

# The Effectiveness of Concept Mapping to Improve Achievement and Scientific Aptitude among IX<sup>th</sup> Standard Students

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## **Abstract:**

The research set out to see how effectively concept mapping, a method to learning grounded in constructivism, could help IX graders understand general science. This quasi-experimental study was conducted using a 2x2 factorial study design. The main objectives of this study were to evaluate the effect of concept mapping as a learning strategy on student academic performance, (ii) to compare the effect of concept mapping on academic performance of male and female students; (iii) concept mapping was to evaluate the effect of as a learning strategy to assess student school performance. Researcher utilized a pre- and post-test achievement instrument. In the course of their five-month treatment, the experimental group learned how to create concept maps over the course of three weeks. Students developed their own concept maps for each of the overarching scientific topics they had been studying, discussed their maps in small groups, and the teacher compared their work to established scientific concept maps to determine whether or not any adjustments or improvements were warranted. Two-way ANOVA was used to analyze the data from the gain accomplishment scores. The results showed that both male and female students benefited from being taught through concept mapping as compared to traditional methods. However, when concept Maps were used in the classroom, the boys performed much better than the girls. Therefore, Concept Mapping is recommended for use in secondary schools to teach general science. Concept maps can also be included in secondary science textbooks.

**Keywords:** Learning Strategy, Science Education, Concept Mapping, Students' Performance

## **1. INTRODUCTION**

Education is a necessary and fundamental component of all forms of progress (Offiah and Achufusi, 2010). It serves as a tool for the global advancement of economic, political, and scientific endeavours (Olarinoye, 2001 and Otuka, 2006). This may be the rationale behind the Federal Government of Nigeria emphasizing the teaching of science in its National Strategy on Education, specifically biology, where genetics belongs (FGN, 2008). It has been noted that one of the most difficult aspects of teaching is coming up with activities that engage students and support their independent thought while also providing the necessary explanation, assessment, communication, and application of scientific models to help students make sense of their experiences (Afolabi & Akinbobola 2010). There is developing information on the worth of student centeredness in science training, which has drawn in a ton of consideration in association with understanding how students advance and how to help them in finding out about logical ideas (Jegede, Alaiymota & Okebukola 1990). As per Cliburn (1990) and Danjuma

(2005), these drives to assist understudies with learning all the more effectively have brought about the production of met mental techniques to help significant learning. Meta-mental strategies, as indicated by Novak (1983), are meta-information and meta-realizing, which are approaches that empower a student to assume responsibility for their own advancing definitively. According to Novak & Godwin (1984), met knowledge is knowledge about the very essence of information and knowing, and metal earning is knowledge about the very nature of learning or knowledge about meaningful learning. Meaningful learning, according to Malone & Dekker (1984), is the ability of learners to incorporate new information into their pre-existing networks of concepts and propositions in their cognitive structures.

According to Kinchin (2005), concept mapping is a method for helping students organizes their cognitive frameworks into more effective integrated patterns. Several scholars have found that idea mapping can enhance meaningful learning and support independent learning, including Okebukola and Jegede (1988), Novak (1983), and Bello and Abimbola (1997). According to Novak & Godwin (1984), idea mapping is a schematic tool for depicting a set of concept meanings that are contained in a hierarchical diagram and show how various concepts are related to one another. It follows that concept maps give learners a visual road map of the several routes they can take to create their understanding of concepts and propositions. According to Novak & Godwin (1984) and Novak (1990), this method works as a teaching and evaluating tool, encouraging the students to employ relevant mode-learning patterns. Similar to this, Chiou (2008) investigated how idea mapping affected students' learning outcomes and interest. Conclusion: Those who were exposed to accounting through idea maps outperformed those who were exposed through expository methods.

