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Original Paper

Effects of Advance Organizers on Students' Achievement in Biology in Secondary Schools in Kilifi County, Kenya

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Abstract

This study investigated the effects of using advance organizers on students' achievement in biology in secondary schools in Kilifi County. Solomon Four, Non-Equivalent control group design was used in this study. The study targeted all secondary school students in Kilifi County. The accessible population consisted of all form two students in Kilifi County. Purposive sampling was used to select four co-educational secondary schools in Kilifi County. The four schools were randomly assigned to experimental groups (E_1) and (E_2) and control groups C_1 and C_2. A total of 156 students participated in the study. Data was collected using Biology Achievement Test (BAT). The reliability of BAT was estimated using Kuder-Richardson (K-R) 20 and Cronbach's coefficient. This yielded a reliability coefficient of 0.82 and 0.79 respectively. BAT was validated by experts in science education from Egerton University. The data collected was analyzed using mean, one-way ANOVA and t-test. The level of significance was 0.05. The findings of this study show that there was statistically significant difference in achievement between learners in favour of those taught using advance organizers compared to those taught using conventional teaching methods. The findings also indicate that there was no statistically significant gender difference in achievement.

Keywords

achievement, advance organizers, conventional teaching method

1. Introduction

United Nations Educational, Scientific and Cultural Organization (UNESCO) (2017) argues that science should equip learners with knowledge and skills that would ensure sustainability of societies. Scientific skills gained from learning biology are vital for economic growth in any society. According to the Republic of Kenya (RoK, 2012a), courses like medicine require strong background in biology. Emerging issues such as HIV/Aids, drug abuse and environmental pollution which have an impact on human lives have been incorporated in biology (Kenya Literature Bureau [KLB], 2012). Apart from inculcating environmental conservation skills, biology also enables learners to acquire problem solving skills, interpersonal skills, project and time management skills and sharpening of one's scientific thinking (Kenya Institute of Education [KIE], 2006). Biological knowledge can be used to find solutions to four key societal needs: sustainable food production, ecosystem restoration, optimized biofuel production and improvement in human health (The National Academy of Sciences [NAS], 2009). Biology as a science is, therefore, an important subject that would contribute towards the realization of Kenya's vision 2030. Thus, biology has a role to play in contributing towards the country's social economic development. For Kenya to realize her vision 2030, the country must adopt a better Science, Technology and Innovation (STI) dissemination strategy (Republic of Kenya [RoK], 2012a).

Despite the benefits that accrue from studying biology, students in Kenyan secondary schools have continued to perform dismally at Kenya Certificate of Secondary Education (KCSE) Examination (RoK, 2012b). Rotich and Mutisya (2013), contend that the persistent state of low academic performance in national examination in sciences has been a major concern to all stakeholders. Performance of biology in 2017 KCSE exams was so dismal leading to low numbers of students admitted into biological science-based careers in Universities in Kenya. Only 18% of the candidates scored at least a grade of C+ in the subject which is the minimum grade required for admission to various biological science courses (KNEC, 2018). This poor performance in biology is also exhibited by other African countries (Trends in International Mathematics, and Science Study [TIMSS], 2011). For instance, the KCSE biology examination results for 2014 and 2015 indicated that students had low mean scores of 31.83% and 34.80%, respectively (KNEC, 2015, 2016). This poor achievement can be attributed to inappropriate teaching strategies, abstractness of science, unqualified science teachers and lack of enough teaching-learning resources (Keraro, Okere, & Anditi, 2013). The teaching strategies employed currently do not help the learners to answer questions which approach the curriculum topics from various angles and perspectives (KNEC, 2018). Gender disparity in biology achievement exists in Kenyan secondary schools. Forum for African Women Educationalists [FAWE] (2007) contends that girls' achievement in biology in Kenya is below average. FAWE (2009) points out that poor achievement among female students is attributed to cultural practices and teaching methods which do not take into account individual needs of the girls. Males attain higher scores in sciences than females at KCSE level (KNEC, 2016). The teaching strategies used in most Kenyan secondary schools are

expository because most schools do not have science laboratories and those that have, are inadequately equipped and in most cases poorly maintained (Tsuma, 1998). This poor performance prompted investigation of an alternative teaching method other than conventional methods which are widely practiced. This alternative teaching method is the use of Advance Organizers. UNESCO (2017) argues that performance in STEM subjects can be improved by a more engaging instructional strategy.

