

## Effects of Vee-Mapping Strategy on Senior Secondary School Students' Acquisition of Science Process Skills in Biology in Adamawa State, Nigeria

<sup>1</sup>Ismaila, Gambo Amara, <sup>2</sup>Kawu, Waziri, <sup>3</sup>Ashiwere, Isaac Obogo

<sup>1</sup>Department of Environmental and Life Sciences Education, Modibbo Adama University, Yola,

<sup>2</sup>Department of Biology, Federal College of Education, Yola,

<sup>3</sup>Department of Biology Education, University of Calabar.

### ABSTRACT

The study investigated the effects of vee-mapping strategy on senior secondary school students' acquisition of science process skills in Biology in Adamawa State, Nigeria. The study had two objectives, two research questions and two null hypotheses. The study adopted pre-test, post-test, non-equivalent control group design. The population of the study composed of all (49,253) Senior Secondary II Biology Students. The sample size for this research comprised of 84 Biology students from two intact classes of SS11 in Yola co-educational zone. The instrument used to collect data for this study was Biology Practical Achievement test (BPT). The validity and reliability of the instruments were established. Data collected were analyzed using SPSS version 23. The descriptive Statistics of mean and standard deviation were used to answer the research questions while inferential statistics of ANCOVA were used in testing the null hypotheses. The findings of the study indicate significant differences in the mean scores of students' science process skills across various aspects when taught using the vee-mapping strategy compared to the lecture method. Specifically, the study found significant differences in observing ( $F(1, 83) = 165.228, p < 0.05$ ) and classifying ( $F(1, 83) = 175.972, p < 0.05$ ). Overall, the results reveal a significant difference in the mean scores of students' science process skills between those taught with the vee-mapping strategy and those taught with the lecture method ( $F(1, 83) = 223.148, p < 0.05$ ). It is concluded that the Vee-mapping strategy is more effective than the lecture method in improving students' science process skills. Specifically, the use of the Vee-mapping strategy led to higher mean scores in observing, classifying and overall science process skills compared to the lecture method. It is recommended among others that teachers should integrate Vee-mapping strategy and real-life examples into their teaching to enhance students' observation skills.

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### INTRODUCTION

Science education is a specialized area of study that introduces students to both the subject matter and the methodologies involved in gaining scientific knowledge for practical purposes. According to Okeke (2007), science

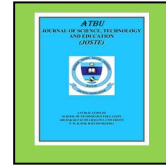
education can be defined as a comprehensive field of study that encompasses both the content knowledge of scientific disciplines such as Biology, Physics, Chemistry, and Agriculture, as well as the instructional processes involved in teaching and learning science. Science is an

Corresponding author: Ismaila Gambo Amara

✉ [amragj@mail@gmail.com](mailto:amragj@mail@gmail.com)

Department of Environmental and Life Sciences Education, Modibbo Adama University, Yola.

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organized body of knowledge in the form of concepts, theories, and generalizations. It is the study of nature and natural phenomena to discover their principles and laws. Ataeva, (2022) defines science as the multidisciplinary human activity that involves a systematic investigation and understanding of the world, nature, and the universe.

Acquisition of science-process skills is the basis for scientific inquiry and development of intellectual skills and attitudes that are needed to learn concepts. Science-process skills are the psychomotor skills and cognitive abilities that are required to be developed by the learner in solving scientific problems. According to (Ping, Halim and Osman, 2020) science process skills involve a collection of competencies and abilities that make possible the establishment of knowledge about the nature and concepts of science through scientific investigation, the most important aspect of studying Science is by developing the skills needed for acquiring scientific attitudes, which are the Science-process Skills.

The American Association for Advancement of science Leading organizations in science education, including the AAAS, NARST and NERDC, have long emphasized the importance of developing science process skills. This shift from rote memorization to active learning prepares students for deeper scientific understanding and future success. There are six essential science process skills used in learning science, especially at the lower levels of education. These include observing, communicating, classifying, measuring, inferring and predicting (Yadav & Mishra, 2013). From this, it appears the basic science process skills provide an intellectual groundwork in problem solving.

Observing skill noting the properties of objects and situations using the five senses. According to Ango (2002), observing qualities can be demonstrated by using the five (5) senses, using words to describe what is seen, felt, heard, smelled and (if appropriate) tasted. Noticing details in objects, breaking things into parts or different components, name and describe the parts, draw what the learner see and label parts of the drawing.

