

## **EFFECTS OF GOWIN'S VEE TEACHING STRATEGY ON SECONDARY SCHOOL STUDENTS' MOTIVATION TO LEARN HOOKE'S LAW TOPIC IN KOIBATEK SUB-COUNTY, KENYA**

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### **Abstract**

*The study sought to find out the effects of Gowin's Vee teaching strategy on secondary school students' motivation to learn Hooke's law topic in Physics in Koibatek Sub-County in Kenya. Gowin's Vee Teaching Strategy is a learning activity involving making a V – shaped representation with two sides: the theoretical and methodological. Data were collected in selected co-educational secondary schools in Koibatek Sub-County, Baringo County. Solomon four non-equivalent control group design was used. Two experimental groups were taught using Gowin's Vee as treatment and two control groups taught using regular teaching methods. The target population was all Physics students in public secondary schools in Koibatek Sub-County. Purposive sampling was used to select 138 students from four co-educational secondary schools which were randomly assigned to experimental and control groups. The instruments used were Physics Students' Motivation Questionnaire (PSMQ) to test students' motivation level. Validity of the instruments was determined by Egerton University lecturers in the Department of Curriculum, Instruction and Educational Management and experienced secondary school Physics teachers in the four selected secondary schools. Reliability of the instruments was established through a pilot test process which was undertaken on the sample of Physics students in a co-educational secondary school in Mogotio Sub-county. Estimation of reliability using Kuder Richardson KR 21 gave 0.94 for PCUAT while Cronbach's alpha coefficient gave 0.88 for PSMQ, which is above 0.7- the accepted value. This study is important in enhancing performance and quality of teaching Physics.*

**Keywords:** Gowin's Vee teaching strategy, learning, motivation, physics

### **Introduction**

Physics is the study of matter and energy and their interactions. Physics is important because it improves the quality of life of human beings and it develops solutions to both energy and environmental problems (*United Nations Educational, Scientific and Cultural Organization [UNESCO, 1999]*). Any breakthrough in science and technology is deeply rooted in the strength of science education (Kehinde and Emmanuel, 2011). It is in recognition of this importance of science that during the Fifth Ordinary Session of the Conference of Ministers of Education in Africa (COMEDAF V) held in April 2012 in Abuja, Nigeria, Centre for Mathematics, Science and Technology Education in Africa (CEMASTE) was showcased as model 'Centre of Excellence' in the promotion of quality of mathematics and science education at the basic level in Africa (Mutula, 2012).

Performance in Physics has been low and many students shun the subject (Njoroge, Changeiywo, Ndirangu, 2014). Table 1 shows performance in Physics in the national exams and the percentage performance are very low. The focus on the study is to avoid the negative effects of the students' preconceptions by involving them in the twelve epistemological steps as laid down in the Gowin's Vee teaching strategy (Novak & Gowin, 1984).

In Kenya, the experience in poor performance in Physics among students at varying levels of learning is reflected in the candidates' performance in the Kenya Certificate of Secondary Education (KCSE) Physics examination between the years 2008 and 2013. The mean score remained low over the period between 2008 and 2013. The best performance was in 2013 with a percentage score of 38.99, while 2009 recorded the worst performance with a mean score of 31.31 (KNEC, 2009). Waihenya (2002) attributed low achievement to poor teaching methods, which lead to lack of mastery of the subject by students. Table 1 shows candidates overall KCSE national performance in Physics in the years 2008 to 2013.

**Table 1**  
**Candidates Overall KCSE National Performance in Physics in the Years 2008 to 2013**

Year	Physics Candidates	All candidates	Percentage	Max. Score	Mean Score	Percentage (%) Score
2008	93,692	305,015	30.71	200	73.42	36.71
2009	104,883	337,404	31.09	200	62.62	31.31
2010	109,811	357,488	30.72	200	70.22	35.11
2011	120,070	411,738	29.16	200	73.28	36.64
2012	119,654	434,121	27.30	200	75.72	37.72
2013	119,862	445,800	26.89	200	77.98	38.99

*Source: Kenya National Examinations Council (2014)*

There has been an increase in Physics student population from 93,692 in 2008 to 119,862 in 2013 may be due to free primary education. The number of Physics students also in 2011, 2012 and 2013 remained stagnant but the total candidature is increasing meaning that the percentage of students doing Physics is decreasing. Although the mean score from 2009 to 2013 has been increasing, the percentage performance in Physics is still below average and the number of Physics students is reducing. The low enrolment in Physics has been attributed to poor performance partly blamed on teaching methods among other factors (Uside, Barchok & Abura, 2013). Many students perceive the subject as difficult as established by Musasia, Abacha and Biyoyo (2012).