Advance organizers is a strategy that would improve students' achievement. Advance organizers are instructional strategies that enable learners' to connect new information to already known material and also construct their own ideas. After his research to promote meaningful learning over rote learning, Ausubel (1960) formulated the subsumption theory. This theory stresses meaningful learning by linking the prior knowledge of students with new information that is presented in the school setting. According to Ausubel, the best way of facilitating retention is to introduce the appropriate subsumers and make them part of a learner's cognitive structure prior to the actual presentation of the learning tasks. The introduced subsumer thus becomes the advance organizers or *anchoring foci* for the reception of new material (Ausubel, 1978). A primary process in learning is subsumption in which new material is related to relevant ideas in the existing cognitive structures (Kearsley, 2000). Mayer (2010) contends that advance organizers are presented material that introduce learners to what they will be learning thus allowing the learners to utilize the relevant prior knowledge.

An advance organizer is an organizational frame work that teachers present to students prior to teaching new content to prepare them for what they are about to learn (Githua & Nyabwa, 2008). Ausubel (1968) argues that advance organizers are relevant introductory materials presented in advance in any format of text, graphics or hypermedia. Chuang and Liu (2014) argue that with the emergence of multimedia technology, multimedia have served as supportive instructional interventional components in multimedia learning environment, new and different forms of information are available for use as advance organizers. Studies have shown that advance organizers have led to improved students' achievement (Omotade, 2016; Nazimuddin, 2015; Mshenga, 2013; Montanero & Lucero, 2012; Agnihotri & Sharma, 2013; Babu & Reddy, 2013). Studies have also demonstrated that advance organizers are associated with improved learning (Tamir, 1992; Dexter & Hughes, 2011; Dexter, Park, & Hughes, 2011). Maryam, Moenikia and Zahed-Babelan (2010) argue that advance organizers are effective ways to facilitate the task because they can provide an overview of a new topic and visually represent links between the concepts to be learned. A study by Atomatofa (2013) revealed that Advance lead to improved students' achievement and retention than those taught using conventional teaching methods. Advance organizers are cognitive bridges, which teachers use to help learners make a link between what they know and what is to be learnt (Novak, 1980). Novak further argues that advance organizers may include analogy, metaphor, model, graphics, concept maps, diagrams, pictures as well as hierarchical structures. Some researchers and developers of Advance Organizers have explored the use of Advance Organizers with educational computer software (Kenny, 1993). According to Chun and Plass (1996) the use of advance organizers aids in overall comprehension.

There are two broad categories of advance organizers namely expository and comparative advance organizers. Kirkman and Shaw (1997) argue that expository advance organizers provide a conceptual frame work for unfamiliar material while comparative organizers are used for recall and when the knowledge to be acquired is familiar. According to Woolfolk, Winnie, Perry and Shapka (2010) expository organizers provide new knowledge that students will need to understand the incoming information. Melrose (2013) contends that advance organizers such as charts, diagrams or other visual tools created by teachers can be used for organizing and representing consensually validated knowledge into their teaching practice. Ausubel (1968) argues that those organizers which are used in the activation of existing schemas are called comparative organizers. He argues that comparative organizers integrate new ideas with basically similar concepts in the cognitive structure.

In this study, a well designed computer simulation, a flip chart and pamphlets on gaseous exchange were used to help relate what learners already knew and the new content. Expository advance organizers are used whenever the new material is totally unfamiliar while Comparative organizers are used when the material to be learned is not entirely new (Bajt, 2004; Keraro & Shihusa, 2009). According to Chiu and Lee (2009), a pre-class video viewing of the lecture content and hands on laboratory activities in class enhanced the learning of high-school students' basic image processing. A study by Kang Sook-Hi (1997) found that advance organizers made a significant difference in facilitating learning in a computer simulation environment. Computer simulation provides visual representation of facts. This study also investigated whether there are gender differences in biology achievement when students are taught using advance organizers.

1.1 Purpose of the Study

The purpose of this study was to determine the effects of advance organizers on students' achievement in biology in secondary schools in Kilifi County, Kenya.

1.2 Objectives of the Study

The study was guided by the following objectives. To:

i. Determine the effects of advance organizers on students' achievement in learning biology.
ii. Determine whether there is any gender difference in achievement in biology when students are taught using advance organizers.

1.3 Hypotheses of the Study

H_O1 There is no statistically significant difference in achievement between students taught using advance organizers and those taught using conventional teaching methods.

H_O2 There is no statistically significant gender difference in achievement in biology when students are taught using advance organizers.

