

Effects of Vee Heuristic Teaching Approach on Secondary School Students' Attitudes Towards Biology In Kenya

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Abstract: Biological knowledge plays fundamental role in most aspects of human life. Its application in genetic engineering has made a tremendous contribution towards meeting the demand of food security, medicine and control of a variety of diseases. Despite this significant role, there is a national concern about the attitude of students towards biology by high school students' especially in physiology and biochemical topics. This study determined the effects of Vee Heuristic Teaching Approach on students' attitudes towards learning Biology. This study was conducted in public secondary schools in Tharaka Nithi County. Solomon Four – Group Non Equivalent Control Group Design was used. Data was collected from 12 schools randomly sampled from within the county. The sample comprised of 396 Form 2 students from four boys, four girls and four co-educational schools. A Biology Attitude Questionnaire was developed and used for data collection. The instruments were pilot-tested in one boy's, one girl's and one co-educational school in Embu East Sub-county to ascertain its reliability. The reliability coefficient was estimated using Cronbach's coefficient alpha. A coefficient value of 0.83 was obtained from the research instruments. Hypotheses was tested using ANOVA, and t-test statistics at $\alpha = 0.05$ level of significance. Means were separated using Least Significant. The study found that Vee Heuristics Teaching Approach (VHTA) facilitated students' attitude in biology subject. Since VHTA benefited students irrespective of gender and type of school attended, education authorities should encourage biology teachers, curriculum developers, quality assurance and standards officers and teacher trainers to apply it in the pursuit of teaching endeavors.

Key words; students' attitude, teaching approach, biology, Vee Heuristic

Date of Submission: 19-12-2017

Date of acceptance: 13-01-2018

I. Background of the study

The international community all over the world aim at educating millennial qualified enough to serve in the global task force particularly in scientific, industrial and capacity building. To this end, more and more studies are conducted in science education and continuously developing discipline which obtains information on the existence, development, modification and interrelationships of living organisms on earth (Hulya&Punar, 2010). Problems related to reproduction, nourishment, environment, health, diseases, marriage and family relationships, learning and memory can be solved only through biology education (Sucuoglu, 2003).

Biological knowledge plays fundamental role in most aspects of human life; its application in genetic engineering has made a tremendous contribution towards meeting the demand of food security, medicine and control of a variety of diseases (UNESCO, 2013). Despite this significant role, there is a global concern about the performance in biology by high school students especially at physiology and anatomy topics particularly in South East Asia and Sub Saharan Africa. The conventional teaching and learning situation calls for comprehensive change in almost every level of education so that practical and dynamic approach can be given to existing and new fields of biology education. The crux of modern education is to awaken the hidden curiosity and interest of the learner, nourishing behavior and beliefs in order to develop basic and essential skills of lifelong learning and ability to think critically (Samreen & Sufiana, 2012).

One of the notable interventions in teaching of sciences is the use of Vee diagrams approaches. This approach emphasizes the structure of and interplay between the theoretical and methodological dimensions of knowledge. It is essentially a pedagogical technique, heuristic where learning occurs through student-directed, constructivist and inquiry-based discoveries (Roehrig, & Edward, 2001). It is ideal for enabling students to understand how events, processes and objects are meaningfully related because its overall purpose is the interplay between what is familiar and what is to be taught in scientific or mathematical explanation (Novak & Alvarez, 2005). Vee heuristic enables the learners to understand the structure of knowledge, and the process of knowledge construction because knowledge is not absolute, but dependent upon concepts, theories and methodologies upon which world is viewed (Roehrig & Edwards, 2001).

Studies show that an attitude towards biology affects learners' achievements in biology (Hulya&Punar, 2010). A study in Ankara Science high school in Turkey revealed a statistically significant difference between male and female science high school students in terms of attitudes towards biology course. A study on relationship between attitude towards biology course and students achievement showed that there is no significant difference between boys and girls although girls had better achievement than boys (Saltan, 2011).