Classifying skill is the ability to be able to sort an organism, objects or phenomenon into groups or order based on observation or measurement or even both. Grouping objects or events is a way of imposing order based on similarities, differences and interrelationships (Vitti & Torres, 2006). This is an important step towards a better understanding of the different objects and events in the world. Students can be serially ordered according to height, size, and calories per serving predicting skill is a process of forecasting events based on observations and previous experiences or certain pattern of reliable data. Therefore, predicting as the extrapolating and inserting data as a tool to predict. e.g. if species of fish is observing with flattened body predict the purpose of this structural adaptation (Yumusak, 2016).

## LITERATURE REVIEW

### *Theoretical Framework*

Vee mapping strategy, is one of the notable innovations in the teaching of sciences, therefore, the Vee is considered a technique used to learn how to think., it is seen as a viable tool in learning the structure of knowledge, and how knowledge formation occurs by enabling students to examine a piece of concept and come out with a meaningful understanding of science process skills. Vee-mapping, is so called because of its shape of the letter "V". It is also called Gowin's Vee, knowledge Vee, and Vee heuristic and was designed by Gowin (1981) to understand a procedure which could be as a strategy to solve a problem or to apply in primary, secondary schools and tertiary education. It was proposed as an instructional strategy to be used to critically analyze research, understand an experiment and also as a teaching method for promoting meaningful learning to elicit knowledge (Villarreal, 2018). Elaborating further, vee-mapping is a heuristic and metacognitive technique that illustrates and facilitates learning through theoretical and methodological elements that interact in the process of building knowledge for solving a problem (Quiroz, Olivares, Merino & Bravo, 2013).

Vee-map shows how concepts, events and records of events are formulated when

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Corresponding author: *Ismaila Gambo Amara*

✉ [amragj@mail@gmail.com](mailto:amragj@mail@gmail.com)

Department of Environmental and Life Sciences Education, Modibbo Adama University, Yola.

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attempting to create new knowledge (Knaggs & Schneider, 2012). As an instructional tool, vee-map has two sides. The left-hand side which presents the theory is the conceptual side. It outlines the philosophy, theories, principles and concepts that vee-mapping instruct learners in choosing or constructing objects or events to be observed in the learning process (Novak, 2010) The right-hand side is the methodological side (doing Side). It outlines the knowledge and value claims as well as data recording and Transforming procedures. Bawaneh (2010) explain that, the basic units in the V-Shape building process are perceived events and objects. The purpose is to ask the main question and then look for recordings. When the V-Shape is built, a learner should ask himself the following questions:

1. What objects and events are noticed in light of the main question?
2. What recordings are produced?
3. What concepts are used to confirm the recordings collected?
4. What concepts are used in the transformations?
5. What are the guiding principles, rules, and theories?
6. How are cognitive demands associated with the preceding principles, rules, recordings, and transformations?

In the middle of the vee-map is the focus question and events or objects to be observed in the learning process. Both sides are interactional because of the focus question. The main idea in using a vee-map is that every element shown is interdependent with every other element on the vee (Kyere & Ameyaw, 2019). In the illustration below the conceptual side (right side) is the thinking side, while the methodology side (left side) is the doing side. Answers require an active interplay between the right side and the left side. However, vee-map remains as an integral part of the vee diagram, in that they are equated as the lower left-hand side, or the thinking side of the Vee (Sakiyo & Waziri 2015).

Vee-maps therefore serves as a path way that guides the students to assimilate easily when presented with a new concept. It helps

students to see the connection between what they already know and the new knowledge they produce or try to understand. It has psychological value since it encourages effective learning and also helps them to understand science process skills in which students at secondary level might construct knowledge (Iofciu, Miron, Dafinei, Dafinei and Antohe, 2012). According to Supranto and Rahmawati, a vee-map is intended to help the learning scientific skills by using the diagram to build knowledge. Through the diagram, students can have established the manipulation of science process skills by certain stages and help them to find something new. Vee-map begins with the identification of the problem; Students then form their investigation by creating an inquiry question. Following completion of the question, students develop a list of key words relevant to the activity. The third portion of the map is vital to visual and innovative learners as they are allowed to develop their own concept map or graphic organizer (Thoron, 2010).

