International Journal of Science and Engineering Applications
Volume 14-Issue 09, 128 – 134, 2025, ISSN:- 2319 - 7560
DOI: 10.7753/IJSEA1409.1014

Application of 7Es Instructional Model in Learning of Physics in Kiambu, Kenya: Academic Achievement in Learners of Physics

Kawira Faith
Department of Communication and Technology, School of Education, Kenyatta University
Nairobi, Kenya

Dr. Waititu Micheal
Department of Communication and Technology, School of Education, Kenyatta University
Nairobi, Kenya

Dr. Kariuki Moses
Department of Communication and Technology, School of Education, Kenyatta University
Nairobi, Kenya

Abstract: Physics as a physical science is essential in process of technology, economic growth and developing a nation. However, the performance of physics in Kenya has been reported to be constantly below average for last ten years, especially in Thika-East Kiambu county, where the mean grade has reamed at E for last seven years. Hence physics has been termed as a difficult subject. In order for learners to fit into the global market, then scientific skills are vital. Studies have shown strong relationship between academic performance and presence of Science Process Skills in learners. Then, an approach to improve both science process skills and achievement learners is necessary. Studies both locally and globally have also reported a gender gap in the field of Physics, which disadvantages female learners. 7Es Instructional Model has been studied vigorously in recent past by researchers, on its influence on learning outcomes of science. Purpose of this study was to investigate success of 7Es-Instructional model in improving academic achievement of learners of physics, their Basic Science Process Skills and gender responsiveness towards learning of Physics. The model was applied in the learning process of Pressure, atopic in form one Physics. A quasi- experimental research design was used, employing use of pretest and posttest. Non- equivalent control group design was used for schools that participated in study. Two co- educational schools were selected using both purposive and stratified sampling techniques. Sample of the study consisted of 247 form one students. 120 in experimental group and 127 in control group. 123 female students and 120 male students were involved as well as two teachers in Thika-East Kiambu county. The pretest and posttests contained achievement questions and experiments carried out by leaners to measure their Basic Process Skills. To test the validity of the research instruments, a piloting study was carried out, and a test-retest technique used to determine BAT reliability coefficient which was obtained as r = 0.921. Results obtained were analyzed using both descriptive and inferential statistics in SPSS computer software, employing independent samples T-test and paired samples T-tests. Results revealed that there was statistical significant difference in academic achievement of learners in control group and treatment group (P=0.000, at α=0.05, and t-value=12.05 at critical value=1.984). Acquisition of Basic Science Process Skills for learners in treatment group also differed statistically significantly, (P = 0.000 and t-value of 13.167). This implied that use of 7Es Instructional Model in learning of Physics increased academic achievement and increased their Basic Science Process Skills. Use of 7Es Instructional Model in learning Physics did not influence gender (P=0.866 at α=0.05, t-value=0.16 at critical value=1.984). That is, male and female learners responded to learning equally, when taught using 7Es Instructional Model.

Keywords: 7Es Instructional Model, academic achievement of learners of Physics, Basic Science Process Skills, Inquiry Learning, Learning pedagogy, Physics education, quasi-experimental design, Gender.

1.0 INTRODUCTION

In order to adapt and fit in this fast-changing world, Kenya as a nation has taken steps to implement the competence-based curriculum (CBC), Amutabi, (2019), a curriculum that offers the learners with individualized skills, since it is a curriculum that is learners centered. The Kenya institute of curriculum development (KICD), 2019) assessed the needs of learners through the ministry of education and an inquiry based learning curriculum had to be put in place in order to satisfy the needs and demands of the learners of Kenyan (KICD), 2019). However, learners of physics have been performing poorly in the Kenya National Examination, (K.C.S.E) in the recent past. This is worrying for the nation, learners, teachers of physics, school heads, parents and the ministry of education.

Many researchers have been trying to find the cause of poor academic achievement of the learners of physics in the past history, simekha, (2014), researched on girls' attitude towards physics, but found out that they were more motived, hence should have posted good result. Konyango, ogeta, otieno and orotho, (2018), researched on the teaching resources and proposed increase in the physics learning materials in Siaya County. However, learners of physics continue leaving high school with very poor grades especially those in the day schools. Hence these learners graduate without the required skills to enable them offer service to the society (Mistry of education, K.I.E, Microsoft, 2021).

Some of the competences that are required by the learners of physics to meet the global needs for the 21st century as Joynes et al., (2019) puts it are: a) the analytical skills listed as the critical thinking, problem solving, decision making, research, and inquiry, b) interpersonal skills which are communication, collaboration, leadership and responsibility, c) ability to execute that is, initiative and self-direction, and productivity (Erdem, 2020). The nature of both the scientific knowledge and the scientific inquiry in physics enable the learners of physics become scientific literate (hammoumi, 2020). Therefore, the learning of physics can only fully implement the CBC by use of the inquiry based learned approach which is enabled by the 7Es Instructional Model, which is an amendment of the 5Es Instructional model by Eisenkraft, (2003).

