

EFFECTS OF VEE MAPPING STRATEGY ON CHEMISTRY STUDENTS' PERFORMANCE IN QUANTITATIVE ANALYSIS IN KADUNA STATE

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Abstract

Practical activities are considered important for learning science by teachers and science educators. This paper therefore investigated the impact of vee mapping strategy on chemistry students' performance in quantitative analysis in Kaduna state. The pretest posttest experimental design was employed. The population was all SS2 Chemistry students from Government owned co-educational schools in Kafanchan zone. Random sampling was used to select two schools which were randomly assigned as experimental and control groups. The experimental group was taught quantitative analysis using vee mapping strategy while the conventional practical method was used on the control group. The instrument for data collection was a 20-item multiple questions tagged Chemistry Quantitative Achievement Test. A total of 80 randomly selected students formed the sample size for the study; 40 male and 40 female. A pre-test was administered to both groups to determine their equivalence in performance before treatment. The experimental mean scores 23.13 did not differ from the control group 22.12 ($t=0.79$, $df=78$, $p>0.05$). Therefore, the two groups were comparable before treatment. After four weeks of treatment, posttest was administered. The results showed that students in the experimental group performed better 58.38 than their counterparts in the control group 47.25 ($t=0.409$, $df=78$, $p<0.05$). No gender differences emerged when male and female students used the vee mapping strategy. A mean score of 60.01 for male and 58.75 for female ($t=0.345$, $df=38$, $p>0.05$) was obtained. It was concluded that vee mapping strategy is gender friendly thus science teachers should utilize it. It was also recommended among others that Government should release funds for teachers to undergo training, workshops and conferences on this method since it has been found effective.

Keywords: Chemistry, Vee Mapping Strategy, Quantitative Analysis, Performance, Senior Secondary School.

Introduction

Chemistry, the study of composition, structure and properties of matter is an important science subject necessary for the acquisition of profitable careers in chemical sciences and other aspects of life. Thus, its knowledge in the world today has become paramount, relevant and indispensable. Therefore, the appropriate method for teaching and learning this noble subject is necessary to proof its usefulness in the society. The teaching of Chemistry especially practical chemistry involves exposing students to participate actively in the concepts, processes, and principles. Chemistry practical in WAEC and NECO is titled Paper 1 which comprises of qualitative and quantitative analysis. Ayinde & Asubiojo 2016 defined quantitative analysis as the determination of the amount (Concentration) of Chemical species in samples like molar concentration, concentration in grams, molecular mass, molecular formula, and percentage purity. The concept is based on volume measurement of solutions hence can also be called volumetric analysis.

Many chemistry students face difficulty in learning practical concepts meaningfully because they remain as passive listeners while the teacher dominates the practical class from start to finish, Gaiya (2014). Similarly, practical work in chemistry is conducted in a boring manner as teachers still engage in "Cookbook" laboratory where learners show their ability to provide a title, aims, procedures, apparatus used and answers to series concluding questions. This method has not in any way enhance students' knowledge and performance rather it works negatively to the best practical approach in which students pursue their own inquiry under the guidance of the teacher, Thoron and Myers (2010). Therefore, the need for a heuristic strategy in practical classroom that will facilitate better knowledge gain. One of such is the vee mapping strategy which is both teacher and learner friendly.

Vee mapping is an instructional strategy in which learning takes place through discoveries from investigation made by the students and leads to improvement in performance Polancos (2012). In another way, a vee map is a strategy that help students develop their thinking skills, Ameyaw & Kyere (2019). Also seen as a road map that shows the route from prior to new and future knowledge, Knaggs & Schneider (2012). It is one of the constructivist models of teaching and learning which enhance students understanding of science practical Thoron & Myers (2010). It was first developed by Gowin in 1977 to help instructors and learners understand the process of constructing their own knowledge during practical. The instructional strategy guide learners through the steps involved in scientific reasoning methods and shows how new knowledge interacts with pre-existing knowledge and make available strategies that will enhance their conceptual understanding of an experiment. In other words, vee map is a metacognitive instructional strategy based on Ausubel's assimilation theory which explains that meaningful learning occurs through the assimilation of new concepts into existing concepts held by the learner.