This teaching strategy promotes the major aims of science, which is searching for explanations of nature's behavior and its forecasting. From this point of view, the creative component of the scientific method is recovered, based on formulating original questions and hypothesis on natural phenomena. Olajide (2019), examined the effects of field trips and peer tutoring on science process skills acquisition in basic science and technology among secondary school students in Osun State, Nigeria. The study aimed to explore the impact of two instructional strategies, field trips and peer tutoring, on the acquisition of science process skills among secondary school students in basic science and technology classes. The research employed a pretest, post-test control group quasi-experimental research design.

The population consisted of all junior secondary school students in Osun State, with a sample size of 315 Junior Secondary II (JS II) students selected from nine intact classes in nine schools using a simple random sampling technique. The Science Process Skills Performance Test (SPSPT) was employed to collect data and mean and standard deviation was

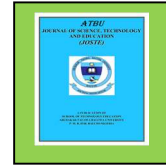
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Corresponding author: *Ismaila Gambo Amara*

✉ [amragismail@gmail.com](mailto:amragismail@gmail.com)

*Department of Environmental and Life Sciences Education, Modibbo Adama University, Yola.*

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used to address the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. The Results of the study revealed significant effects of the two instructional strategies, field trips, and peer tutoring, on the acquisition of science process skills among secondary school students.

The results indicated that both methods led to improvements in students' observation, classification, communication, measurement, inference, and prediction skills. Peer tutoring was found to be more effective in enhancing observation, classification, communication, and measurement skills, while the field trip strategy exhibited higher effectiveness in improving students' inference and prediction skills. The findings suggest that incorporating field trips and peer tutoring into basic science and technology lessons can be beneficial in fostering students' science process skills. The study recommended among others that basic science and technology classes should include regular field trips as an integral part of the curriculum.

Irede and Okoli (2019) conducted a study in Delta State, Nigeria, investigating the effect of science writing heuristics on students' acquisition of science process skills. The study was guided by four research questions and five hypotheses, employing a quasi-experimental design, specifically the pretest-posttest non-equivalent control group design. The population of the study consisted of 1,946 senior secondary school two (SS2) Biology students in Oshimilli North Local Government of Delta State. The sample used for the study comprised 201 senior Secondary School two (SS 2) Biology students. For data collection, the researchers utilized the Science Process Skills Acquisition Test (SPSAT) as the instrument. The reliability of the instrument was established to be 0.83 using the Kuder-Richardson formula 20. Mean and standard deviation were employed to address the research questions, and Analysis of Covariance (ANCOVA) was used to test the hypotheses at a significance level of 0.05.

The study's results indicated a significant difference in the mean scores of

students' science process skills (observing, experimenting, inferring, classifying, and communicating) between those taught Biology using the science writing heuristics (SWH) teaching approach and those taught using the conventional method. Students taught with the SWH approach exhibited better performance in science process skills compared to those taught conventionally. This suggests that implementing SWH in teaching Biology can be beneficial for enhancing students' acquisition of science process skills. Based on these findings, the researchers recommended that school administrators should organize seminars and workshops for Biology teachers to acquaint them with the science writing heuristic instructional approach.

Adah and Nsikhe (2020) investigated the interaction effect of selected science process skills (drawing, observing, classifying, measurement, and problem-solving) on students' academic performance in Practical Biology in the Calabar Education Zone of Cross River State, Nigeria. The research employed a quasi-experimental design of pretest-posttest non-equivalent intact class. One hundred and ninety Senior Secondary One (SS1) Biology students from three secondary schools participated in the study. The research question and one null hypothesis were addressed using two research instruments: the Science Process Skills Acquisition Test (SPSAT) and Practical Biology Performance Test (PBPT).

The reliability indices of the instruments, established via Cronbach alpha, were 0.812 and 0.815, respectively. The data obtained were analyzed using Analysis of Covariance (ANCOVA). The study revealed a significant interaction effect of acquired science process skills (classifying, measuring, and problem-solving) on instructional methods and students' academic performance in Practical Biology. However, the interaction was not significant for the science process skills of drawing and observing. Based on the results, the study recommended that biology teachers should incorporate classroom practices that enhance the acquisition of all process skills to improve academic performance

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Corresponding author: *Ismaila Gambo Amara*

✉ [amragismail@gmail.com](mailto:amragismail@gmail.com)

*Department of Environmental and Life Sciences Education, Modibbo Adama University, Yola.*

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in Practical Biology. It's worth noting that this study focused on the interaction effect of specific science process skills on academic performance. Additionally, the present study, which investigates all basic science process skills on SS2 biology students in Adamawa State, differs in terms of research instruments, as it uses the vee-mapping strategy. The comparison provides valuable insights into how different instructional strategies may impact the acquisition of science process skills and academic performance in biology.

