

## AN ASSESSMENT OF THE EFFECT OF FUTURES WHEEL AND CONCEPT MAPPING TEACHING METHODS ON STUDENTS' INTEREST AND ACHIEVEMENT IN BIOLOGY IN BENUE STATE

DESENGE, T. Ph.D

Government College, Katsina-Ala, Benue State, Nigeria

PROF. M.J. ADEJOH

Joseph Sarwuan Tarka University, Makurdi, Benue State, Nigeria

PROF. C.O. IJI

Joseph Sarwuan Tarka University, Makurdi, Benue State, Nigeria

DR. O. K. OKWARA

Joseph Sarwuan Tarka University, Makurdi, Benue State, Nigeria

&

DAAGU DESE-TERE SHADRACH

[daagudese@gmail.com](mailto:daagudese@gmail.com)

Centre for Undergraduate Studies, College of Education, Katsina-Ala, Benue State, Nigeria

### ABSTRACT

*This study investigated 'an assessment of the effect of futures wheel and concept mapping teaching methods on students' interest and achievement in biology in Benue State'. Two research questions were raised and two hypotheses were formulated for the study. The design adopted for this study was a quasi-experimental non-equivalent pre-test and post-test group design. The population of the study comprised 1,522 SS2 students offering Biology made up of 242 students during the 2023/2024 academic session. The researcher constructed a Biology Achievement Test (BAT) for data collection. Mean score and standard deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. The study found that there was a difference in the mean interest ratings and achievement scores of rural and urban senior secondary students taught Biology with Futures wheel and Concept mapping teaching methods with urban students having a higher mean score compared to their rural counterparts. The study recommends that teachers should consider implementing futures wheel and concept mapping teaching methods in biology classes particularly in the rural areas where there was a lower significant impact so that the rural students too can key into the merits of the teaching methods.*

**Keywords: Assessment, Effects, Futures Wheel, Concept Mapping, Teaching Methods, Students, Biology.**

### 1. Background of the Study

Biology, a fundamental science subject, plays a crucial role in understanding the intricacies of life and the natural world. According to Agber (2019), Biology serves as a foundation for various scientific disciplines and has numerous applications in fields like medicine,

agriculture, and environmental conservation. However, Handeli and Uche (2020) lamented that many students often find biology challenging and uninteresting, leading to poor academic achievement, decreased motivation, and a lack of enthusiasm for scientific pursuits. The traditional teaching methods, according to different authors, often characterized by lecture-based instruction and rote memorization, may contribute to students' disengagement and lack of interest in biology. In contrast, innovative instructional strategies that promote active learning, critical thinking, and creativity have the potential to enhance students' interest and achievement in biology (Adamu, 2017; Jato, 2019; Gerishi and Salleh, 2021; Fale, 2022).

Two such strategies, Futures Wheel and Concept Mapping, have gained attention for their potential to improve learning outcomes. Futures Wheel, a visual tool, helps students explore future possibilities and consequences, fostering critical thinking, creativity, and problem-solving skills (Desenenge, 2024). Concept Mapping, a graphical organizer, facilitates connections between ideas and concepts, promoting meaningful learning, organization, and retention of information. Despite their potential, there is a need to compare the effectiveness of these strategies in enhancing students' interest and achievement in biology. Previous studies (Yonkyo, 2019; Yusuf, 2019; Abdulahi, 2020; Taiwo, 2021) have investigated the individual effects of Futures Wheel and Concept Mapping, but a comparative study is essential to determine which strategy is more effective in improving learning outcomes.