Barchok (2011) observed that collaborative concept mapping teaching strategy showed a significant difference in achievement between the students exposed to it and those not exposed to it. However, it was observed that this teaching approach do not affect the attitude of students towards learning of chemistry. The findings of this study are in agreement with a study finding by Muthomi (2014) who inferred that differentiated instruction did not have any effects on students' attitudes towards learning mathematics.

The use of Vee heuristic has been proven to be effective tool in enhancing achievements, attitudes and creativity in mathematics, chemistry and physics, however there is scanty research known to the researcher that has been conducted in Kenya to evaluate the effects of VHTA on students' attitudes. It is against this background that the present study sought to investigate the effects of Vee Heuristic Teaching Approach on students' achievements, attitudes and creativity in biology in Kenyan secondary schools.

II. Statement of the Problem

The government of Kenya is geared towards provision of quality education, training and innovation in schools and other institutions of learning. This is important in making Kenya an industrialized-middle income economy providing high quality life for its citizens as envisaged in vision 2030 blue print. Despite the massive allocation of resources to education sector, the sector is still faced with challenges which are likely to undermine the achievement of envisioned development. One of the challenges is the dismal performance in science subjects among high school students particularly in biology KNEC reports indicates that students are unable to interpret questions, possess poor scientific language and fail to relate biological knowledge to real life. In addition attitudes towards biology remain negative. Research finding recommends a shift from conventional methods of teaching biology to metacognitive approaches to reverse on this negative trend. Research has shown that a good teaching approach can enhance cognitive and affective characteristics of the students. In an attempt to bridge this gap, this study investigated the effects of Vee Heuristic Teaching Approach (VHTA) on students' attitudes towards learning biology.

Objectives of the Study

To establish the effects of Vee Heuristic Teaching Approach on students' attitudes towards Biology as a subject as compared to conventional teaching approach.

Hypotheses

To achieve the study objectives, the following hypothesis was tested at $\alpha= 0.05$ level of significant.

H₀1: There is no statistical significant difference in attitude towards Biology as a subject between students who are exposed to Vee Heuristic Teaching Approach and those not exposed to it.

III. Literature Review

Attitude is a mental tendency shown by individuals towards other people, objects, subjects and events (Adesoji, 2008). Attitude is deemed an important predictor of behavior, academic self-concept which is a cognitive characteristic, is another important factor effective on learning process in turn, on academic achievement (Adesoji, 2008). Attitude outcomes are of a different form than outcomes for achievements and knowledge. They are exhibited in a different way, and have deeper roots in the experiences that students bring to school. Attitude development is a lifelong process that involves the home school and the environment, Goswami and Bryant (2007).

Development of a positive attitude plays an important role in student's growth by interacting with intellectual development and creating a readiness for responsible application of what is taught (Albert, 2004). It is therefore difficult to separate affective factors from other learning process. These support embodiment theories that describe the interrelationship between affective, cognitive and perceptual process. Moreover, aesthetic experiences that promote affective and often emotional resources associated with the dispositions like fascination, anticipation and engagement, wander, and interests that spark curiosity can lead to use of scientific inquiry to develop explanation of biological phenomena (Milne, 2010). Students' attitudes toward the subject matter have been found to have a perfect correlation with achievements.

Osguthorpe and Graham (2003) in Brigham Young University in the United States of America found that blended instructional methods improved pedagogy, increased access to knowledge, fostered sound interaction, and increased teacher presence during learning, improved cost effectiveness. Several reasons have been suggested for negative attitudes including students' undesirable experiences in previous science courses

with teachers lack of needed skills to learn and apply scientific concepts, lack of motivation, biases of peer groups and students perception of rewards associated with learning (Rogers and Ford, 2004). There is growing evidence that students with positive attitude towards biology will perform better academically. Russel and Hollander (2000) collated the biology attitude scale - a tool for measuring students attitudes, supported this claim using controversial issues to introduce topics and concepts in biology classes help to raise questions that deserve answers and also generate interest among students and interest can improve motivation to learn biology (Leonard, 2010). In addition, making the learning and teaching of the topic more relevant to the students' lives help them see the value of science and in turn motivate them to develop in better attitude towards biology and biology education.

