taught utilizing a concept mapping method did better than those in the control group who were given lectures. Students in this research seemed to have a better understanding of the subject matter, going by the results of their post-test.

It is recommended that the school's administrators to hold concept mapping method in every subject's. To further improve students' conceptual understanding; they should make sure that science is taught at the school level via concept mapping method.

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