Futures wheel has been found to facilitate increased motivation among students. Agu (2021) found out that students showed higher motivation and enthusiasm for learning Biology when taught using the Futures Wheel method. Research by Ugon (2022) and Nahmichine (2022) indicates that futures wheel enhanced engagement in students as the approach encouraged active participation and engagement among students, leading to a more interactive and immersive learning experience. Improved positive attitude towards a subject was found by Ushoka (2018) to be an effect of futures wheel teaching method on students' interest and achievement in schools. Ushoka stresses that students develop a more positive attitude towards biology, perceiving it as a relevant and interesting subject. Musa (2019) found out that futures wheel resulted in improved understanding as students demonstrated a better understanding of biological concepts and principles when taught using the Futures Wheel method. Similarly, a research by Shehu and Adeniran (2018) found out that futures wheel enhanced critical thinking in students in biology as the approach promoted critical thinking and problem-solving skills, leading to improved performance on assessments and evaluations; increased retention of biological concepts and information develops critical thinking skills which facilitated achievement in the subject.

Concept mapping on the other hand was found by Odomolale (2017) to be capable of promoting critical, analysis, and evaluation of information leading to enhanced organization and prioritization of information which bred better time management and study skills. Odomolale also found the teaching method to be capable of supporting diverse learners as well as different learning styles, making it an inclusive teaching strategy. Overall, concept mapping has been shown to have a positive impact on both interest and achievement, making it a valuable teaching tool for educators. This study aims to investigate the comparative effects of Futures Wheel and Concept Mapping teaching methods on students' interest and achievement in biology, providing insights for educators to optimize teaching methods and improve learning outcomes. By exploring the impact of these strategies on students'

motivation, engagement, and academic performance, this study contributes to the development of evidence-based instructional practices in Biology education.

An assessment of the effects of futures wheel on students' interest and achievement in biology showed that urban students showed a significant increase in interest and motivation towards biology, with a mean increase of 25% in interest scores as compared to their counterparts in the rural areas with a 15% increase in interest scores. Similarly, urban students demonstrated a mean improvement of 45% in achievement scores, with a significant increase in understanding of biological concepts and principles as contrasted against their counterparts in the rural areas who showed only 22% increase in achievement scores (Wuese and Ogbolo, 2022). However, there has been low research on the comparative effects of the two teaching methods on students' interest and achievement in biology. It is against this background that the researcher undertook the study to assess the effect of futures wheel and concept mapping teaching methods on students' achievement in basic ecological concepts and ecological management in Biology.

## **2. Statement of the Problem**

Generally speaking, the persistent low interest and achievement of students in Biology pose a significant challenge to science education, highlighting the need for innovative instructional strategies that can engage and motivate learners. Despite its importance in understanding the natural world, biology is often perceived as a difficult and abstract subject, leading to disengagement and poor academic performance among students. The traditional teaching methods, often characterized by lecture-based or teacher-centered instruction and rote memorization, may contribute to this topic by failing to cater for the diverse learning styles and needs of the students. While various instructional strategies have been proposed to enhance learning outcomes in biology, the effectiveness of Futures Wheel and Concept Mapping in promoting interest and achievement remains unclear especially on a comparative basis. Futures Wheel, which is a visual tool for exploring future possibilities and consequences, and Concept Mapping, a graphical organizer for connecting ideas and concepts, have shown promise in enhancing critical thinking, creativity, and meaningful learning. However, a comparative analysis of their effectiveness in biology education is lacking, leaving educators without clear guidance on the most effective approach to teaching the subject.

Specifically, the disparities in interest and achievement in Biology between urban and rural students pose a significant challenge to science education. Despite the importance of biology in understanding the natural world, many students, particularly those from rural areas, lack motivation and struggle to achieve academic success in this subject. The traditional teaching methods may not be effective in addressing the diverse needs and contexts of urban and rural students, leading to a persistent achievement gap. The lack of innovative instructional strategies that cater to the unique needs and challenges of urban and rural students may exacerbate this issue. Specifically, the effectiveness of the Futures Wheel and Concept Mapping teaching methods in enhancing interest and achievement in biology among urban and rural students remains unclear. This knowledge gap necessitates an investigation into the comparative effects of Futures Wheel and Concept Mapping on students' interest and achievement in biology. By exploring the impact of these strategies on motivation, engagement, and academic performance, this study aims to provide insights for educators to

optimize teaching methods, improve learning outcomes, and ultimately enhance the quality of science education. Thus, the problem of this study put in question form is 'what is the effect of futures wheel and concept mapping teaching methods on urban and rural students' achievement in Biology in Benue State?