1.4 Conceptual Framework

The conceptual framework that guided this study was based on the subsumption theory of meaningful learning. The subsumption theory of meaningful learning is of the view that learners require subsumers to link new knowledge with previous knowledge. This conceptual framework is based on the

presumption that learners benefit and enjoy the lesson more when they are allowed to link prior knowledge with new knowledge. This study had three independent variables namely the use of advance organizer, conventional teaching methods and gender. These variables were perceived as factors which are likely to influence the dependent variables of the study comprising of students' achievement and attitude.

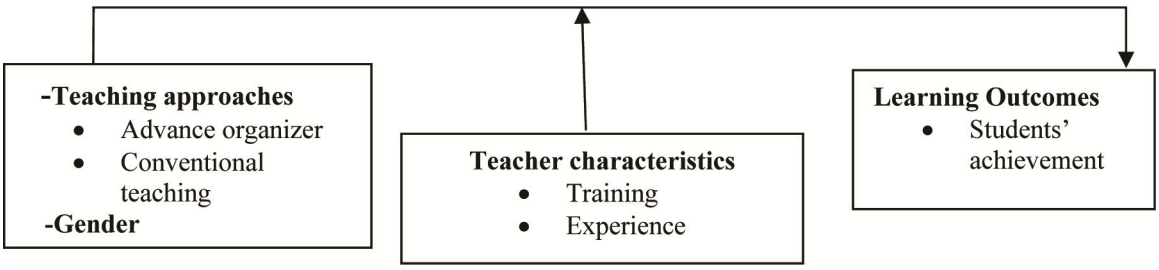

Figure 1. Conceptualization of Relationship between Teaching and Learning Outcomes

This framework shows Advance Organizers as an intervention in the teaching and learning of biology. Learning outcomes are also influenced by intervening variables such as teacher training and experiences which determines the effective methods of teaching to be employed. The teacher characteristics were controlled by involving qualified biology teachers with a teaching experience of a minimum of two years. The effects of teaching methods on students' achievement was studied. Students' gender may also affect their achievement and this was addressed by the choice of co-educational schools.

2. Research Methodology

Solomon Four, Non-Equivalent Control-Group Design was used in this study. Non-Equivalent Control-Group Design is used when research participants are not randomly assigned to the experimental and control groups (Gall M., Gall J., & Borg, 2007).

Solomon four, non-equivalent control-group design was used as shown in Figure 2.

GROUP	PRE-TEST	TREATMENT	POST TEST
E_1	O_1	X	O_2
E_2	—	X	O_3
C_1		—	O_5
C_2	—	—	O_6

Figure 2. Solomon IV, Non-Equivalent Control-Group Design

X is Experimental treatment where students were taught using advance organizers.

O_1 and O_4 were Pre-test while O_2, O_3, O_5 and O_6 were Post-test.

Group E_1 is the experimental group which received the pre-test, the treatment X and the post-test. Group E_2 received treatment X and a post test, but did not receive pre-test.

Group C_1 is the control group which received pre-test followed by control condition and Post-test. Group C_2 is the control group which received post-test only.

Groups C_1 and C_2 were taught using the conventional methods.

2.1 Target and Accessible Population

The target population comprised all secondary school students in Kilifi County who are about 37529 in 120 secondary schools. The study focused on county co-educational secondary school students. The accessible population was all Form Two (second grade) students in Secondary Schools Kilifi County.

2.2 Sampling Procedure and Sample Size

Purposive sampling was used to select the four schools out of the ten co-educational secondary schools in Kilifi County. Purposive sampling was used because the study required individuals with particular characteristics (Mugenda O. & Mugenda A., 1999). Not all schools had all the required characteristics for the study. The characteristics required of the schools included science laboratory, approximately same number of boys and girls. Other characteristics are computer laboratory for viewing computer simulations and a qualified biology teacher with a minimum of two years of teaching experience. A total of 156 form two students in the sample schools participated in this study.

2.3 Instrumentation

2.3.1 Biology Achievement Test (BAT)

Data was collected using Biology Achievement Test (BAT) which consisted of 51 multiple choice test items and 14 free response items. BAT consisted of section A and B. Section A items were multiple choice items while those of section B were free response. Maximum score for the BAT was 100marks. BAT was validated by three experts in science education and four secondary school biology teachers. BAT was pilot tested on form two students in two randomly selected schools in Kwale County. Kwale County schools were identified for piloting because students in that county have similar characteristics to those found in Kilifi County. Reliability of section A of BAT comprising multiple choice items was estimated using K-R 20. This yielded a reliability coefficient of 0.82. The reliability of section B of BAT was estimated using Cronbach's coefficient Alpha. Reliability coefficient obtained was 0.79.

