

# Creative Map Instruction: An Experimental Effect on Biology Students' Mental Ability

**Augustinah Nireti Duyilemi**

**Professor**

Department of Science Education

Faculty of Education

Adekunle Ajasin University, Akungba-Akoko, Ondo State, Nigeria

E-mail: Duyilemitina53@yahoo.ie

**Grace Titilope Babafemi**

Department of Science Education

Faculty of Education

Adekunle Ajasin University, Akungba-Akoko, Ondo State, Nigeria

E-mail: babafemi.tritilope@gmail.com

Tel: 08100427311, 08022649536

## Abstract

The study investigated the effect of creative map on senior secondary biology students' mental ability. Three research questions were raised and answered. The research design was a quasi-experimental pretest, posttest control group design. Two randomly selected schools involving a total of 71 biology students participated in the study. Biology Achievement Test (BAT) and Attitude towards Biology Questionnaire (ABQ) served data collection process. The sample were grouped into three ability levels (High, Medium and Low) using BAT before and after treatment administration. The experimental group was taught using creative map package while the control group was exposed to lecture method. Data collected was analyzed using frequency count, mean and Analysis of Variance. The result ( $F_{(1,61)} = 38.44$ ;  $p < 0.05$ , partial  $\eta^2 = 0.39$ ) revealed a positive influence of creative map on students' mental ability with an upward movement from low and medium ability to high ability group. The study recommends the usage of creative map which offers to student the avenue to self-manage and actively participate in learning while enjoying equal platform to proceed with learning

**Keywords:** Creative map, Mental ability, Attitude to biology

## 1. Introduction

Creativity, the ability to produce work that is novel and appropriate (Sternberg, Kaufman & Pretz, 2002), continues to relate to the social context as it varies from situation to situation. The creative map, which often emerged from engrossed brainstorming, involves generation of ideas, associations and relationships among concepts and phenomena being learnt. Introduced by Buzan, creative or mind map offers to its users the platform to construct meaning out of the learning materials. The map is termed creative tool as it provides the advantage of inventing ideas, internalizing ideas and communicating ideas to students. Also, in order to achieve the goal of teaching for creativity, Mind map is more practical to develop learners' innovative ways of learning activities (Khodabakhshzadeh, Hosseinnia, Moghadam & Ahmadi, 2018). Contrary to the report that the classroom does not appear to be a place where creativity occurs (Plucker, Beghetto & Dow 2004; Asih, 2014), these maps promises to prompt learners to use their cognitive, metacognitive and creative potentials, which are essential skills, for the 21<sup>st</sup> century world. With a shift from teacher-centeredness, mind maps appoint the learner as active participant during learning. Students' engagement, being passionately and successfully engrossed in a task of high quality (Munns, 2007), continues to be the aim of the cognitive tools thereby enhancing interest, involvement, organization, understanding and concentration ( Goodnough & Woods, 2002; D'Antoni & Pinto Zipp, 2005, and Cain 2006).

Research has revealed that the prevalent lecture method in Nigerian schools inhibit students' capacity, involvement and competence (Akingbemisilu & Babafemi, 2018; Owwoeye, 2016) and is not effective. This ineffectiveness is to the disadvantage of educational goal attainment of improving students' mental ability. The concern for high mental ability stems from the fact that the global compatibility and competitiveness that the country, Nigeria, aims to attain cannot be achieved without a sound foundation in science and technology. Mental Ability is related to mental perception, capacity for abstract thinking and capacity to recognize patterns in things (Onabanjo, 2007). This may further influence citizens' thought and pattern of data or situation analysis in favour of the nation building. High mental ability has shown prove in the improvement of students' performance (Sangodoyin, 2011; Olagunju, Duyilemi and Adesina, 2013) thereby reflecting the aim of education. Students with high memory capacity are addressed as high ability learners performing above average in school work, medium ability students revolve around average in information processing and interpretation while low learners do not display encouraging efficiency in their approach. There is a substantial need to identify pedagogical tools to better enhance students' mental potential so as to offer students with varying ability the equal platform to proceed with learning. This need becomes expedient since a typical Nigerian classroom consists of students represented in the three groups. Differences continues to exist in the performance of students taught with varying methods of instruction (Akingbemisilu & Babafemi, 2018; Owwoeye, 2016), therefore indicating the significant role of pedagogical approaches in teaching and learning. The procedure employed by a teacher during instruction in addition to techniques and strategies connotes the method of teaching. It is therefore no doubt that these methods influence academic outcomes such as performance, attitudes and skills among others. Various studies have shown the positive influence of mind maps on self-regulated learning (Tanriseven, 2014), brain lobes usage (Brinkmann, 2003), Knowledge construction (Dhindsa, Makarimi & Anderson, 2011), disposition (Akinoglu & Yasar, 2007), retention and conceptual understanding (Babafemi & Adewumi, 2019) but there is a need to reveal its effect on mental ability.