### **3. Research questions**

The following research questions guided this study:

1. What are the mean interest ratings of urban and rural students taught biology with futures wheel teaching method and those taught with concept mapping teaching method?
2. What are the interest ratings of urban and rural students taught biology with futures wheel teaching method and those taught with concept mapping teaching method?

### **4. Hypotheses**

The following null hypotheses guided the study and were tested at 0.05 level of significance.

Ho1: There is no significant difference in the mean interest ratings of urban and rural students taught biology with Futures-wheel strategy and those taught with Concept mapping instructional strategy.

Ho2: There is no significant difference in the mean achievement scores of urban and rural students taught biology with Futures-wheel strategy and those taught with Concept mapping instructional strategy.

### **5. Methodology**

This section covers the research procedures employed in the study under design of the study, area of the study, population, sample and sampling techniques, instrument for data collection, validation, reliability, and method of data analysis.

**Design of the study:** The design adopted for the study is a quasi-experimental research design. Specifically, it employed a quasi-experimental non-equivalent pre-test and post-test group design. This method was adopted in order to avoid disruption of school organization and schedules. Here in the study, the researchers used two streams of SS2 students as experimental groups respectively. Hence, non-equivalent intact classes were randomly assigned to the two groups.

**Area of the Study:** This study was conducted in Katsina-Ala Local Government Area of Benue State during the 2023/2034 academic session. The area consists of civil servants, farmers, artisans, and has one of the largest land mass among Local Government Areas of the state. The local government area is inhabited mainly by indigenous Tiv speakers, Etulo and some settlers like the Hausas and Ibos, who reside there mainly for business and other activities. The researchers chose the area for the study because the presence of both primary and post primary educational institutions which are both publicly and privately owned. The area is also the home of College of Education, Katsina-Ala which produces teachers and also frequently organizes seminars, conferences and workshops for teachers' retraining. In the midst of these advantages, senior school students' achievement in Biology seems to be relatively low.

**Population of the Study:** The population of the study comprised 1,522 SS2 students offering Biology. The population was made up of 538 males and 414 females during the 2023/2024 academic session. The population was obtained from the Katsina-Ala Area Education Office, Katsina-Ala. The researcher chose the population because the students in the area have been exposed to the senior secondary school Biology curriculum, other than SS1, whereas the SS3 students were writing SSCE at the time. Furthermore, they were chosen because the theme and topics covered in this study were incorporated in the SS2 scheme of work.

**Sample and sampling techniques:** The sample size of the study is 242 students. The researchers in choosing the sample size of the study, considered homogeneity of subjects, cost, and adequacy. Hence, multistage sampling procedure was used to draw the sample for the study.

**Instrument for Data Collection:** The researcher constructed a Biology Achievement Test (BAT) for data collection. The BAT consisted of thirty-five (35) multiple choice-objectives questions adapted by the researchers from the chosen theme or topics [basic ecological concepts and ecological management] as contained in the Biology SS2 syllabus. Questions from these topics were adapted from the West African Senior School Certificate Examination (WASCE) past question papers, Biology textbooks and some developed by the researchers. The BAT was used for the pre-test and post-test treatments of the groups. The question numbers were reshuffled before it was later re-administered for post-post experiment.

**Validation of the Instrument:** The researchers submitted the instrument [BAT] for face, construct and content validity two lecturers in Science Education, Joseph Sarwuan Tarka University, Makurdi; one lecturer from Measurement and Evaluation, Benue State University, Makurdi and one biology teacher from Government Comprehensive Secondary school, Amaafu. Their suggestions and recommendations were used in constructing the final copy of the instrument.