The vee map follows the shape "V" as its name implies by two axes extending down from the top to form a crux where the join at the bottom. The left and the right sides of the vee emphasize two interdependent aspects of science learning, knowing and doing respectively. The knowing or the conceptual side forms the left axis of the vee while the doing or methodological side forms the right axis. The knowing side comprises of; associated words, philosophy, principles and relevant concepts which are the constructs that provide the foundation for methodology or context for further learning. On the other hand, the methodological side comprises claims, transformation and records. It is worthy to know that what a student knows about a topic at any one moment (previous knowledge), the investigative tools available and their ideas will determine the quality of questions they ask. Also, the answers students give to their questions will affect what they know by changing, adding to, refining, or reconfiguring their knowledge. A vee map is shown in figure 1.

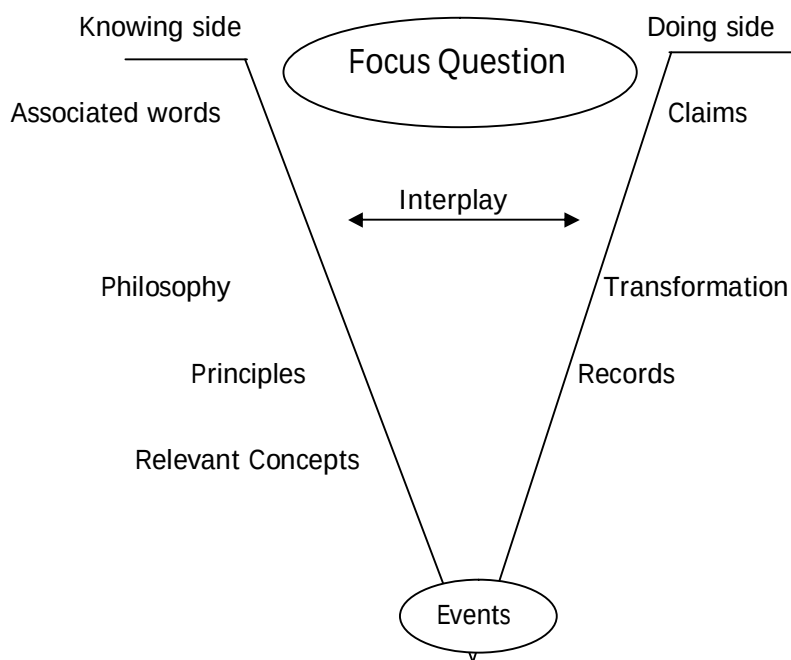


Figure 1: Vee Map Components (Gaiya, 2014)

Most research on vee mapping have proved better performance on students. For instance, Ameyaw and Kyere (2019) conducted a research on vee maps: an improver of students' performance in science concepts using third year students from Anglican senior high school Kumasi. A quasi

experimental and non- equivalent approach was used for the study. The result showed that students who used vee mapping approach perform better than their counterparts in the control group.

Similarly, Gaiya (2014) conducted a research on comparative effectiveness of computer vee mapping and practical demonstration methods on Chemistry students' academic performance in volumetric analysis using pretest posttest experimental control design. Four co-educational secondary schools were selected by simple random sampling and assigned to experimental and control groups. The vee mapping group scored more than students in the practical demonstration method. On the other hand, Polancos (2012) conducted a research on effects of vee diagram and concept mapping on the achievement of students in chemistry using quasi- experimental and non- equivalent comparison group approach. Third-year students of Liceo de Cagayan University were used. The result of the t- test and ANCOVA showed no significant difference between the two groups.

Gender is the biological difference in terms of sex. It has been identified as one of the moderating factors affecting students' performance in science practical (Chemistry) at senior secondary school level. For instance, Olasehinde and Olatoye (2014), Umar (2011), Gaiya (2014) and Thoron and Myer (2010) found no significant difference between the performance of male and female students taught science concepts. Amoo (2011), Kauru (2010) in their separate research found that girls achieved higher in science concepts while Udousoro (2011), Aniodah & Eze (2014) found that male students out-performed their female counterparts, therefore the need to study gender effects in this research because of the inconclusiveness of its findings in previous studies.