Creative map is rooted in Ausubel's theory of meaningful learning. The requirement for meaningful learning as stated by Novak, (1998) are prior knowledge, meaningful material and the willingness to learn meaningfully. Buzan initiated mind map, also known as creative map, as an advanced organizer which allows students to subsume or harmonize what is already known with what is being learnt. The map therefore becomes the pictorial display of students' mental representation. Figure 1 shows an example of a creative map

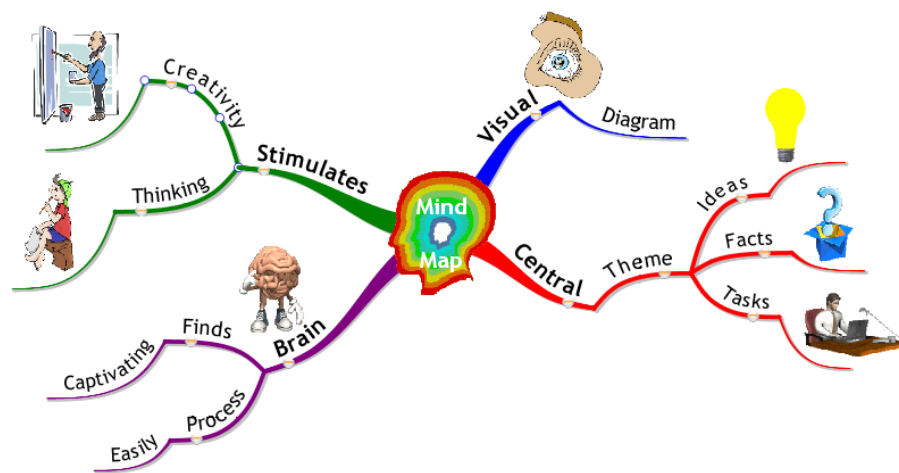


Figure 1: A sample of a creative map (source: ThinkBuzan.com)

Figure 1 reveals the technique of creative maps which involves a central projection into branches of stimulates, keywords, ideas, themes, and facts. The maps further harmonizes relationships, connections and associations between concepts. Visuals including pictures, images and colours beautify the thinking process requiring active usage of both lobes of the brain. The system dysfunction of students not attaining maximum potential (Balduf, 2009) necessitated the need to investigate the role of creative map in enhancing students' mental ability.

## 2. Objective of this Study

The purpose of this study is to examine the effect of creative mapping on biology students' mental ability in Ondo state, Nigeria. It also examined the interaction effect of creative mapping and attitude towards biology on students' mental ability.

## 3. Research Questions

- Does creative mapping instruction significantly influence biology students' mental ability?
- Does creative mapping instruction significantly interact with attitude towards biology to influence students' mental ability?
- Will creative mapping instruction interact significantly with students' mental ability to influence their performance in biology?