### **Purpose of the Study**

The purpose of the study is to investigate the effects of vee-mapping strategy on Biology students' acquisition of science process skills among senior secondary school in Adamawa State.

The specific, objectives of the study are to;

1. Determine the effect of the vee-mapping strategy and lecture method on biology students' acquisition of science process skill of observing in senior secondary school Adamawa State, Nigeria.
2. Determine the effect of the vee-mapping strategy on biology students' acquisition of science process skills of classifying in senior secondary school Adamawa State, Nigeria.

### **Research Questions**

The following research questions were raised to guide the study

1. What are the pre-test and post-test means scores of student's science process skill (observing) taught using vee-mapping strategy and those taught with lecture method?
2. What are the pre-test and post-test means scores of student's science process skill (classifying) taught using vee-mapping strategy and those taught with lecture method?

### **Hypotheses**

The following null hypotheses were formulated to guide the study and were tested at a 0.05 level of significance.

**Ho<sub>1</sub>:** There is no significant difference between the mean scores of student's science process skill (observing) taught using vee-mapping strategy and those taught with lecture method

**Ho<sub>2</sub>:** There is no significant difference between the mean scores of student's science process skill (classifying) taught using vee-mapping strategy and those taught with lecture method

### **METHODOLOGY**

The research adopted quasi-experimental pre-test, post-test non-equivalent control group design. The study was conducted in Adamawa State, Nigeria. The population of the study comprised all 49,253 SS II students in Adamawa state (Adamawa State Post Primary Schools Management Board, 2023). The sample of the study composed of 84 Senior Secondary II Biology students in two intact classes from the selected education zones in Adamawa state. The study employed the multi-stage sampling procedure. In the first stage, simple random sampling technique was used to select two education zones from the five education zones in the State. In the second stage, purposive sampling technique was used to sample two schools from the two education zones.

The basis for using purposive sampling technique is that the schools should have Biology laboratory, co-educational type and have science laboratories and qualified Biology teachers with at least B.Sc. (Ed) or B. Tech (Ed) who had taught the subject for a minimum of 5 years. The third stage involved the use of simple random to assign the selected schools into experimental and control groups respectively. In each school one Biology teacher was picked by lucky dip through simple random sampling technique. The selected biology teachers in each school followed the school time table as provided by the school management after training on how to teach using vee- mapping method. The instrument for data collection was Biology Practical Achievement test (BPT).

The biology practical achievement Test (BPT) consisted of 50 objective tests with five options adopted from West African Examination Council (WAEC) Biology past questions from 2013-2023. The questions were based on Pests

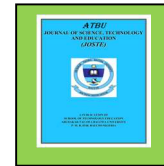
Corresponding author: *Ismaila Gambo Amara*

✉ [amraqismail@gmail.com](mailto:amraqismail@gmail.com)

Department of Environmental and Life Sciences Education, Modibbo Adama University, Yola.

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and diseases of crops following science process skills. To ensure content and construct validity the BPT was subjected to validation by two lecturers from the Department of Environmental and Life Sciences Education, Modibbo Adama University, Yola and one Biology teacher from senior secondary school. The validators checked the appropriateness of the items and ensured that the performance test items represent the true picture of the sampled content areas. The test items were administered to 50 non-participating Biology students in the study who have educationally similar background offering Biology as a subject. The trial testing was carried out in Government Day Secondary School Yola south which is not part of the study area. The students were

administered the BPT. The BPT score was then subjected to K-R 20 to determine the reliability of the instrument which yielded the reliability coefficient of 0.81. The research questions were answered using descriptive statistics of mean and standard deviation while the hypotheses were tested at 0.05 level of significance using Two-way Analysis of Covariance (ANCOVA).

## RESULTS

**Research Question 1:** What are the pre-test and post-test means scores of student's science process skill (observing) taught using vee-mapping strategy and those taught with lecture method?

**Table 1.** Mean and Standard Deviation of pre-test and post-test means scores of student's science process skill (observing) taught using vee-mapping strategy and those taught with lecture method.