2.4 Advance Organizers Instructional Module

Advance organizer teaching module for use by teachers of the experimental groups was developed by the researcher. This module was used to teach gaseous exchange to form two students. The advance organizers that was used included computer simulations, handouts and charts. The computer simulations were shown for ten minutes. Before the start of each lesson learners were exposed to an advance organizer. Teachers were inducted on how to employ advance organizers in the teaching of biology lessons. Students were expected to observe gaseous exchange structures, features of gaseous

exchange surfaces and mechanism of gaseous exchange. Students were then asked to present what they observed.

2.5 Data Collection

BAT was administered as pre-test to two groups; one experimental and one control group before the treatment. After the pre-tests, the experimental groups were subjected to the treatment. Students in the experimental group were taught using advance organizers. The students in the control group were taught using conventional teaching methods. All groups were taught by their regular teachers. All simulation lessons were carried out in the schools' computer laboratories and all the requirements were provided by the schools. The intervention took a period of four weeks. The post-test was administered to all students after the intervention.

2.6 Data Analysis

Pre-test scores were analyzed using the t-test to assess homogeneity of the groups before treatment. Post test scores for the four groups were analyzed using one-way Analysis of Variance (ANOVA) to test for any significant difference in achievement between the experimental and control groups at 0.05 level of significance. A t-test was also used to test the gender difference in students' achievement. All the tests were computed at 0.05 alpha level of significance.

3. Results

3.1 Pre-Test Results

3.1.1 Pre-Test Performance between Experimental and Control Groups

The mean scores for the two groups were compared using independent t-test statistic to establish if any statistical difference existed in their performance. The results of the t-test are shown in Table 1.

Table 1. BAT Pre-Test Mean Scores and Independent T-Test Results

Maximum scores=100 marks

Learning method	N	Mean	SD	df	t-test	P-value
E_1	39	29.54	5.26	72	0.862	0.392
C_1	35	29.29	5.24			

Results in Table 1 show that the differences between the mean scores of groups E1 and C1 were not statistically significant at df=72, t=0.862, P>0.05. The results in Table 1 show that the groups exhibited comparable characteristics and were therefore suitable for the study. The p-value of 0.392 is greater than 0.05. This indicates that the two groups were homogeneous and therefore suitable for the study.

3.2 Comparison of Students Pre-Test BAT Scores by Gender

Pre-test BAT scores for male and female students were compared to find out if the groups are comparable. The results were tabulated in Table 2.

Table 2. Pre-Test Mean Scores by Gender on BAT and Independent T-Test Results

Gender	N	Mean	SD	df	t-test	P-value
Male	35	29.91	5.29	71	1.82	0.0730
Female	39	29.38	5.08			

The results in Table 2 show that the groups were homogeneous and could be studied. Table 2 show that male students had a slightly higher mean score in the pre-test scores (29.91) than girls (29.38). Independent t-test was computed to find out whether statistically significant gender differences existed. The results in Table 2 indicate that there are no statistically significant differences between male and female students in pre-test scores; $t(71)=1.82$, $p>0.05$. This indicates that male and female students had the same level of achievement in biology before treatment.

3.3 Post-Test Results

3.3.1 Effects of Advance Organizers on Students Achievement

Objective one of the study was to determine the effects of advance organizers on students' achievement towards learning biology. This was achieved by comparing post test results for students taught using advance organizers and those taught using conventional teaching methods. The post test scores were analyzed using mean scores, Standard deviation and One-Way ANOVA to compare effects of the two teaching approaches on students' achievement. The post-test mean scores for all the groups are presented in Table 3.

Table 3. BAT Post-Test Mean Scores of the Four Groups

Maximum scores=100 marks

Gender	N	Mean	SD
E_1	39	52.42	8.3298
E_2	47	50.21	7.9288
C_1	35	38.03	7.7781
C_2	35	39.29	4.0408
TOTAL	156		

The results in Table 3 show that post-test mean scores for experimental groups (E_1=52.42 and E_2=50.21) were higher than those of control groups (C_1=38.03 and C_2=39.29).

Further analysis was done using One-Way Analysis of Variance (ANOVA), to determine whether the difference in the mean scores was statistically significant at 0.05 level of significance. This was done to test $H_0$1 of the study, which sought to establish if there was any statistically significant difference in achievement between students exposed to advance organizers and those taught using conventional methods.

One Way ANOVA results for the four groups are presented in Table 4.