## 4. Methodology

The study adopted the pretest posttest control group quasi-experimental design. The population of the study was all Senior Secondary school biology students in Ondo State, Nigeria. The target population was all senior secondary school two biology students in Akoko South Local Government Area from which Seventy-one (71) randomly selected students participated in the study. The experimental group contained 39 students while the 32 students were assigned to the control group.

## 5. Instrumentation

Three instruments were used in this study: the Biology Achievement Test (BAT), Student Attitude towards Biology Questionnaire (SABQ) and teachers' instructional guide for each of the strategies. The validated instructional guide was developed by the researcher using the mental map model proposed by Buzan. The BAT contained 20 adapted multiple choice questions from the WASSCE past questions. Pest and Disease control and Reproduction were the content area of the BAT. BAT reliability yielded 0.85 using Pearson product moment correlation. The SABQ contained 15 items on a four Likert-type response ranging from Strongly Agree (SA), Agree (A), Disagree (DA), and Strongly Disagree (SD). In scoring the SABQ, positively structured statements were done in this order: SA-4, A-3, D-2 and SD-1 while negatively structured statements were done in this order: SA-1, A-2 D-3, and SD-4. The instruments was trial-tested and Cronbach Alpha was used to obtained  $r=0.81$

## 6. Treatment Administration

The data collection procedure was in three main phases and last for Six weeks. Research Assistants training and pretest administration took place in the first week (BAT and SABQ), Students were exposed to creative mapping in the experimental group and lecture method in the control group from 2nd to 5th week and only the BAT (posttest) was administered during the 6<sup>th</sup> week. The pretest score (BAT) was used to group students into three mental ability level; High, Average and Low. Students who score 15 and above were assigned to High ability level, 8 to 14 were Average ability level and below 8 were low ability level.

### 6.1 Treatment Procedure: Experimental group

The Research Assistant was the facilitator here while students coordinate and reflect on content area.

Step One: Research Assistant introduced the topic and guided the students in identifying the concepts in the topic

Step Two: Students embarked on brainstorming activities to understand each concept.

Step Three: Students create a central idea (starting point of the Mind map)

Step Four: Students identify relationship and add branches and Keywords to their map (First level branches)

Step Five: Students colour code the branches and include images and symbol (connection) and add second level branches

Step Six: Research Assistant request students to pause and reflect on the activities

Step Seven: Each student present their maps in class while other students react to the constructed map.

## 6.2 Control group

The treatment for each lesson was in form of lecture.

## 7. Result

The obtained data was analyzed using mean, frequency table and Three-way Analysis of Variance.

RQ 1: Does creative mapping instruction significantly influence biology students' mental ability?

Table 1: Analysis of Variance of students' mental ability by Treatment and Attitude

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	partial Eta Squared
Corrected Model	8178.728	9	908.748	10.52	.000	.608
Intercept	38622.351	1	38622.351	447.02	.000	.880
Treatment	3321.226	1	3321.226	38.44	.000	.387
Attitude towards Biology	69.219	1	69.219	.801	.374	.013
Mental Ability Treatment *	279.511	2	139.756	1.618	.207	.050
Attitude towards Biology	4.241	1	4.241	.049	.825	.001
Treatment * Mental Ability	675.411	2	337.705	3.909	.025	.114
Attitude towards Biology *	158.743	2	79.372	.919	.405	.029
Error	5270.427	61	86.400			
Total	79101.000	71				
Corrected Total	13449.155	70				

a. R Squared = .608 (Adjusted R Squared = .550)

The result ( $F_{(1,61)} = 38.44$ ;  $p < 0.05$ , partial  $\eta^2 = 0.39$ ) revealed that creative mapping significantly influence students' mental ability with a p-value less than 0.05. The effect size is 39%; this means that 39% of the variance observed in students' mental ability is due to the treatment. The difference in the mean scores and number of students in the three ability group after exposure to treatment is presented below in table 2

Table 2: A descriptive analysis of students' mental ability within the treatment group, before and after experiment