Teaching Methods	Pre – test			Post – test		Mean Difference
	N	Mean	SD	Mean	SD	
V Mapping	44	7.00	1.49	12.45	2.04	5.15
Control	40	5.80	1.90	7.30	1.18	

The results from Table 1 shows an analysis conducted to compare the effectiveness of two teaching methods, vee-mapping strategy and lecture method, on students' science process skills, specifically observing. The effectiveness was measured using pre-test and post-test scores. For the vee-mapping strategy group, there were 44 students who had a mean pre-test score of 7.00 with a standard deviation (SD) of 1.49. After being taught using the vee-mapping strategy, their post-test scores increased to a mean of 12.45 with an SD of 2.04. This indicates a significant improvement in their observing skills, with a mean difference of 5.45 between the pre-test and post-test scores. In contrast, the control group, which was taught using the traditional lecture method, consisted of 40 students. They had a lower mean pre-test score of 5.80 with an SD of 1.90. Their post-test scores showed a mean of 7.30 with an SD of 1.18, which is an improvement but not as pronounced as the vee-mapping group. The mean difference between the

pre-test and post-test scores for the control group was 1.50. Comparing the mean differences between the post-tests of the two groups, students taught with the vee-mapping strategy outperformed those taught with the lecture method by a mean difference of 5.15. This suggests that the vee-mapping strategy is more effective in enhancing students' science process skills in observing compared to the lecture method.

**Research Question 2:** What are the pre-test and post-test means scores of student's science process skill (classifying) taught using vee-mapping strategy and those taught with lecture method?

Corresponding author: *Ismaila Gambo Amara*

✉ [amragismail@gmail.com](mailto:amragismail@gmail.com)

Department of Environmental and Life Sciences Education, Modibbo Adama University, Yola.

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**Table 2:** Mean and Standard Deviation of pre-test and post-test means scores of student's science process skill (classifying) taught using vee-mapping strategy and those taught with lecture method.

Teaching Method	N	Pre – test		Post – test		Mean Difference
		Mean	SD	Mean	SD	
V Mapping	44	6.93	1.39	12.57	2.1	5.24
Control	40	5.68	1.77	7.23	1.05	

The Table 2 presents the pre-test and post-test mean scores of students' science process skills, specifically in classifying, comparing two teaching methods: Vee-mapping strategy and lecture method. In the Vee-mapping group, comprised of 44 students, the pre-test mean score was 6.93 with a standard deviation of 1.39. Following the intervention, the post-test mean score substantially increased to 12.57, with a standard deviation of 2.1. This marks a significant mean difference of 5.24 between the post-test scores of the Vee-mapping group and their pre-test scores, indicating substantial improvement in science process skills after employing the Vee-mapping strategy.

On the other hand, in the control group taught via lecture method, consisting of 40 students, the pre-test mean score was slightly lower at 5.68, with a higher standard deviation of 1.77 compared to the Vee-mapping group. After the instructional period, the post-test mean score

increased to 7.23, with a smaller standard deviation of 1.05. The mean difference between the post-test scores of the control group and their pre-test scores was 1.55, reflecting a moderate improvement in science process skills through the traditional lecture method.

These results suggest that the Vee-mapping strategy led to a more significant improvement in students' science process skills, particularly in classifying, compared to the lecture method. The substantial mean difference between pre-test and post-test scores in the Vee-mapping group indicates the effectiveness of this teaching approach in enhancing students' understanding and application of science concepts.

**Ho<sub>1</sub>:** There is no significant difference between the mean scores of student's science process skill (observing) taught using vee-mapping strategy and those taught with lecture method

**Table 3.** ANCOVA of Difference between the Mean Scores of Student's Science Process Skill (Observing) taught using Vee-mapping Strategy and those taught with Conventional Lecture Method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	559.007 <sup>a</sup>	2	279.504	98.011	.000	.708
Intercept	461.385	1	461.385	161.789	.000	.666
Observing-test	2.316	1	2.316	.812	.370	.010
Teaching Method	471.192	1	471.192	165.228	.000	.671
Error	230.993	81	2.852			
Total	9190.000	84				
Corrected Total	790.000	83				

a. R Squared = .708 (Adjusted R Squared = .700)

Analysis in Table 3 presented summary of ANCOVA conducted to test whether significant difference exist between the mean scores of student's science process skill (observing) taught using vee-mapping strategy and those taught with lecture method. The results show that there is

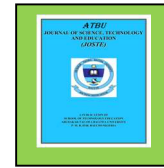
significant difference between the mean scores of student's science process skill (observing) taught using vee-mapping strategy and those taught with lecture method,  $F(1, 83) = 165.228$ ,  $p < 0.05$  with large effect size as indicated by the partial Eta squared of 0.671.