Statement of the Problem

Meaningful learning is considered as a critical issue to raising man-power needed to grow the individual and national economy. However, persistent poor performance of students in public examinations like WAEC and NECO in practical chemistry leading to the general poor performance in the subject is quite disheartening. WAEC chief examiners' report on practical chemistry 2011, 2014 and 2016 pointed among others; students' inability to link theoretical knowledge with practical work in quantitative analysis which has contributed to the unsatisfactory performance. Also, the problem of inappropriate and uninspiring method of teaching was lamented by some reseachers, Gaiya (2014) & (Amoo 2011). Other problems also mentioned include; manipulation of titre values by students to agree with that of the supervisor, inability to express numerical answers in the right units, decimal places and significant figures respectively; poor calculations and omission of units. This leaves one in doubt about the effectiveness of strategies used in practical lessons. The traditional laboratory method failed to improve performance thus the need for other strategies that will help learners learn meaningfully. Hence, the need to try alternative instructional materials that are learner-centred and actively engage the student in the learning process. One of such instructional strategy is concept mapping instructional strategy. Hence, this study investigated the effects of vee mapping strategy on chemistry students' performance in quantitative analysis in Kaduna State.

Research Questions

The study sought answers to the following research questions:

- i. Will there be any difference in the performance of students taught quantitative analysis using vee mapping strategy and those taught with conventional practical method?
- ii. Will there be any difference in the performance of male and female students taught quantitative analysis using vee mapping strategy?

Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance:

HO₁: There is no significant difference in the mean performance scores of students exposed to vee mapping strategy and those in the conventional practical method.

HO₂: There is no significant difference in the mean performance scores of male and female students exposed to vee mapping strategy.

Research Methodology

The study adopted pretest–posttest experimental control group research design. The experimental group was taught using vee mapping strategy while the control used the conventional practical style. Random sampling was adopted to obtain two Government co-educational secondary schools in the division. The schools must have been writing WAEC for the past ten years. The two selected schools were further assigned to experimental and control group using random sampling. GSS.

Kagoro formed the experimental group while GSS Ngarshang, Kwoi formed the control group. Lastly, a total of (80) eighty SSII Chemistry students were randomly selected as sample size; 40 males and 40 females. The research instrument for data collection was the Chemistry Quantitative Analysis Achievement Test (CQAAT) developed by the researchers. The (CQAAT) consisted 20 multiple choice objective items (A-D). The items in the CQAAT were validated by two principal lecturers in the department of Chemistry, Kaduna state college of Education, Gidan Waya. Also, the CQAAT was pilot tested on 20 randomly selected SSII students at Government secondary school Fadan Kagoma, Kaduna state, which was part of the population for the study using test retest method. The reliability index calculated using KR-21 was 0.74 which was considered adequate for the study.

Results

The data collected for the study was analysed using mean, standard deviation, and t-test while the significance of the analysis was ascertained at 0.05 alpha level.

Pre-test Results

To determine the equivalence of the two groups before treatment, pre-test was conducted, and the data collected and analysed using independent t-test the result is presented in table 1.

Table 1: t-test Comparison of Pretest Mean Scores of Experimental and Control Groups

Variables	N	X	SD	Df	t-value	P	Remarks
Experimental	40	23.13	5.51	78	0.79	0.433	NS
Control	40	22.12	5.87				

NS- not significant at 0.05 level of significance

Table 1: Indicated a pretest mean scores of experimental 23:13 and 22:12 for the control which did not differ significantly ($t = 0.79$; $df = 78$; $p > 0.05$). This showed that the two groups were comparable before treatment

Answering Research Questions

Research Question 1: Will there be any difference in the performance of students taught quantitative analysis using vee mapping strategy and those taught with conventional practical method? To answer this question, mean and standard deviation was employed.

Table 2: Mean and Standard Deviation of Pretest and Posttest Scores of Experimental and Control Groups

Group	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Experimental Group	40	23.13	5.51	58.38	8.68	35.25
Control Group	40	22.12	5.87	47.25	7.41	25.13

Table 2 shows the mean and standard deviation of achievement scores of the experimental and control group in the pretest and posttest. The result revealed the mean and standard deviation scores of the pretest and posttest experimental group are 23.13, 5.51 and 58.38, 8.86, respectively. Similarly, the mean and standard deviation scores of the pretest and posttest control group are 22.12, 5.87 and 47.25, 7.41, respectively.