<b>Mental Ability</b>	<b>Mean before treatment</b>	<b>Mean after treatment</b>	<b>(N) before treatment</b>	<b>(N) After treatment</b>	<b>St. D before</b>	<b>St. D after</b>
Low mental						
Ability	7.69	9.00	13	2	1.55	.000
Medium						
mental Ability	14.00	20.00	16	2	3.23	.000
High mental Ability	28.40	41.34	10	35	2.72	9.834
Total	-	-	39	39	-	-

Table 2 indicated that there is a difference in the mean scores of students in the three ability groups in favour of the high ability learners. The result further revealed that after exposure to creative mapping, there is a shift from low and medium ability groups to high ability group with N- value rising from 10 to 35 at the end of the treatment procedure. Also the estimated marginal mean analysis reveals that students exposed to creative map outperformed those taught using lecture method as seen in the table 3 below

Table 3: Estimated Marginal Means of Treatment and Control group

<b>Treatment</b>	<b>Mean</b>	<b>Std. Error</b>	<b>95% Confidence Interval</b>	
			<b>Lower Bound</b>	<b>Upper Bound</b>
Creative Map	38.255	1.771	34.713	41.798
Lecture method	20.469	2.145	16.177	24.760

Research Question 2: Does creative mapping instruction significantly interact with attitude towards biology to influence students' mental ability?

Table 1 showed that creative mapping does not significantly interact with students' attitude towards biology to influence students' mental ability ( $F_{(1,61)} = .049$ ;  $p > 0.05$ ). This implies that the mental map instructional strategy has no significant relationship with students' attitude towards biology in affecting students' mental ability.

Research Question 3: Will creative mapping instruction interact significantly with students' mental ability to influence their performance in biology?

Table 1 indicated that creative mapping significantly interact with students' mental ability ( $F_{(1,61)} = .049$ ;  $p > 0.05$ ). This implies that after exposure to mental map instructional strategy while considering students' ability level, their performance in biology was aided.

## 8. Discussion

Findings from this study showed that creative mapping instruction had a significant effect on students' mental ability as students in the creative mapping group had enhanced mental ability than the conventional group after treatment. This position of significant appears to be associated with the capacity of mental maps in requiring students to actively participate in learning while discovering the budding asset embedded in concepts being learnt. This budding asset further leads to discovery of meaning and generation of idea in the process of knowledge

construction. Also, the advantage of coordinating and self-pacing learning which these maps offers may be responsible for this trend. This result is buttressed by Erden (2017) who identified mental map as a lifelong learning tool for all levels of education and for any set of people. The research findings of Al-jarf (2009) which revealed the effectiveness of mental map in improving students' writing skills after a 12 week course further supports this study. Treatment and students' attitude towards biology does not interplay to influence their mental ability. This therefore suggests that creative map instructional strategy is not sensitive to students' attitude towards biology.

## 9. Conclusion and Implication

The study concludes that creative map significantly enhanced students' mental ability with an upward improvement from low and medium mental abilities to High ability level. Attitude towards biology does not influence students' mental ability. Finally, Creative map significantly interact with students' mental ability to affect their performance in biology.

By implication, employing creative maps in Nigerian classrooms promises to improve citizens' mental ability which is an indispensable necessity in attaining the global compatibility and competitiveness the nation aspires.

## 10. Recommendation

The study recommends the usage of creative map in teaching as it offers the avenue to be actively involved in learning while enjoying equal platform to proceed with learning.