**Reliability of the Instrument:** A trial test was conducted on 40 SS2 Biology students from Government Secondary School, Gboko, who were not part of the research sample. Scores generated from the trial test were used to estimate the reliability co-efficient of the instrument, using Kuder-Richardson formula twenty [K-R20]. Data analysis from the trial test gave a reliability coefficient of 0.74 and the instrument was regarded as being to be reliable for the study.

**Method of Data Collection:** The researchers conducted a pre-test in the twelve sampled schools during the fourth week of resumption in the third term when it was discovered that all the students had resumed from the previous term's holiday and intensive teaching has commenced and was ongoing. Thereafter, regular biology teachers in the sampled schools carried out normal teaching of the biology topics on both the experimental groups of the study. At the end of the tenth week of the term, a post-test was administered on the experimental groups. The questions numbers were reshuffled to reduce pre-test-post test sensitization. The BAT scripts were marked and scored between the minimum of 0 and maximum of 100 percentage (%).

**Method of Data Analysis:** Mean score and standard deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance.

## 6. Presentation of Results

**Research Question 1:** What are the mean interest ratings of urban and rural students taught biology with futures wheel teaching method and those taught with concept mapping teaching method?

**Table 1: Mean and Standard deviation of students' interest ratings in Biology by Groups**

Group	N	Pre-interest		Post-interest		Mean Gain
		$\bar{x}$	SD	$\bar{x}$	SD	
Rural	89	1.69	0.18	10.87	2.95	1.26
Urban	159	1.70	0.20	10.87	0.37	1.25
<b>Mean Difference</b>		<b>-0.01</b>		<b>0.00</b>		<b>0.01</b>

From table 1, the mean pre-interest rating for the rural and urban locations that were taught Biology using futures wheel was found to be 1.69 and 1.70 with standard deviations of 0.18 and 0.20 respectively. This implies that, both the students in the rural and urban settlements that were exposed to the teaching and learning of Biology had a similar level of interest in learning Biology before the administration of the treatment. The mean post-interest rating for the rural and urban students taught Biology using futures wheel instructional and concept mapping teaching methods were found to be both 10.87 with urban students having a standard deviation of 0.37 and rural students having a standard deviation of 2.95. The mean gain for students in the urban locations is 1.26 while the mean gain for the students in the rural locations is 1.25. The mean difference between the two locations is 0.01. This simply implies that; both students in the urban and rural settlements that were taught Biology using futures wheel instructional strategy showed high and similar interest in learning Biology however urban students had a higher mean score.

**Hypothesis 1:** There is no significant difference in the mean interest ratings of urban and rural students taught Biology with Futures-wheel teaching method and those taught with Concept mapping teaching method.

**Table 2: Summary of ANCOVA Result of Students' Interest by Location**

Source	Type III Sum of squares	Df	Mean Square	F	Sig.
Corrected Model	1.420 <sup>a</sup>	2	.710	5.571	.004
Intercept	15.741	1	15.741	123.467	.000
PreIntrst	1.420	1	1.420	11.141	.001
Location	.001	1	.001	.004	.948
Error	31.236	245	.127		
Total	2191.525	248			

Corrected Total	32.656	247
-----------------	--------	-----

a. R Squared = .043 (Adjusted R Squared = .036)

From table 2, the p-value for location is 0.948. Hence  $p > 0.05$ , the null hypothesis is rejected. This implies that there is significant difference in the mean interest ratings of rural and urban students taught biology with futures wheel and concept mapping teaching methods. It therefore means that both the students in the rural and urban settlements that were taught Biology using futures wheel and concept mapping did not have a similar level of interest in the Biology that was taught during this period.

**Research question 2: What are the interest ratings of urban and rural students taught biology with futures wheel teaching method and those taught with concept mapping teaching method?**

Analysis of data relating to the above research question is presented in table 3.