Table 4. **Analysis of Variance (ANOVA) Results of the Post-Test Scores**

	Sum of squares	df.	Mean of square	F	p-value
Between groups	6469.1349	3	2071.9958	38.69	0.000*
Within groups	8328.174	152	53.5548		
Total	14797.3089	155			

The calculated value of F(3,152)=38.69, P<0.05 presented in Table 4 show that there is a statistically significant difference between the mean scores of the experimental groups and control groups. Scheffe's Post hoc test of multiple comparison was used to determine groups means with significant differences. Sheffe's Post hoc was preferred because the group sizes were unequal (Kleinbaum, Kupper, Muller, & Nizam, 1998). The results are presented in Table 5.

Table 5. Sheffe's Post Hoc Comparisons of the BAT Post-Test Scores for the Four Groups

Learning method	Learning method	Mean difference	p-value
E_1	E_2	2.21	0.915
	C_1	14.39	0.0001*
	C_2	13.13	0.0001*
E_2	E_1	-2.21	0.915
	C_1	11.91	0.0001*
	C_2	10.92	0.0001*
C_1	E_1	-14.39	0.0001*
	E_2	-11.91	0.0001*
	C_2	-1.26	0.74
C_2	E_1	-13.13	0.0001*
	E_2	-10.92	0.0001*
	C_1	0.0001*	0.74

* Mean statistically significant at Alpha (α)=0.05 level. P<0.05.

Results in Table 5 reveal that there was statistically significant mean score difference between experimental and control groups since the p-value is less than 0.05. The results show that statistically significant differences existed between groups: E_1 and C_1, E_1 and C_2, E_2 and C_1 and E_2 and C_2. The results also indicate that there is no statistically significant mean score difference between the two experimental groups. The same case applies to control groups. This implies that the difference in mean for E_1 and E_2 is statistically insignificant since their p-values of 0.217 are more than 0.05. The results show that there is

no significant difference when one treatment group is compared with another treatment group. The same scenario is witnessed for C_1 and C_2. Significant differences exists when a treatment group is compared to a control group.

Cohen's d was used to accompany the reporting of one-way ANOVA and t-test. Cohen's d statistic is a type of effect size. As an effect size it is used to represent the magnitude of differences between two or more groups on a given variable (Salkind, 2010). Cohen's d was used to determine the standardized difference between the mean scores of the control and treatments groups. According to Cohen (1988) Cohen's d is used to establish the size of difference between the means. Cohen further argues that cohen's d is suitable for establishing the extent to which a null hypothesis is false. This is done to determine how large the effect size of treatment was. The rule of thumb for effect sizes includes; d=0.2 small, d=0.5 medium and d=0.8 large (Cohen, 1988). Post-test results for the groups E_1 and C_1 were analyzed using Cohen's d. The results from this analysis was Cohen's d=(38.03-52.42/8.0587=1.786. The value of d obtained is 1.786 which is greater than 0.8. This implies that the effect size of advance organizers is larger. Post-test scores for groups E_2 and C_2 were also analyzed using Cohen's d to establish the effect size of treatment of groups that were only exposed to post-test only. Cohen's d result was d=939.29-50.21/6.293=1.735. The value of d is greater than 0.8.

3.4 Effects of Advance Organizers on Students' Achievement by Gender

Objective two sought to determine whether there was gender difference in achievement in biology when students are taught using Advance Organizers. To achieve this, the post BAT mean scores were analyzed using independent t-test on the basis of gender. Post BAT scores were analyzed using Independent t-test to compare means obtained by male and female students exposed to advance organizers. The results are presented as in Table 6.

Table 6. Independent T-Test Results of the Post-Test BAT by Gender for Students Subjected to Advance Organizers

Gender	N	Mean	Std. dev	t-value	df	p-value
Male	41	51.46	7.99	0.29	84	0.387
Female	45	50.97	7.85			

Table 6 shows post-test BAT mean scores for boys and girls exposed to Advance Organizers. The table shows that boys had a slightly higher mean score of 51.46 while girls had 50.97. The standard deviation for boys was slightly higher (7.99) than girls (7.85). The results as shown in Table 6 indicate that there was no statistically significant gender difference in achievement in biology ($t(84)=0.29$; $p>0.05$). This is because the p-value is greater than 0.05. This implies that both male and female students had equal achievement.