## References

- Akingbemisilu A. A. & Babafemi G.T (2018). Implications of flipped instructional strategies and gender on students' attitude to Biology. *Journal of Research in Science Education (JORISE)* A publication of the Department of Science Education, Ekiti State University, Ado Ekiti. 2(2), 28-34
- Akinoglu, O., & Yasar, Z. (2007). The effects of note taking in science education through the mind mapping technique on students' attitudes, academic achievement and concept learning. *Journal of Baltic Science Education*, 6(3), 34-43
- Al-Jarf, R. (2009), 'Enhancing Freshman students' Writing Skills with a Mind Mapping software'. *Paper presented at the 5th International Scientific Conference, eLearning and Software for Education, Bucharest, April 2009.*
- Asih, D. (2014). Teachers' beliefs about creativity in the elementary classroom. (*Thesis, Doctor of Education*). Pepperdine University
- Balduf, M. (2009). Underachievement among college students. *Journal of Advanced Academics*, 20, 274–294. Retrieved from <http://journals.sagepub.com/home/joa>
- Brinkmann, A. (2003). Graphical knowledge display mind mapping and concept mapping as efficient tools in mathematics education. *Mathematics Education Review*, 16, 3548.
- Cain, M. E. (2001/2002), 'Using Mind Maps to raise standards in literacy, improve confidence and encourage positive attitudes towards learning'. Study conducted at New church Community Primary School, Warrington.
- D'Antoni, A. V., and Pinto Zipp, G. (2005), 'Applications of the Mind Map Learning Technique in Chiropractic Education'. *Journal of Chiropractic Education*, 19:53-4.
- Dhindsa, H. S., Makarimi, K., & Anderson, O. R. (2011). Constructivist-visual mind map teaching approach and the quality of students' cognitive structures. *Journal of Science Education and Technology*, 20(2), 186-200. <http://dx.doi.org/10.1007/s10956-010-9245-4>
- Erden, A. (2017). Mind maps as a Lifelong learning Tool. *Universal Journal of Educational Research*. vol.5, no. 12, pp 1-7.
- Goodnough, K. & Woods, R. (2002), 'Student and Teacher Perceptions of Mind Mapping: A Middle School Case Study'. Paper presented at the Annual Meeting of American Educational Research Association, New Orleans, 1st to 5th April 2002.

- Khodabakhshzadeh, H., Hosseinnia, M., Moghadam, H. A., & Ahmadi, F. (2018). EFL Teachers' Creativity and Their Teaching's Effectiveness: A Structural Equation Modelling Approach. *International Journal of Instruction*, 11(1).
- Munns, G. (2007). A sense of wonder: Pedagogies to engage students who live in poverty. *International Journal of Inclusive Education*, 11(3), 301–315.
- Olagunju, A. M; Duyilemi, A. N. & Adesina, A. E. (2013). The Relationship between Pre-service Teachers' Attitude, Self-concept, Mathematical Mental Ability and Knowledge of Agricultural Economics in Selected Nigerian College of Education. *East African Journal of Educational Research and policy (EASJERS)*. 9:57 – 73.
- Onabanjo, C. R. (2007). Cognitive and affective factors as correlates of senior secondary schools female students' achievement in Mathematics. An Unpublished Ph.D Thesis, University of Ibadan, Ibadan.
- Owoeye, P.O. (2016). Effectiveness of Problem-Solving and Advance Organizer strategies on secondary school students' learning outcomes in Biology. *Unpublished Doctor of Philosophy (Ph D) Thesis*. Ekiti State University, Ado-Ekiti. Ekiti State, Nigeria
- Plucker, J., Beghetto, R., & Dow, G. (2004). Why isn't creativity more important to educational psychologists? Potentials, pitfalls, and future directions in creativity research. *Educational Psychologist*, 39(2), 83-96.
- Sangodoyin, I. A. (2011). Effects of Computer Graphics and Animation Presentation Modes on Senior Secondary School Students Learning Outcomes in Biology in Southwestern Nigeria. A Ph.D Thesis, University of Ibadan, Ibadan.
- Sternberg, R. J., Kaufman, J. C., & Pretz, J. E. (2002). *The creativity conundrum: A propulsion model of kinds of creative contributions*. New York: Psychology Press.
- Tanriseven, I. (2014). A Tool That Can Be Effective in the Self-regulated Learning of Pre-service Teachers: The Mind Map. *Australian Journal of Teacher Education*, 39(1)

### Copyrights

Copyright for this article is retained by the author(s), with first publication rights granted to the journal. This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).