Corresponding author: Ismaila Gambo Amara

✉ [amraqismail@gmail.com](mailto:amraqismail@gmail.com)

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**Ho<sub>2</sub>:** There is no significant difference between the mean scores of student's science process skill

(classifying) taught using vee-mapping strategy and those taught with lecture method.

**Table 4.** ANCOVA of Difference between the Mean Scores of Student's Science Process Skill (Classifying) taught using Vee-mapping Strategy and those taught with Conventional Lecture Method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	598.216 <sup>a</sup>	2	299.108	102.774	.000	.717
Intercept	469.527	1	469.527	161.331	.000	.666
Classifying Pretest	.034	1	.034	.012	.915	.000
Teaching Method	512.135	1	512.135	175.972	.000	.685
Error	235.737	81	2.910			
Total	9274.000	84				
Corrected Total	833.952	83				

a. R Squared = .717 (Adjusted R Squared = .710)

Table 4 summarizes the ANCOVA analysis, comparing the mean scores of students' science process skill (classifying) when taught using the Vee-mapping strategy versus the lecture method. The results reveal a significant difference between the mean scores of students' science process skill (classifying) when taught using the Vee-mapping strategy versus the lecture method,  $F(1, 83) = 175.972, p < 0.05$ , with a large effect size, as indicated by the partial Eta squared of 0.685.

#### DISCUSSION OF FINDINGS OF THE STUDY

The study investigated the effects of vee-mapping strategy on senior secondary school students' acquisition of science process skills in Biology in Adamawa State, Nigeria. The following are the discussion of findings of the study. The finding revealed that there is a significant difference between the mean scores of students' science process skill (observing) taught using the Vee-mapping strategy and those taught with the lecture method. The study's findings highlight a significant difference in the mean scores of students' science process skill (specifically observing) when taught using the Vee-mapping strategy compared to the traditional lecture method. This suggests that the Vee-mapping strategy, with its visual organization of information, has a more positive impact on students' ability to observe. This result is consistent with prior research by Irede and Okoli (2019) and Olajide

(2019), which also found significant improvements in students' observation skills with the use of alternative teaching approaches. These findings collectively imply that instructional strategies emphasizing visual organization, such as Vee-mapping, science writing heuristics (SWH), field trips, and peer tutoring, may be more effective in enhancing students' observing skill compared to traditional lecture-based methods.

The finding also reveals that there is a significant difference between the mean scores of students' science process skill (classifying) when taught using the Vee-mapping strategy versus the lecture method. The findings from this study suggest that the Vee-mapping strategy is more effective than the traditional lecture method in enhancing students' science process skill of classifying. This indicates that the Vee-mapping strategy, with its potential for better organization, clearer categorization, and interactive activities, may contribute more effectively to the development of students' classifying skills. This finding aligns with previous research by Irede and Okoli (2019), Adah and Nsikhe (2020), and Olajide (2019), which also found significant improvements in students' classifying skills with the use of alternative instructional methods such as science writing heuristics, field trips, and peer tutoring.

#### CONCLUSION

Based on the findings of the study, it can be concluded that the Vee-mapping strategy is more effective than the lecture method in

Corresponding author: *Ismaila Gambo Amara*

✉ [amragismail@gmail.com](mailto:amragismail@gmail.com)

Department of Environmental and Life Sciences Education, Modibbo Adama University, Yola.

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improving students' science process skills. Specifically, the use of the Vee-mapping strategy led to higher mean scores in observing, classifying and overall science process skills compared to the lecture method. This suggests that the Vee-mapping strategy enhances students' ability to engage in scientific inquiry and processes.

### RECOMMENDATIONS

Based on the findings of this study, the following recommendations were made:

1. Teachers should integrate Vee-mapping strategy and real-life examples into their teaching to enhance students' observation skills.
2. To improve students' classifying skills, teachers should use more interactive and collaborative activities such as Vee-mapping strategy that require students to categorize and group information based on similarities and differences.