Research Question 2: Will there be any difference in the performance of male and female students taught quantitative analysis using vee mapping strategy? To answer this question, mean and standard deviation was employed.

Table 3: Mean and Standard Deviation of Pretest and Posttest Scores of Male and Female

Group	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Male	20	27.54	7.78	60.01	8.92	33.47
Female	20	27.08	8.80	57.75	9.62	30.67

Table 3 shows the mean and standard deviation of achievement scores of the male and female in the pretest and posttest. The result revealed the mean and standard deviation scores of the pretest and posttest male group are 26.54, 7.78, and 60.01, 8.92, respectively. Similarly, the mean and standard deviation scores of the pretest and posttest control group are 27.08, 8.80 and 57.75, 9.62, respectively. The mean gain of the male and female was 33.47 and 30.67, respectively. Inferential statistics will be employed to determine whether the mean difference is significant.

Testing the Hypotheses

Hypothesis One: There is no significant difference between the mean performance scores of students exposed to vee mapping strategy and the conventional practical method. To test this formulated hypothesis, independent t-test was employed, and the analysis is presented in table 4.

Table 4: t-test Comparison of posttest mean scores between experimental and groups.

Variables	N	X	SD	Df	t-value	P	Remark
Experimental	40	58.38	8.68	78	0.409	0.001	Significant
Control	40	47.25	7.41				

Significant $P < 0.05$.

Table 4: Presents the t-test result of experimental and control groups. The mean scores of experimental group, 58.38 and 47.25 for the control. The calculated t-value of 0.409 was significant at 0.05 level. Hence, the null hypothesis one (H_{02}) was rejected with a mean difference of 11.13 in favour of the experimental group. This implies that the experimental group performed significantly better than the control group.

Hypothesis two: There is no significant difference in the mean performance scores of male and female students exposed to vee mapping strategy. To test this formulated hypothesis, independent t-test was employed, and the analysis is presented in table 5.

Table 5: Independent t-test comparison of mean scores of male and female students exposed to vee mapping strategy.

Variables	N	x	sd	df	t-value	P	Remark
Male	20	60.01	8.92	38	0.345 ^{ns}	0.732	NS
Female	20	58.75	9.65				

ns- not significant

The result in Table 5 presents the t-test result of the posttest mean scores of male and female students exposed to vee mapping strategy. The t-value of 0.345 was not significant at 0.05 level, ($t=0.345$, $df=38$, $P>0.05$). Both male and female students performed in the same manner, thus null hypothesis three was therefore upheld.

Discussion of Findings

Practical activities are considered important by teachers and educators. The result of hypothesis one showed that the two groups (vee mapping and conventional practical method) were comparable before treatment. The result of hypothesis one (H_{O1}) revealed a significant difference in performance in favour of students taught quantitative analysis using vee mapping strategy. This result agrees with the findings of Gaiya (2014) in chemistry practical, Thoron & Myers (2010); Knaggs & Schneider (2012) in science practical. Thus, Vee mapping strategy has been confirmed to be an effective strategy for enhancing students' performance in practical science.

The results of hypothesis two (H_{O2}) shows no gender effect on the performance of male and female students taught volumetric analysis with vee mapping strategy. This agrees with the findings of Gaiya (2014); Olatoye (2014) in science concepts. The findings disagree with the results of Amoo (2011) and Kauru 2010 who found that female students performed better in science concepts. The results also disagree with the findings of Aniodoh & Eze (2014) and Udousoro, (2011) who found that male students performed better in practical concepts. This finding can be attributed to the gender friendly nature of vee mapping and it also actively engage the learners actively in the learning process.

Conclusion

The study showed that the use of vee mapping strategy have the potential of improving the performance of students in quantitative analysis. This may be due to the fact that vee mapping strategy is a formative practical tool which provides a framework and guide learners through the steps involved in practical reasoning. Gender did not show any significant role when vee mapping was used. We can therefore conclude that vee mapping strategy is gender friendly as it affected both male and female in the same manner.

Recommendations

The following recommendations were made based on the findings.

- i. vee mapping strategy should be encouraged for teaching and learning chemistry practical in schools since it has been found to improve performance.
- ii. Government should release more funds for training of teachers on the strategy through seminars, workshops, and conferences since it is learners friendly.

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