Motivation is the initiation, direction, intensity and persistence of behaviour. It means having the encouragement to do something, (Reeve, 2004). Teachers tend to believe that when students are motivated to perform competently on academic tasks, they will learn in accordance with their academic abilities. For this reason alone, working to enhance students' academic motivation is worthwhile, (Dale, 2007). But in addition to maximizing student learning, another beneficial by-product of having highly motivated students in class is that they make the teacher's job of managing the instructional program simpler (Huitt, 2001). When students are academically motivated, their teachers often become professionally

motivated, working hard to provide students with worthwhile educational experiences and finding more satisfaction in doing so (Cheryl, 1992).

In Kenya, Physics, Chemistry and Biology science subjects are offered in its 8-4-4 curriculum (KIE, 2002). Many students do not do well at KCSE as shown in table 1. A student is required to choose at least two sciences upon transition from form two to form three. However, during this transition many students drop Physics leading to low enrolment in the subject. Performance in Physics in Koibatek Sub-County in Baringo County has been very low. Table 2 shows performance in Biology, Chemistry and Physics in KCSE in Koibatek Sub-County from 2010 to 2014.

**Table 2**  
**Candidates Science Mean Scores for Koibatek Sub-County for the Years 2010 to 2014**

Year	Subject	No. of Candidates	Mean Score	Maximum Score
2010	Biology	1128	4.90	12
	Physics	483	4.95	12
	Chemistry	1203	4.11	12
2011	Biology	1449	4.85	12
	Physics	521	4.95	12
	Chemistry	1292	3.79	12
2012	Biology	1564	5.43	12
	Physics	532	4.96	12
	Chemistry	1504	4.14	12
2013	Biology	1645	4.04	12
	Physics	560	4.34	12
	Chemistry	1662	3.24	12
2014	Biology	1634	5.10	12
	Physics	562	4.81	12
	Chemistry	1613	4.28	12

**Source: Koibatek Sub-County Education Office**

The number of students doing Physics is very low compared to Chemistry and Biology. Although Physics sometimes lead in the three sciences, its performance is still below average in the Sub-County. Effective Physics instruction should be able to change students' way of thinking about Physics. In an attempt to achieve this, various contemporary researches in education and psychology have come out with epistemologies, theories and pedagogies like constructivism and meaningful learning theories (Ausubel,1968), metacognition (Flavell, 1979), creativity and process skills (Okere, 1996), advanced organizers (Ausubel,1968), Gowin's Vee (Gowin, 1981) and concept maps (Novak & Gowin, 1984; Mutai, 2015).

These researches have shifted Physics education from building the knowledge capacity to improving thinking skills and creativity through conceptual understanding. Thus the use of socio-constructivist perspective and meaningful learning theory has offered a window of hope in the teaching and learning of various topics in Physics and science in general. Students should be made to understand the Physics world as made up of coherent structure of concepts

which are interlinked together (Ausubel, 1968; Novak & Gowin, 1984). Gowin's Vee is a very useful teaching and learning tool which has been extensively used in many countries like USA (Novak & Gowin, 1984), Finland (Ahlberg, 1993), Australia (Afamasaga, 1998), Venezuela (Ramírez, Aspéén, Sanabria & Tellez, 2008) and South Africa (Ramahlape, 2004) among others in bringing about meaningful learning.

This study aims at finding out the effects of Gowin's Vee teaching strategy on form two Physics students' motivation in the topic of Hooke's Law in Physics in secondary schools within Koibatek Sub-County. This is because physics needs a lot of practical and calculations and the students have been performing poorly in Physics at KCSE. It has also been identified as one of the difficult areas according to the Kenya National Examinations Council Examination (KNEC, 2013). Therefore this topic needs a strategy which carries the learners step by step in order for them to get the concepts right so that meaningful learning can be realized.

### **Research Objective/Hypothesis**

#### **Research Objective**

The study sought to find out the effects of using Gowin's Vee teaching strategy on secondary school students' motivation to learn Physics

#### **Research Hypothesis**

The study was guided by the following null hypothesis.

- Ho1:** There is no statistically significant effect in the level of motivation between students taught using Gowin's Vee and those taught using regular methods in Physics.

**METHODOLOGICAL**

**CONCEPTUAL/THEORETICAL**

(Thinking)

(Doing)

**WORLD VIEW:**

The general belief and knowledge system motivating and guiding the inquiry.