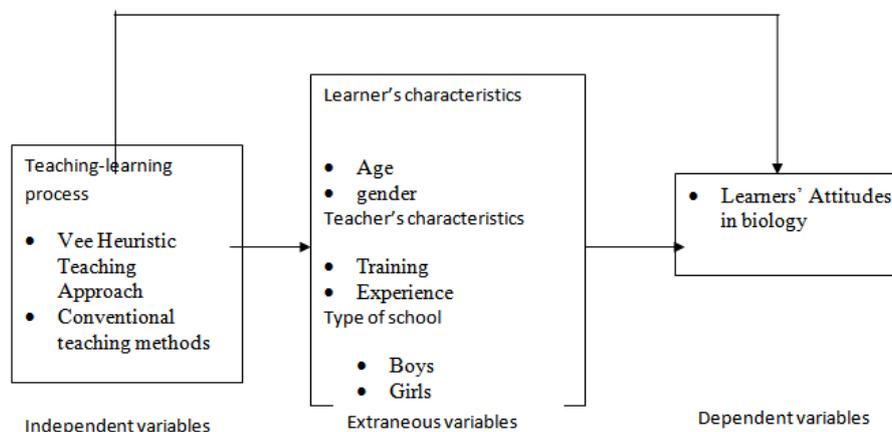
Students' attitudes towards the subjects they study influence performance in those subjects. In a Meta-analysis research investigating relationships between attitude and achievement, Wilson (1983) concluded that attitude had modest effects on later achievement for college students. However research has been equivocal with respect to the relationship between attitude and achievements in biological science courses .For example, Wilson, Akerman and Malane (2000) found no association between student's attitudes and their later achievement in college biology course. Similarly, Nicoll, Nakhlem and Francesco (2010) reported those students' attitudes about mathematics ability and about a particular course did not predict achievement in college level in Biological sciences.

In contrast, Freeman (1997) found that attitude was positively and moderately correlated with achievement for high school natural science students, when both attitude and achievement are measured at the end of a course. Likewise, House (1995) found that initial attitude toward Biology was better predictors of achievement for university Biology students than cognitive factors like admission test scores. German (1994) using faith analytic model hypothesized that attitudes towards natural sciences in school directly or indirectly influence students' performance or indirectly influence student's performance in a subject. In another study, Zeidner (1988) researched on the degree of co-variation between attitudes and test performance in biology using regression analysis showed a significant difference in performance across different attitudinal groups with respect to their different levels of attitudes.

Students attitude have been found to be a major predictor of students performance in science subjects, Abukniro and Joshua (2004). Their findings are in agreement with earlier research finding Bassery (2000). All these researchers found in their different attitude studies that students with positive attitude towards a school subject perform better in such subject than students with negative attitude towards a subject. When an individual has an interest or positive feeling towards any subject he/she behaves favorably towards that object and vice versa. This study endeavored to establish whether there is significance difference in attitudes towards learning Biology among secondary school students who are exposed to VHTA and those not exposed to it.

IV. Conceptual Framework

The conceptual framework to guide the study was based on systems approach which holds that the teaching and learning process has inputs and outputs. To achieve good results, then the input must have suitable materials. This study was based on the assumption that the blame for a student failure and negative attitude towards subject matter rests with the quality of instruction and not lack of students' ability to learn. Learning outcomes are influenced by various factors which include: learners characteristics, type of school and teacher characteristics.



The conceptual framework used to investigate the effects of VHTA on students' attitudes

Teacher training defines the teaching approach a teacher uses and how effective the teacher will use the approach. The learners' age and hence their class determines what is to be taught. The type of a school as a teaching environment affects the learning outcomes. This study involved trained biology teachers who had taught biology for a minimum of three years to control teacher variable. The types of schools used were boys', girls' and coeducation to control the school category variable. Form 2 biology students who are approximately the same age were involved in the study to control the age variable.