4. Discussion

The results obtained from the study indicate that students taught using advance organizers achieved higher scores than those taught using conventional methods. It can be argued that advance organizers enhance students' retention of biology concepts, therefore making them to score highly. According to the findings of this study, hypothesis one (H_1) was rejected. H_1 sought to establish if there was a statistically significant difference in biology achievement between students who are taught biology using advance organizers and those taught using conventional methods was rejected. The findings of this study concur with that of Muiruri (2016) on effects of Advance Organizers teaching strategy on primary school pupils' achievement in poetry in Nakuru North Sub County which found out that advance organizers have positive effects on students' achievement. A study by Korur, Toker and Eryilmaz (2016) revealed that the use of online advance organizers increases students' achievement scores. The findings of this study are also in agreement with those of Kapri (2017) and Muiruri, Wambugu and Wamukuru (2016) who established that Advance Organizers improved students' achievement. Student centered and participatory strategies improve students' achievement towards biology. The findings of this study further concur with the findings of the study by Wachanga, Arimba and Mbugua (2013) on the effects of Advance Organizers teaching approach on secondary school students' achievement in chemistry in Maara district in Kenya.

Objective two sought to determine whether there was any gender difference in achievement in biology when students are taught using advance organizers. The findings indicate that there is no statistically significant gender difference in achievement for students taught using advance organizers. This implies that the performance of both boys and girls was comparable. This is consistent with the findings of Wachanga et al. (2013) that gender has no significant effect on achievement when students are taught using advance organizers. A study by Githua and Nyabwa (2008) on the effects of Advance Organizers strategy during instruction on secondary school students' mathematics achievement established that the use of Advance Organizers improved male and female students equally. Advance Organizers can be used to reduce gender disparity in biology achievement at KCSE level. This finding is also in agreement with the findings of Akinbobola (2008) who observed that both the male and the female students do well in science if exposed to similar conditions. The findings of this study are also in agreement with that of Omotade (2016) that male and female students taught using Advance Organizers did not differ significantly in achievement.

5. Conclusions

Findings in this study indicate that:

(i) The use of advance organizers in teaching biology leads to higher student achievement in biology compared to the conventional teaching methods. Advance organizers can be used to address the challenge of poor performance.

(ii) This study also revealed that the use of advance organizers reduces gender parity in biology achievement. Advance organizers could therefore be used to address the challenges of gender parity towards learning biology. This study revealed that gender does not affect achievement in biology when advance organizers are used.

6. Implications of the Findings

The findings of this study show that the use of advance organizers in teaching leads to improved performance in biology. This makes advance organizers a suitable method of instruction. It is therefore essential that teachers employ advance organizers in classroom instruction. This study has shown that the use of advance organizers leads to an improvement in performance for both male and female students.

References

Agnihotri, K., & Sharma, R. (2013). Effectiveness of Instructional Materials Based on Advance Organizer for Teaching Educational Technology to B.ED Students in terms of Achievement and Reactions. *Research Directions*, *1*(6).

Akinbobola, A. O. (2008). Facilitating Nigerian Physics Students' Attitude towards the Concept of Heat Energy. *Scientia Pedagogcal Experimentalis*, *XLV*(2), 353-366.

Atomatofa, R. (2013). Effects of Advance Organizers on Attainment and Retention of Students' Concept of Gravity in Nigeria. *International Journal of Research Studies in Educational Technology*, *2*(1), 81-90. https://doi.org/10.5861/ijrset.2013.363

Ausubel, D. P. (1960). The Use of Advance Organizers in the Learning and Retention of Meaningful Verbal Material. *Journal of Educational Psychology*, *51*, 267-272. https://doi.org/10.1037/h0046669

Ausubel, D. P. (1968). *Educational Psychology*: *A Cognitive View*. New York: Holt, Rinehart And Winston.

Ausubel, D. P. (1978). In Defence of Advance Organizers: A Reply to Critics. *Review of Educational Research*, *48*, 251-257. https://doi.org/10.3102/00346543048002251

Babu, R. N., & Reddy, V. D. (2013). Effects of Advance Organizers Model on Achievement of IX Standard Students In Mathematics. *International Journal of Scientific Research*, *2*(9), 110-111. https://doi.org/10.3102/00346543048002251

Bajt, M. J. (2004). *Advanced Organizer*. Retrieved November 10, 2012, from http://wik.ed.uiuc.edu/index.phd/advance_organizer

Chiu, C. F., & Lee, G. C. (2009). A Video Lecture and Lab Based Approach for Learning of Image Processing Concepts. *Computers and Education*, *52*(2), 313-323. https://doi.org/10.1016/j.compedu.2008.09.003

Chuang, H.-H., & Liu, H.-C. (2014). Investigating the Effect of Different Verbal Formats of Advance Organizers on Third Graders Understanding of Heat Transfer Concept. *International Journal of Education In Mathematics, Science and Technology*, *2*(1), 78-84. https://doi.org/10.18404/ijemst.59887

Chun, D. M., & Plass, J. L. (1996). Facilitating Reading Comprehension with Multimedia. *System*, *24*(4), 503-519. https://doi.org/10.1016/S0346-251X(96)00038-3

Cohen, J. (1988). *Statistical Power Analysis for the Behavioural Sciences* (2nd ed.). Hillsdale, NJ: Lawrence Earlbaum Associates.