Despite the work of scientific educators like Bello (1996), Danjuma (2005), Jibrin and Abba (2011) in identifying an effective instructional approach for secondary school teaching. There are still occasional reports of students performing poorly in school as seen by their NECO and WAEC biology exam results (Lakpini, 2007; Ogbenevwe, 2010; Adebayo, 2011 & WAEC, 2011). Poor performance was attributed, among other things, to the use of inappropriate teaching methods, incorrect spelling of technical terminology, inadequate subject-matter understanding, and failure to distinguish between phenotypic and genotypic ratio in genetics. Moreover, Omole (2011) believed that 75% failure in math and science is concerning. Finding instructional strategies that students can relate to, share ideas with, and engage in academic interaction within them, is necessary. The goal of the current study is to determine how the idea map teaching technique affects senior secondary school students' academic performance in genetics.

## 2. REVIEW OF LITERATURE

It is evident and plain that numerous researchers, like Sushma, Lakshmi, and Baveja.B from India, have used idea mapping. In the 1880s, experiments were done by Novak. D. Joseph and others for schoolchildren in the disciplines of science, English, and mathematics. Zain Ben and Lavie Bar concentrate on environmental education. Concept mapping was used in 1992 by Lambiotte, J., and Danseau, D. to teach mathematics to secondary school students. Schoolchildren were taught general mathematical principles by Baroody A. and Bartels B. Regarding modular education during standard VIII, Shajahan and Anita did a study on fundamental mathematics. For high school students, Broome created a curriculum on spherical trigonometry as a 4–8 hour topic. John did study on "genetics" for students in higher education. Sadia Sadiq pursued academic pursuits at the college level. Pertaining to Homework and experiment by Velmurugan involved eighth-grade students. Shahzad Saqib et al.'s

research focused on elementary school students. Somoski, Holler et al., Hagerty and Smith researched collegiate algebra homework using web-based software. Taylor dealt with algebra pupils at the intermediate level. In their collegiate Calculus course, Gutarts and Bains concentrated their efforts. i.e. the effects of making homework both necessary and optional. Four collegiate mathematics classes were used in Cox and Singer's investigation of online assignments. i.e. online vs. homework done using a pen and paper. The aforementioned investigations were deemed to be insufficient and restricted to particular fields, which allowed the researcher to start the new study. The researcher's gap is that neither concept maps nor modular learning strategies, nor the students' attitudes about homework, have been used in any studies of trigonometry and calculus for higher secondary students.

After analyzing the literature on this subject from both inside and outside of India, it is clear that concept mapping instruction increases students' knowledge of subject matter at higher levels of cognition and raises their academic accomplishment compared to traditional instruction. The similar outcome was observed in the investigations mentioned below, including etc. Also, it is evident that some research has been done on the connection between idea mapping approach and attitude towards science subjects and other topics. The teaching-learning process for students should flourish as a result of this technique. The concept mapping teaching technique is connected to student motivation, higher education, and collaborative learning. Some researchers will also conduct studies on the relationship between idea mapping and the teaching technique of mind mapping etc. Yet, very few studies are likely to be found about the relationship between student intelligence level and the improvement of science success through idea mapping teaching technique. In this way, it is clear from the examinations referenced over that the thought planning showing method decidedly affects understudies' scholarly advancement.

Concept Map: Visual tools for organizing and constructing knowledge about certain concepts, concept maps are. To create understandable sentences, this graphic organizer uses a schematic depiction of concepts. It serves as a framework for how significant concepts are related to one another. In a framework of propositions, concepts maps serve as "a schematic mechanism for describing a set of idea meaning". According to another statement, "Knowledge is structured for each learner as internal idea maps or schemata, which are psychological webs of interconnected bits of information." Concept mapping is a word that broadly refers to any method for conveying concepts as images or maps.

### **2.1. OBJECTIVE OF THE STUDY**

1. Analyze how the use of concept mapping as a teaching method influences students' grades in 11th grade.
2. Examine how idea mapping affects male and female students differently in terms of academic performance.
3. Determine the connection between the gender of the instructor and the students' academic performance.