V. Research Design

This study involved quasi-experimental research in which the researcher used Solomon's four –group, non –equivalent control group design. This design helped to assess the effect of the experimental treatment relative to the control condition, to assess the interaction between pre-test and treatment conditions. It also enables the researcher to assess the effect of the pre-test relative to no-pretest and also to assess the homogeneity of the groups before administration of the treatment. Four schools in each school category were randomly assigned to treatment and control conditions. Each group had one boy's, one girl's and one coeducational school. Randomly assigning the schools to the four groups of study controlled interaction between selection and maturation. To control the interaction between selection and instrumentation, the instruments were administered under similar conditions across the schools. Hence there was reasonable control of the threats to internal validity of the study.

Group I	(E 1)	O ₁	X	O ₂
Group II	(C 1)	O ₃	-	O ₄
Group III	(E 2)	-	X	O ₅
Group IV	(C 2)	-	-	O ₆

Figure 1: Solomon's four nonequivalent control group design

X is the treatment where students were taught through Vee Heuristic Teaching Approach.

O₁ and O₃ are pretest while O₂, O₄, O₅, O₆ are posttests.

Group I is the experimental group, which received the pretest, the treatment and the posttest

Group II is the control group, which received a pretest followed by the control condition and finally a posttest.

Group III is the group that received X and a post test, it was not be pretested.

Group IV is a group that received pre-test only.

Biology Attitude Questionnaire (BAQ)

This questionnaire contained 27 closed-ended items adopted from National Foundation for Educational Research of the University of London and used to solicit students' feelings on biology based on attitudinal scales. It was divided into five sections which included the fun factor, scale 1 with 7 items, is a measure of the degree to which pupils consider the subject an activity to be enjoyed. Practical investigations scale 2 with 8 items is a measure of positive response to the challenge of practical inquiry and speculation in the subject. Committed scientist, scale 3 with 6 items, measures a fairly deep commitment to the study of the subject extending beyond the limits of the school curriculum. Concrete scientist, scale 4 with four items indicates a preference for practical involvement in the subject and career scientist, scale 5 with 4 items, indicates career preference in favour of the subject. These items were based on 5-likert marking scheme ranging from Strongly Agree SA – 5, Agree (A) – 4, Undecided (U) – 3, Disagree (D) -2, Strongly Disagree (SD)-1.

VI. Results and Discussion

Attitudes towards biology was measured along five attitudinal scales including fun factor (1), practical investigations (2), committed scientist (3), concrete scientist (4) and career scientist (5). The mean scores for the five attitudinal scales are presented in Table 1.

Table 1; Mean Scores of BAQ

Scale	Group	N	Mean	Stdev
1.Fun Factor	Experimental control	201	24.44	4.22
		195	23.73	4.50
2.Practical Investigation	Experimental control	201	28.05	4.82
		195	27.18	5.10
3.Committed Scientist	Experimental control	201	17.26	4.85
		195	16.26	4.87
4.Concret Scientist	Experimental control	201	18.77	3.61
		195	18.32	3,75
5.Career Scientist	Experimental control	201	9.41	3.61
		195	9.45	3.50

Results in Table 1, shows a slight difference in attitude scores. The experimental groups attained higher mean scores in virtually all attitudinal scales except scale five. To establish whether the mean scores were significantly different, one way ANOVA of BAT scores based on attitude scales was conducted.