Dexter, D. D., & Hughes, C. A. (2011). Graphic Organizers and Students with Learning Disabilities: A meta analysis. *Learning Disability Quarterly*, *34*, 51-72. https://doi.org/10.1177/073194871103400104

Dexter, D. D., Park, Y. J., & Hughes, C. A. (2011). A Meta-Analytic Review of Graphic Organizers and Science Instruction for Adolescents with Learning Disabilities: Implications for the Intermediate and Secondary Science Classroom. *Learning Disabilities Research and Practice*, *26*, 204-213. https://doi.org/10.1111/j.1540-5826.2011.00341.x

Forum for African Women Educationist. (2007). *FAWE Annual Report* (pp. 8-9). Nairobi, Kenya.

Forum for African Women Educationist. (2009). *FAWE Annual Report* (pp. 17-19). Nairobi, Kenya.

Gall, M. D., Gall, J. P., & Borg, W. R. (2007). *Education Research: An Introduction* (8th ed.). New York: Pearson Education Inc.

Githua, B., & Nyabwa, R. A. (2008). Effects of Advance Organizer Strategy During Instruction on Secondary School Students' Mathematics Achievement in Kenya's Nakuru District. *International Journal of Science and Mathematics Education*, *6*(3), 439-457. https://doi.org/10.1007/s10763-006-9037-8

Kang, S. (1997). The Effects of Using Advance Organizers on Students' Learning in a Computer Simulation Environment. *Journal of Educational Technology Systems*, *25*(1), 57-65. https://doi.org/10.2190/X384-8VLY-GPVD-UKTY

Kapri, U. C. (2017). Effectiveness of Advance Organizer Model over Conventional Methods of Teaching Science at Secondary level. *International Journal of Research-Granthaalaya*, *5*(7), 193-198.

Kearsley, G. (2000). *The Theory into Practice Database*. Retrieved from http://tip.pschology.org/ausubel.html.Retrieved 5/12/2010

Kenny, R. F. (1993). *The Effectiveness of Instructional Orienting Activities in Computer-Based Instruction* (Report No. IR016328). Washington DC: Office of Educational Research and Improvement (ERIC Document Reproduction Service NO.362172).

Kenya Institute of Education. (2006). *Teacher's Handbook for Secondary Biology*. Nairobi: KIE.

Kenya Literature of Bereau. (2012). *Secondary Biology: Form Two Teachers' Guide*. Nairobi: KLB.

Kenya National Examinations Council. (2015). *The Year 2014 KCSE Examination Report*. Nairobi: Kenya National Examinations Council.

Kenya National Examinations Council. (2016). *The Year 2015 KCSE Examination Statitistics*. Nairobi: Kenya National Examinations Council.

Kenya National Examinations Council. (2018). *The Year 2017 KCSE Examination Statitistics*. Nairobi: Kenya National Examinations Council.

Keraro, F. N., & Shihusa, H. (2009). Using Advance Organizers to Enhance Students' Motivation in Learning Biology. *Eurasia Journal of Mathematics, Science and Technology Education*, *5*(4), 413-420. https://doi.org/10.12973/ejmste/75290

Keraro, N. F., Okere, M. I. O., & Anditi, Z. O. (2013). Cultural Influence on pupils' Understanding of Conception, Birth of Twins and Sex Determination in Kenya. *International Education Studies*, *6*(5), 11-21. https://doi.org/10.5539/ies.v6n5p11

Kirkman, G., & Shaw, E. L. (1997). *Effects of an Oral Advance Organizer on Immediate and Delayed Retention* (Report No. TM027960). Washington Dc: Office of Educational Research and Improvement (Eric Document Reproduction Service No. ED415263).

Kleinbaum, D. J., Kupper, L. L., Muller, K. E., & Nizam, A. (1998). *Applied Regression Analysis and Other Multivariable Methods* (3rd ed.). Pacific Grove: Duxburry Press.