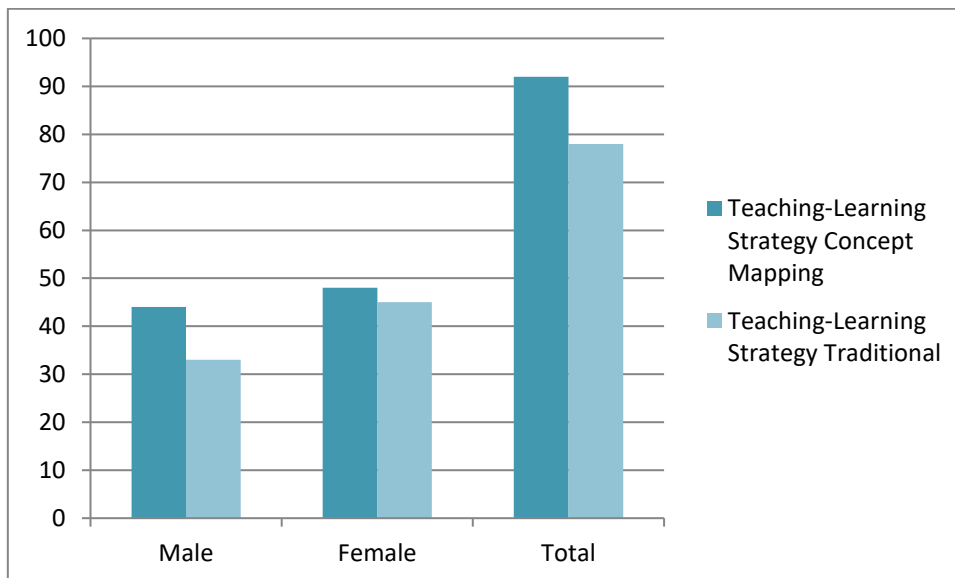
## **3. METHODOLOGY**

### **3.1. Research Design**

Two levels of every one of the two free factors — orientation and showing learning system — were utilized in this semi trial study. To address all possible mixes of the picked levels of the two autonomous factors, the 2x2 factorial plans were utilized.

**Table: 1 Student-Number Factorial Design**

Method of Instruction		
Gender	Using concept maps	Traditional
Male	44	33
Female	48	45
<b>Total</b>	92	78



**Fig.1. Number of Students**

### 3.2. Sampling

To pick the best example, various phases of inspecting were completed. Out of 16 male and 12 female schools in Meerut, Uttar Pradesh, two Honorable Government funded schools — one for male students and one for female students — were promptly picked at the underlying round. Each of the two schools that were chosen had four sections of grade 11 classes with roughly 45 pupils each. At the second round of testing, two areas were haphazardly browsed each school, one of which filled in as the benchmark group and the other as the exploratory gathering.

Students received a briefing at the beginning of the course outlining the purpose, timeline and responsibilities of the study programme. You can leave the study at any time if you feel uncomfortable

### 3.3. Research Tool

A scientific achievement exam covering the chosen material from the 11th grade General Science curriculum textbook was prepared for this study in order to assess students' academic achievement.

The accomplishment test had questions from all subject areas, including Chemistry and Physics, and the distribution of questions and scores were 45% (38), 33% (25), and 29% (22), respectively. Also, the test's items were created with consideration for the cognitive domain's levels, namely Knowledge, Comprehension, and Application or higher. A generally equivalent number of things covering Information (34%), Understanding (38%) and Application or more elevated levels (35%) were remembered for the test, as exhorted by BouJaoude and Attieh (2003). The accomplishment test has 18 limited reaction questions and 42 different decision questions.