**PHILOSOPHY/EPISTEMOLOGY:**

The belief about the nature of knowledge and knowing guiding the inquiry.

**THEORY:**

The general principles guiding the inquiry that explain why events or objects exhibit what is observed.

**PRINCIPLES:**

Statements of relationships between concepts that explain how events or objects can be expected to appear or behave.

**CONSTRUCTS:**

Ideas showing specific relationships between concepts, without direct origin in events or objects.

**CONCEPTS:**

Perceived regularities in events or objects (or records of events or objects) designated by a label.

**FOCUS QUESTIONS:**

Questions that serve to focus the inquiry about events and /or objects studied

**VALUE CLAIMS:**

Statements based on knowledge claims that declare the worth or value of the inquiry.

**KNOWLEDGE CLAIMS:**

Statements that answer the focus question(s) and are reasonable interpretations of the records and transformed records (or data) obtained.

**TRANSFORMATIONS:**

Tables, graphs, concept maps, statistics, or other forms of organization of records made.

**RECORDS:**

The observations made and recorded from the events/objects studied.

**EVENTS AND /OR OBJECTS:**

Description of event(s) and /or object(s) to be studied in order to answer the focus question.

**Figure 1: Gowin's Vee Heuristic Diagram with a Description of All the Twelve Epistemological Elements**

## Research Methods

### Research Design

In this study Solomon-four non-equivalent control group design was used as shown in figure 5. According to Fraenkel and Wallen (2009) Solomon-Four is suitable in experimental and Quasi-experimental research because it can control all the threats to internal validity. This design is adopted because under school arrangement the students have already been assigned classes and cannot be randomly constituted during the study. This cannot be authorized in the schools since it will affect the laid down criteria for which they were initially constituted. Figure 5 shows structure of Solomon four non-equivalent control group design.

Group 1(E <sub>1</sub> )	O <sub>1</sub>	X	O <sub>2</sub>
Group 2(C <sub>1</sub> )	O <sub>3</sub>	–	O <sub>4</sub>
Group 3(E <sub>2</sub> )	–	X	O <sub>5</sub>
Group 4(C <sub>2</sub> )	–	–	O <sub>6</sub>

### Key

- .....= No randomization is done
- X = treatment
- O<sub>1</sub> & O<sub>3</sub> = pretest results
- O<sub>2</sub>, O<sub>4</sub>, O<sub>5</sub> & O<sub>6</sub> = Posttests results

**Figure 5: Solomon four non-equivalent control group design (Cohen & Manion, 1990)**

There are two experimental groups E1 and E2 and two control group C1 and C2. One of the experimental group E1 and control group C1 received the pretest while the other experimental group E2 and control group C2 were not pretested. At the end of the study, all the groups were post-tested simultaneously. Most of the threats to internal and external validity were addressed by this design. Sensitization was addressed by having one of the experimental and control group pretested. The reactive effect was controlled by ensuring that the subjects under the study were not made aware that they are in an experimental situation. The schools that acted as control groups were selected at a far distance from the experimental groups in order to prevent any contamination during inter-school activities.

### Sampling Procedures and Sample Sizes

Four co-educational secondary schools out of 24 schools were purposively selected to ensure that there was equivalence in terms of resources and performance in national examination to form the study sample. Co-educational secondary schools were selected so as to control gender issues. This was done by checking their background performance including KCPE entry marks. Two co-educational secondary schools were chosen in Eldama Ravine division since it has many schools, one from Esageri division and one from Mumberes division.

To get the sample size from the four schools one class was used then the results were generalized to other classes and schools. The number of students per class is expected to be 45

that mean a total of 180 students. However, four classes were selected randomly in each of the four schools. They were grouped into: E1=30, E2=36, C1=40 and C2=32 giving a total of 138 students. Correlational designs require at least 30 participants and experimental, quasi-experimental, and causal-comparative designs require at least 15 participants per group (Onwuegbuzie & Leech). The size of the sample in experiments depends on how effective the treatment is. However, if the treatment is weak, then a larger sample size is necessary to find a significant effect (Korb, 2015).

### **Instrumentation**

A 35 item 5-Likert scale questionnaire adopted from Cooper and Sandi-Urena (2009) was given to students by the Physics teachers in the selected secondary schools to test student motivation to learn physics. The 5-Likert scales are; SA-Strongly Agree, A-Agree, U-Undecided, D-Disagree, SD-Strongly Disagree. For positive questions the scoring was be; SA-5, A-4, U-3, D-2, SD-1 and for negative questions it was SD-5, D-4, U-3, A-2 and SA-1.