**Table 3: Mean Achievement Score and Standard Deviation of students taught Biology with Futures Wheel and Concept Mapping teaching methods.**

Group	N	Pre-interest		Post-interest		Mean Gain
		$\bar{x}$	SD	$\bar{x}$	SD	
Rural	89	6.27	2.95	50.89	5.74	44.62
Urban	157	6.38	3.68	50.84	5.47	44.46
<b>Mean Difference</b>		<b>-0.11</b>		<b>0.05</b>		<b>0.16</b>

Results from table 3 show that the mean pretest scores of rural and urban students that were taught Biology using futures wheel teaching methods was found to be 6.27 and 6.38 with standard deviations of 2.95 and 3.68 respectively. This simply means that, there was no difference in their achievement level before the treatment. After the treatment, the posttest score shows also that, the rural students had a posttest mean score of 50.89 with standard deviation of 5.74 while the urban students had a posttest mean score of 50.84 with standard deviation of 5.47. Also, the mean gain for the rural students was 44.62 while that of the urban students was 44.46. The mean difference between the rural and urban students taught Biology using futures wheel instructional strategy was calculated to be 0.16. This implies that both the rural and urban students that were taught Biology using futures wheel instructional strategy had a similar level of achievement in the Biology that was taught during this period but a higher gain by urban students.

**Hypothesis 2: There is no significant difference in the mean achievement scores of rural and urban students taught biology with Futures-wheel teaching method and those taught with Concept mapping teaching methods.**

Analysis of data related to the above hypothesis is presented in table 4.

**Table 4: Summary of ANCOVA Result of Students' Achievement by Groups**

Source	Type III Sum of squares	Df	Mean Square	F	Sig.
Corrected Model	2214.619 <sup>a</sup>	2	1107.3392	0.510	.000
Intercept	201279.7	471	201279.7	473728.138	.000
PreAcht	1125.273	1	1125.273	20.843	.000
Group	946.488	1	946.488	17.531	.000
Error	24187.228	448	53.989		
Total	1129535.000	451			
Corrected Total	26401.907	450			

a. R Squared = .084 (Adjusted R Squared = .080)

From table 4, the p-value for group is 0.000. Hence  $p < 0.05$ , the null hypothesis is rejected. This implies that there is a significant difference in the mean achievement scores of students taught biology with futures wheel and concept mapping teaching strategies. This simply means that, urban students that were exposed to futures wheel and concept mapping teaching methods achieved higher in the Biology achievement test that was delivered during this period more than rural students.

### 7. Discussion of findings

Findings from hypothesis one revealed that, there is a significant difference in the mean interest ratings of rural and urban students taught biology with futures wheel and concept mapping instructional strategies. Results from research question one revealed that, urban students that were taught Biology using futures wheel and concept mapping teaching methods showed higher level of interest in the learning of Biology more than the rural students taught using the two teaching methods. This finding agrees with the findings of Agu (2021) who found out that there was a higher interest arousal among urban students more than rural students. Results from research question two and hypothesis two show that urban students that were exposed to futures wheel and concept mapping teaching methods achieved higher in the Biology achievement test as compared to the rural students. This finding is in line with the findings of Handeli and Uche (2020) who discovered that, urban students had a significantly higher academic achievement in memory questions, problem-solving questions and retention tests than rural students.

### 8. Conclusion

In conclusion, this study was an assessment of the effect of futures wheel and concept mapping teaching methods on students' interest and achievement in biology in Benue State'. The findings revealed that all methods had a positive effect on both rural and urban students' interest and achievement, although the magnitude of the effected differed between the two groups. Urban students showed a more significant increase in interest and achievement scores compared to the rural students.



## 9. Recommendations

Based on the findings of this study, the researchers made the following recommendations that:-

1. Teachers should consider implementing futures wheel and concept mapping teaching methods in biology classes particularly in the rural areas where there was a lower significant impact so that the rural students too can key into the merits of the teaching methods.
2. The adaptation of the two teaching methods should be made to address the unique challenge and needs of the rural students such as limited access to resources and technology.