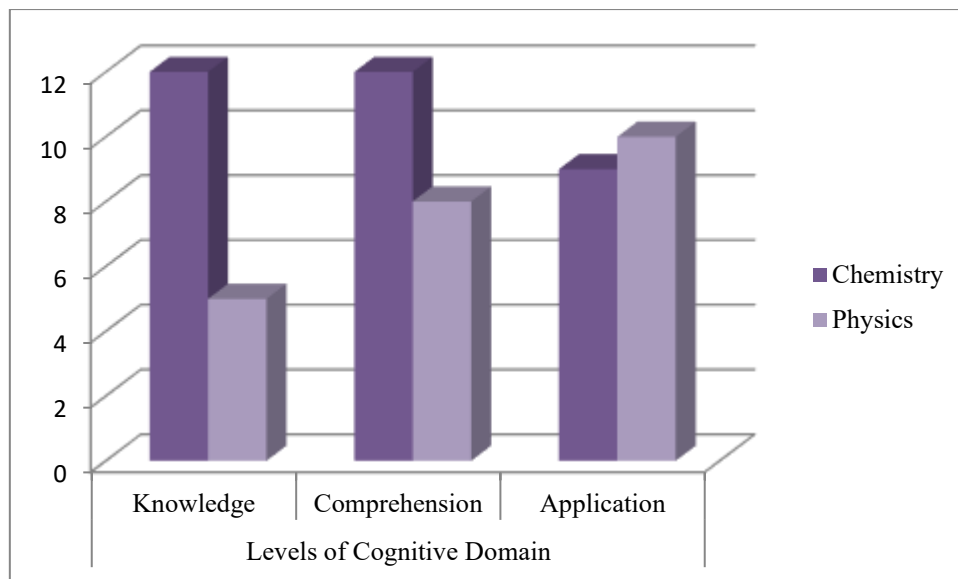
Four subject matter experts assessed the accomplishment test to ensure the content and terminology was accurate. 200 pupils from Noble Public School (120 men and 80 women) participated in the pilot study. The "Trouble Level" and "Segregation Power" of every not entirely settled by thing examination. As per Kubiszyn and Bolich's proposals, things with segregation lists above 0.20 and trouble files somewhere in the range of 0.20 and 0.70 were remembered for the test (2004). According to Linn and Grunlund (2000), the test's 0.84 Cronbach alpha is seen as being extremely suitable for an achievement test.

Process for the Test the experiment's steps were as follows:

1. Researchers must have a bachelor's degree in science or a related field, a master's degree in science education, and have at least 10 years of high school or college science teaching experience to complete all of the concept maps in the pack with the help of an educator created. These concept maps were used as a reference against which students' own maps could be measured during the treatment process.
2. A pre-test achievement exam was given.

**Table 2: Table of Accomplishment Test Specifications**

Subject Area	Cognitive Domain Levels			Scores/Marks
	Knowledge	Comprehension	Application	
Chemistry	12	12	9	18(35%)
Physics	5	8	10	24(25%)



**Fig.2. Accomplishment Test**

**Table 3: Primary Effects of the Teaching-Learning Technique on the Experimental and Control Groups: A Two-Way Analysis of Variance**

Group	Mean	S.D	Df	F	Sig.
Experimental	17.3	6.37	157	46.5	0.000
Control	4.72	3.57			

**3. Five months were spent doing the experiment.**

The exploratory gatherings from the picked young men's and young ladies' schools were first shown how

to make thought maps by the scientist.

Understudies in trial bunches were told to make idea maps for a long time prior to being urged to make their own utilizing general science data. This practice came after groups created concept maps through negotiation and discussion.

Educators and researchers used the approved Key Ideas Maps to assess undergraduate thought maps, guide anticipated improvements and adjustments, and improve idea planning skills for upcoming classes and subjects.

#### 4. FINDING AND RESULTS

The primary impacts and the cooperation impacts of orientation and educating learning approach on understudies' scholarly accomplishment were resolved utilizing a two-way (2x2) ANOVA.

The consequences of the ANOVA demonstrate a significant treatment impact, showing that trial bunch understudies acquired fundamentally more than their partners in the benchmark group.