Table 2: ANOVA of BAQ Scores

Scale		Sum of Squares	df	Mean Square	F	p-value
Fun factor	Between Groups	60.330	3	20.110	14.89	.000
	Within Groups	529.418	392	1.351		
	Total	589.747	395			
Practical investigation	Between Groups	93.128	3	31.043	11.025	.000
	Within Groups	1103.782	392	2.816		
	Total	1196.909	395			
Committed scientist	Between Groups	59.374	3	19.791	5.046	.002
	Within Groups	1537.603	392	3.922		
	Total	1596.977	395			
Concrete scientist	Between Groups	7.859	3	2.620	.332	.802
	Within Groups	3095.563	392	7.897		
	Total	3103.422	395			
Career scientist	Between Groups	14.025	3	4.675	2.770	.041
	Within Groups	661.639	392	1.688		
	Total	675.664	395			

The results on Table 2 shows that the students' means for the BAQ scores for the five scales among the 4 groups of study were significant except in scale on concrete scientist which was not significant, ($F_{(3,392)} = 0.332, P \geq 0.05$). In order to establish whether the difference in BAQ mean scores of the five scales between experimental and control groups were significant; an independent sample t-test was conducted. Table 2 shows the Independent sample t-test of BAQ scores.

Table 3. Independent Sample t-test BAT scores

Group	N	Means	SD	t	P
Experimental	201	72.45	7.16	0.76	0.454
Control	195	70.75	7.06		

The results on Table 3 shows that the students' scores on BAQ between experimental and control groups of the study were not statistically significant

($t_{(1,395)} = 0.76, p > 0.05$). This means that VHTA did not have significant influence on students' attitude towards learning biology. Therefore, hypothesis which stated that there is no statistically significant difference in attitude towards Biology as a subject among students who are exposed to Vee Heuristic Teaching Approach and those not exposed to it is therefore accepted. Although the difference between the means of the experimental and control group was not statistically significant, the experimental group which was exposed to VHTA attained a slightly higher mean score. This is probably because when students when students work in group they can depend on each other for help and therefore increase their confidence solving problems. Since both experimental and control groups recorded a developed attitude towards biology as a subject, one cannot precisely associate the change of attitude with exposure to VHTA.

In a related study on relationship between attitude towards biology course and students achievement showed that there is no significant difference between boys and girls although girls had better achievement than boys (Saltan, 2011). Attitude is deemed an important predictor of behavior, academic self-concept which is a cognitive characteristic, is another important factor effective on learning process in turn, on academic achievement (Adesoji, 2008). Similar studies conducted by Ifamuyiwa&Akinsola(2008) found that students in experimental group developed a positive attitude towards the subject.

Development of a positive attitude plays an important role in student's growth by interacting with

intellectual development and creating a readiness for responsible application of what is taught (Rogers & Ford, 2004). However research has been equivocal with respect to the relationship between attitude and achievements in biological science courses. For example, Wilson, Akerman & Malane (2000) found no association between student's attitudes and their later achievement in college biology course. Similarly, Nicoll, Nakhlem & Francesco (2010) reported those students' attitudes about mathematics ability and about a particular course did not predict achievement in college level in Biological sciences.

In contrast, Freeman (1997) found that attitude was positively and moderately correlated with achievement for high school natural science students, when both attitude and achievement are measured at the end of a course (Albert, 2004). Findings of this study are in agreement with Erol (2005) who investigated attitude towards physics, the study of Nakipoglu and Altiparmak (2002) related to attitude towards biology and Ergin (2006) where the effects of science education using discovery teaching strategy on students attitudes towards science were investigated. When the studies were investigated, the duration of the application varied from 4-8 weeks. A possible reason for not changing the attitudes was due to the short application period. Findings of this study are in agreement with Muthomi (2014) who inferred that differentiated instruction did not have any effects on students' attitudes towards learning mathematics.

VII. Conclusion

VHTA embraced in this study revealed a positive impact on students' attitude towards biology. Heads of Departments and teachers of biology are recommended to embrace it in facilitating attitude change towards the subject. VHTA embraced in this study revealed that coverage of Vee heuristic lessons took longer than what it would have taken a conventional lesson. This means adequate time is needed for the preparation of VHTA lessons so as to develop challenging activities which will enhance effective acquisition attitude change by the learners.

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Antony K. Njue "Effects of Vee Heuristic Teaching Approach on Secondary School Students' Attitudes Towards Biology In Kenya." *IOSR Journal of Research & Method in Education (IOSR-JRME)* 8.1 (2018): 18-23