## **Results and Discussion**

### **Comparison of motivation to learn Physics between students taught using Gowin's Vee and those taught using regular methods in Physics.**

All the groups did posttest to show the motivation level of the experimental and control groups. Table 3 shows the mean of each group.

**Table 3**  
**Posttest Results of Motivation of Experimental and Control Groups.**

<b>Group</b>	<b>N</b>	<b>Mean</b>	<b>SD</b>
E1	30	4.53	0.41
E2	36	4.23	0.39
C1	40	3.46	0.72
C2	32	3.35	0.70

An examination of the scores in Table 3 reveal that the mean scores of experimental groups E1 (M = 4.53, SD = 0.41) and E2 (M = 4.23, SD=0.39) were higher than those of the control groups C1 (M = 3.46, SD = 0.72) and C2 (M = 3.35, SD = 0.70). Examinations of the results reveal that the experimental groups were more motivated than the control groups. In order to find out whether the difference among the groups was statistically significant, the ANOVA test was used to establish whether the difference among the mean scores were significantly different or not. Table 4 shows the F-value using one way ANOVA.

**Table 4**  
**Analysis of Variance (ANOVA) of the Post Test Scores on PSMQ**

Scale	Sum of Squares	Df	Mean Square	F-value	p-value
Between Groups	33.061	3	11.020	32.383	.000
Within Groups	45.602	134	.340		
Total	78.664	137			

The results of the ANOVA test in Table 13 show that the difference among the mean scores of E1, C1, E2 and C2 were significant at the 0.05 level in favour of the experimental groups,  $F(32.383) = 0.000$ ,  $p < 0.05$ . The results in Table 12 did not reveal where the differences were given that it involved 4 groups thus the need for further analysis. Further analysis was conducted to reveal where the differences were. The Scheffe multiple comparison test was used as shown in table 5.

**Table 5**  
**Scheffe's Multiple Comparison Test for Motivation**

Pair	Mean Differences	Std. Error	P-value.
E1 - E2	0.31	0.14	.214
E1 - C1	1.07	0.14	.000*
E1 - C2	1.18	0.19	.000*
E2 - C1	0.77	0.13	.000*
E2 - C2	0.87	0.14	.000*
C1 - C2	0.11	0.14	.892

The mean gain analysis was done for motivation by checking the pretest and posttest. The results are shown in table 6 below.

The difference between E1-E2 (.214) and C1-C2 (.892) were not statistically significant. The results show that the experimental groups (E1 and E2) were more motivated than the control groups given that the groups were similar at the commencement of the treatment. The motivation of the experimental groups was attributed to the effects of the Gowin's Vee teaching strategy. This shows Gowin's Vee teaching strategy can motivate Physics students.

**Table 6**  
**Mean Gain Analysis**

Group	Pretest			Posttest			Gain
	N	Mean	SD	N	Mean	SD	
E1	30	2.27	0.59	30	4.53	0.41	2.26
C1	40	2.15	0.58	40	3.46	0.72	1.31

The differences in mean gains for motivation was done using t-test as shown in table 7

**Table 7**  
**Differences in Mean Gain for Motivation**

Group	N	Mean	SD	df	t-value	p-value
E1	30	2.26	0.60	68	4.512	.000
C1	40	1.31	1.03			

The results of the t-test reveal that the difference between the mean gain (M = 2.26) of E1 was significantly different from that (M = 1.31) of C1,  $t(68) = 4.512$ ,  $p < 0.05$ . Given that E1 and C1 were similar at the point of entry, the major improvement in learning outcomes of E1 was attributed to the treatment. The results in the table 14 indicates that the difference in the Physics mean scores between pairs E1- C1 (P=.000), E1-C2 (P=.000), E2-C1 (P=.000), E2-C2 (P=.000) were statistically significant.

### Conclusion and Recommendation

The study established that Gowin's Vee teaching strategy statistically improved students' motivation in learning Hooke's Law topic in Physics in secondary schools within Koibatek Sub-County. The method is interactive, engaging, and practical due to its twelve epistemological elements. Therefore the students are able to plan, monitor and evaluate their own learning process since they are more motivated in Physics. This study recommended that teachers and curriculum developers should consider Gowin's Vee teaching strategy as a useful tool in the teaching and learning of Physics in secondary schools in Kenya.

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