Korur, F., Toker, S., & Eryilmaz, A. (2016). Effects of Intergrated Online Advance Organizer Teaching Materials in Students' Science Achievement and Attitude. *Journal of Science Education and Technology*, *25*(4), 628-640. https://doi.org/10.1007/s10956-016-9618-4

Maryan, M., Moenikia, M., & Zahed-Babelan, A. (2010). The Role of Advance Organizer on English Language Learning as a Second Language. *Procedia Social and Behavioural Sciences*, *2*(2010), 4667-4671. https://doi.org/10.1016/j.sbspro.2010.03.747

Mayer, R. E. (2010). *The Cambridge Handbook of Multimedia Learning*. New York: Cambridge University Press.

Melrose, S. (2013). Facilitating Constructivist Learning Enviroments Using Mind Mapsand Concept Maps as Advance Organizers. *Journal for the Practical Application of Constructivist Theory in Education*, *7*(1), 1-11.

Montanero, M., & Lucero, M. (2012). Rhetorical Structure and Graphic Organizers: Effects on Learning from a History Text. *International Journal of Instruction*, *5*(2), 21-40.

Mshenga, R. (2013). *Effects of Advance organizer on Students' Achievement, Perception and Attitude Towards the Learning of Narratives in Literature in English in Secondary Schools in Kilifi District, Kenya* (Unpublished Masters Thesis). Egerton University.

Mugenda, O. M., & Mugenda, A. G. (1999). *Research Methods: Quantitative and Qualitative Approaches*. Nairobi: ACTS Press.

Muiruri, M. (2016). *Effects of Advance Organizers Teaching Strategy on Primary School Pupils'Achievement in Poetry In Secondary Nakuru North Sub County, Kenya* (Unpublished Masters Thesis). Njoro, Kenya: Egerton University.

Muiruri, M., Wambugu, P., & Wamukuru, K. (2016). Using Advance Organizers to Enhance Pupils' Achievement I Learning Poetry in English Language. *Journal of Education and Practice*, *7*(31), 113-117.

Nazimuddin, S. K. (2015). Effects of Advance Organizer Model (AOM) on Pupil's Academic Achievement in Geography. *International Journal of Scientific Engineering and Research (IJSER)*, *3*(7), 18-23.

Novak, J. D. (1980). Learning Theory Applied to the biology Classroom: A Useful tool for Science Education. *The American Biology Teacher*, *42*(5), 280-285. https://doi.org/10.2307/4446939

Omotade, A. A. (2016). Effects of Advance Organizer Teaching Approach on Students' Academic Performance in Physics in Senior Secondary School in Ekiti State, Nigeria. *International Journal of Research and Analytical Reviews*, *3*(2), 172-179.

Republic of Kenya. (2012a). Ministry of Education, Directorate of Quality Assurance and Standards. In *Teaching Biology Circular* (2nd ed., March 2012). Nairobi: Government Printer.

Republic of Kenya. (2012b). *Education Sector 2013/14-2015/16 Medium Term Expenditure Framework*. Nairobi: Government Printer.

Rotich, S. K., & Mutisya, S. (2013). Evaluation of Capacity Development Programs in Kenya: A Case of SMASSE INSET for Science Teachers. *International Journal of Human Resource and Procurement*, *1*(3), 1-16.

Tamir, P. (1992). The Design and Use of a Practical Test Assessment Inventory. *Journal of Biology Education*, *16*, 42-50. https://doi.org/10.1080/00219266.1982.9654417

The National Academy of Sciences [NAS]. (2009). *A New Biology for the 21st Century*. Washington DC.: National Academies Press.

Trends in International Mathematics, and Science Studies [TIMMS]. (2011). *International Results in Science*. Boston College: TIMSS and PIRU.

Tsuma, O. G. K. (1998). *Science Education In the African Context*. Nairobi, The Jomo Kenyatta Foundation.

UNESCO. (2017). *Cracking the Code: Girls' and Women's Education in Science, Technology, Engineering and Mathematics (STEM)*. UNESCO, Paris, France.

Wachanga, S. W., Arimba, A. M., & Mbugua, Z. K. (2013). Effects of Advance Organizers Teaching Approach on Secondary School Students' Achievement in Chemistry in Maara District, Kenya. *International Journal of Social Science and Interdisciplinary Research*, *2*(6), June 2013.

Woolfolk, A. E., Winnie, P. H., Perry, N. E., & Shapka, C. (2010). *Educational psychology* (4th ed.). Toronto: Pearson.