### REFERENCES

- Adah, S. & Nsikhe, U. (2020). Interaction Effect of Selected Science Process Skills Acquisition on Students' Academic Performance in Practical Biology in Calabar Education Zone, Cross River State of Nigeria. *Interaction*, 11(29).
- Ango, M. L. (2002). Mastery of science process skills and their effective use in the teaching of science: An Educology of Science Education in the Nigerian Context. *International Journal of Educology*, 3(1), 12-41
- Ataeva, N. (2022). Teaching natural sciences through the prism of philosophy: an attempt to define the relationship. *Futurity Philosophy*, 1(4), 15-28.
- Bawaneh, A.K.A. (2010). The effectiveness of conflict maps and the V-Shape teaching method in science conceptual change among eighth-grade students in Jordan. *International Education Studies*, 1(1), 1-13.
- Iofciu, F., Miron, C., Dafinei, M., Dafinei, A. & Antohe, S. (2012). MURPHY–Multimedia Tool for Advanced Physics Concept Approach: Giant Magnetoresistance (GMR). *Romanian Reports in Physics*, 64(3), 841-852.
- Irede, E. A. and Okoli, J. N. (2019). Teachers' Use of Science Writing Heuristics in Biology Instruction and Its Effect on Students' Acquisition of Science Process Skills. *Journal of Research and Method in Education*, 9(6), 17-26.
- Knaggs, C. M. & Schneider, R. M. (2012). Thinking like a scientist: Using vee-maps to understand process and concepts in science. *Research in Science Education*, 42, 609-632.
- Kyere, I. & Ameyaw, Y. (2019). Mapping Biological Concepts: Concept-Vee maps an Improver of students performance in photosynthesis. *International Journal of Innovative Research and Technology*, 6(6), 169-181.
- Novak, J. D. (2010). *Learning, creating, and using knowledge: Concept maps as facilitative tools in schools and corporations*. Routledge, London.
- Okeke, E. A. C. (2007). *Making Science Education Accessible to all 23rd Inaugural lecture series*. University of Nigeria Nsukka
- Olajide, S.O. (2019). Effect of Field Trip and Peer Tutoring Instructional Strategies on Students' Science Process Skills in Basic Science and Technology. *Journal of Education, Society and Behavioural Science*. 32(4), 1 – 12.
- Ping, I. L. L., Halim, L. & Osman, K. (2020). Explicit Teaching of Scientific Argumentation as an Approach in Developing Argumentation Skills, Science Process Skills and Biology Understanding. *Journal of Baltic Science Education*, 19(2), 276-288.
- Quiroz, W., Olivares, C., Merino, C. & Bravo, M. (2013). The urgent need for figures of merit in order to evaluate the performance of teaching and learning methodologies: constructive criticism

Corresponding author: Ismaila Gambo Amara

✉ [amragj@mail@gmail.com](mailto:amragj@mail@gmail.com)

Department of Environmental and Life Sciences Education, Modibbo Adama University, Yola.

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- from a scientific metrological discipline. *Quality and Quantity*, 47, 367-381.
- Sakiyo, J. & Waziri, K. (2015). Concept mapping strategy: An effective tool for improving Students' Academic Achievement in Biology. *Journal of Education: in Science, Environment and Health (JESEH)*, 1(1), 56-62.
- Thoron, A. C. & Myers, B. E. (2010). The effect of using vee maps versus standard laboratory reports on achieving student content knowledge. *Journal of Agricultural Education*, 51(3), 12-22.
- Villarreal, M.P. (2018). Design of Knowledge Models for Teaching Experimental Sciences at University. *Universal Journal of Educational Research*, 6(3), 519-540.
- Vitti, D. & Torres, A. (2006). Practicing Science Process Skills at Home: A handbook for parents. Retrieved 24/6/17 from: [http://www.stantic.nsta.org/connections/elementary/school/200712Torres Handout Parent NSTA conn](http://www.stantic.nsta.org/connections/elementary/school/200712Torres%20Handout%20Parent%20NSTA%20conn).
- Yadav, B. & Mishra, K. (2013). A study of the impact of laboratory approach on achievement and process skills in science among is standard students. *International Journal of Scientific and Research Publications*, 3(1), 1-10.
- Yumusak, G. K. (2016). Science Process Skills in Science curricula Applied in Turkey. *Journal of Education and Practice*, 7(20), 94-98.

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Corresponding author: Ismaila Gambo Amara

✉ [amragismail@gmail.com](mailto:amragismail@gmail.com)

Department of Environmental and Life Sciences Education, Modibbo Adama University, Yola.

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