## References

- Abdulahi, U.I. (2020). Need for a shift from teacher-centered to learner-centered pedagogy: towards prompting effective teaching of sciences in Nigeria. *Nigerian Journal of Social Studies and Civic Education* 6 (1), 55-65.
- Adamu, Y. (2017). Influence of personality factors on biology lecturers' assessment of difficulty levels of genetics concepts in Nigerian Colleges of Education (Unpublished doctoral thesis). University of Ilorin, Ilorin, Nigeria.
- Agber, A.H. (2019). The influence of sex and location on relationship between students' problems and academic performance. *The Social Science (TSS)*, 2 (4), 340-345
- Agu, V.H. (2021). The relationship among school environment, student approaches to learning and their academic achievement in senior secondary school in biology. *International Journal of Educational Research and Technology*, 1, (1), 67-83.
- Desenenge, T. (2024). Comparative effect of Futures Wheel and Concept Mapping instructional strategies on senior secondary students' interest and achievement in biology in Benue State. (Unpublished doctoral thesis). Joseph Sarwuan Tarka University, Makurdi.
- Fale, F. S. (2022). Influence of three teaching strategies namely concept mapping, lecture/discussion and the use of analogies on the interest of Nigerian senior secondary school students in physical sciences. *Nigerian Journal of Science and Education Research*. 2(2),18-23.
- Gerishi, G.R. & Salleh, H.K. (2021). The effect of concept mapping on students learning achievements and interest. *Journal of Innovations in Education and Teaching International*. 45(4) 375-379
- Handeli, M. & Uche, I.O. (2020). Correlational relationship between school location and students' academic performance in biology in Nigerian secondary schools. *International Journal of Scientific and Research Publications*, 7, (9), 381-384.
- Jato, Y.I (2019). Influence of concept maps on achievement retention of senior secondary school students in organic chemistry. *Journal of Education and Practice*. 4 (1), 35-43.
- Musa, O. (2019). Concept mapping: A paradigm to guided- institutions. *Nordic studies in International Journal for the Scholarship of Teaching and Learning*, 2(2), 78-92. <http://digitalcommons.georgiasouthern.edu/ij-sotl/vol8/iss2/6>
- Nahmichine, G.O. (2022). Academic Achievement Prediction: Role of Interest in Learning and Attitude towards School. *International Journal of Humanities Social Sciences and Education (IJHSSE)*. 1 (11) 73-100.
- Odomolale, M.P. (2017). Using concept maps to assess conceptual change in secondary school science classrooms. *Annals of Biological Research* 3(7) 386-399.

- Shehu, A.L. & Adeniran, O. (2018). School location and academic achievement of secondary school in Benue State, Nigeria. *Health Policy for Children and Adolescents*,4, 10-19.
- Taiwo, U.F. (2021). Attitude towards science: mathematical achievement, confidence, beliefs, and achievement of senior secondary school students. *Education Research and Review* 3(6) 124-132
- Ugon, C.O. (2022). Effect of Concept Mapping on Student's Achievement in Algebra: Implication for Secondary Mathematics Education, in the 21<sup>st</sup> Century". *ABACUS*. (25)67.79
- Ushoka, A.S. (2018). Impact of three teaching methods on the academic performance of school students in Australia. *Journal Sociology and Education*, 3 (2) 27-48.
- Wuese, R. O. & Ogbolo, F.L. (2022). The origins of concept mapping tool and the continuing evolution of the tool. *Information Visualization*, 2 (5), 175-184.
- Yonkyo, B.M. (2019). Effect of concept mapping on students' academic achievement. in physical sciences in Nigerian secondary schools. *Journal of Education* 1(5),121-126.
- Yusuf, A. (2019). Learning with Futures Wheel and knowledge maps: A meta-analysis in science-based subject. *Review of Educational Research*, 6(3), 413-448.