A solid treatment influence is seen for the two sexes, as per an examination of the increase scores in table 4. Male  $F(1, 69) = 97.59, =0.00$ , showing that male understudies in the exploratory gathering helped altogether more than those in the benchmark group ( $X=3.00, SD= 3.48$ ), as demonstrated by their benefits of 16.41 and 8.30, separately. In contrast with the female understudies in the benchmark group, the female understudies in the exploratory gathering gain considerably more.

It was also looked for whether idea mapping had a different impact on male and female students.

**Table 4: Study of Achievement Scores' Variance by Gender in Experimental and Control Groups**

Group		Mean	S.D	Df	F	Sig.
Experimental Control	Male	15.3	7.37	36	83.6	0.000
		43.6	4.82			
Experimental Control	Female	37	8.26	54	8.27	0.006
		46	5.62			

**Table 5: Analysis of Male And Female Learners in the Experimental Group's Rise in Achievement Scores**

Gender	Mean	S.D	Df	F	Sig.
Male	15.3	8.26	74	17.3	0.000
Female	34.5	8.19			

Table 5 shows that there is a significant gender effect, with  $F(1, 76) = 18.25, =0.00$ , indicating that male students in the experimental group gained significantly more than female students ( $X=8.62, S.D= 8.17$ ) within the experimental group ( $X=14.51, SD= 9.20$ ).

Examining any potential interactions between gender and teaching/learning strategies and student academic achievement was a key goal of the study.

The error variance between the groups was investigated using Levene's test. The results of Lavene's test indicate that the error variation in gain accomplishment score was not the same across all groups ( $F= 9.5, df= 3, = 0.00$ ). The significance level of the F-test was set at 0.01 to meet the statistical requirements for using ANOVA.

**Table 6: A Two-Way ANOVA was used To Examine Differences between the Two Groups and the Effects of Gender and Methodology on the Experimental and Control Groups.**

	Experimental Group		Control Group		df	F	Sig.
	Mean	SD	Mean	S.D.			
Male	15.2	7.24	3.00	4.27	157	18.27	0.000
Female	8.23	7.43	5.21	4.17			

## 5. DISCUSSION

This experimental review shown that thought planning is a more powerful educating and learning methodology than the customary way to deal with raises understudies' scholastic accomplishment in the overall science topic for the two genders. The main reason is that idea mapping gives students the chance to actively participate in their education, which improves their ability to think critically and cross-examine problems in order to find solutions. The learner's imagination is aided and even stimulated through concept mapping (McAleese, 1999). Presenting the ideas to the other pupils helps them understand it more clearly (Freeman, 2004). Students become aware of their assumptions throughout the peer conversation. Cognitive conflict results from inconsistent reasoning. There is a danger that learners' misconceptions will go uncorrected in casual conversation. Yet, if a concept map is created, it is relatively simple for a teacher to identify misconceptions by comparing the student-created concept map to a concept map that has been approved by science. As a result, concept mapping can improve academic performance of both male and female students through active participation in learning, discussion, sharing of concepts, and resolution of misunderstandings.

Regarding science performance, boys outperform girls when concept mapping is used as a teaching and learning method. Thus, the impact of her mapping of ideas on science academic performance is moderated by gender. This can be explained by the large difference in average performance of boys and girls on pretests. Female students in the experimental group performed better than male students on pretests and had less room for improvement than male students. Brant et al. (2001). There is not much research in the literature on how idea mapping affects academic performance differently by gender. Female students benefit more from her mapping of ideas than male students, according to a study conducted at the university level. Bilesanmi-Aworderu (2002) and Albert and Ahoranta (2004) argued that there is no difference in applying concept mapping to gender-based meaningful learning. Boujaoude and Attieh (2003) show that female students perform better when using idea mapping as a study tool for physics and chemistry in the tenth grade.

## 6. CONCLUSION

According to the study, concept map instruction is one of the most efficient ways to teach general science at the secondary school level since it has the ability to raise student academic performance.

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