The 7Es Instructional Model comprise of seven phases/stages that a learner goes through during the learning process. These are: elicit, explore, explain, expand, elaborate, evaluate and expand. Although both the 7Es and 5Es have the same learning framework, emphasizing on the prior knowledge, acquisition of

new knowledge, application and assessment of learning. The 7Es Instructional Model helps align tasks, questions and evaluation with the learning competences in both skill and content. This is whereby the learner is able to confront what they already know about the new knowledge/skill to be learned, and being able to transfer it to new situations (Nicol et al., 2020). The figure below shows the sequence of the phases.

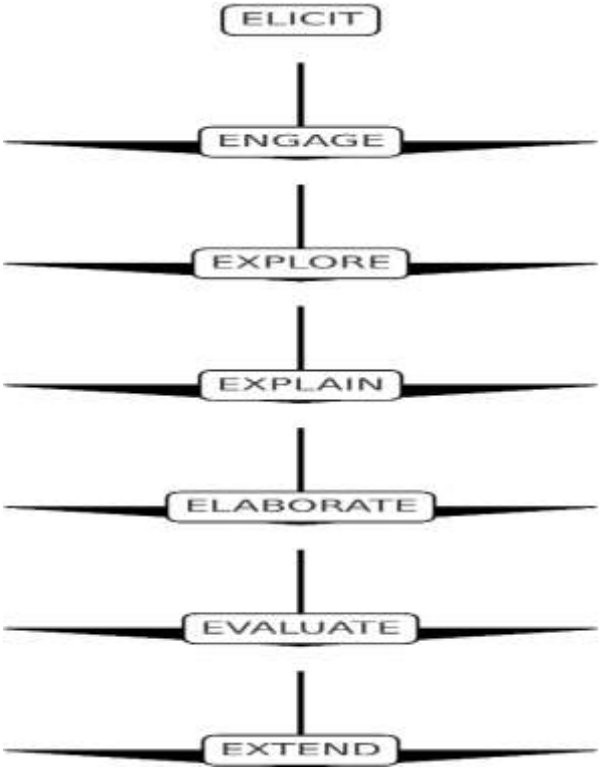

Figure 1.0: Sequence of the 7Es Instruction

1.1 Statement of Problem

Kenyan nation is bothered Poor achievement in physics.

Teachers of Physics get demotivated by results their learners get all time. Parents who would like their children to pursue Physics related courses get discouraged by results posted in Physics nationally and especially in Thika-East. Students who choose Physics lack confidence in doing well in their exams when they see results being posted by their fellow students ahead of them, as well as being discouraged by other learners and the community at large. Researchers in this field have constantly studied on the interventions to improve the situation, suggested a number of ways, such as; the use of the science skills approach in teaching, perform more practical by teachers while teaching physics, promoting the learners' attitude towards physics, lowering the grading system of Physics examinations, so as to post better results at the K.C.S.E., increasing the supply of teaching resources, and among others. However, the performance of physics has remained below average every year in the recent past as show in table 1.1 above. This has been the case in Kiambu County and worse in Thika-East, as shown in the table 1.2. Study after study report that learners who possess stronger science process skills have better academic achievement, then it means that the learners of Thika-East who have been posting a mean grade of E, leave secondary school with minimum science process skills. This means they also do not qualify to pursue physics related carriers despite having taken Physics in high school. It could mean that these students could end up regretting for having chosen to pursue secondary school physics.

Hence the society end up discouraging learners from pursuing physics. If this trend of declining performance continues, then a learner in Thika-East would find no need of choosing Physics as subject. Hence physics will lose relevance in Thika-East. This is not good for physics teachers as well, for they will become irrelevant too. For the society, the technological and economic growth that strongly depend on physics' knowledge and skills, would be compromised. Therefore, irrespective of all the interventions being put in place, Physics achievement bother the educational stake holders in Kenya, and society at large.

However, the recent global vigorous studies on application of 7Es Instructional Model in learning of Physics, to influence the academic achievement. Therefore, this study sought to find the impact of application of 7Es-Instructional Model could on performance of the learners of Physics in Thika-East Kiambu county.

1.2 Main Objective

The main objective of this study was to determine effects of use of 7Es Instructional Model in learning of Physics, on the learners' achievement, in Kiambu-county.

1.3 The significance of the study

Findings of this research benefited the form one learners of physics in Thika-east sub County, by promoting their academic achievement in physics. The inquiry skills of these learners was promoted as well, by the application of the 7Es Instructional Model. Other skills acquired by these learners were the critical thinking and problem-solving skills, which would enable these learners solve the problems experienced in their environment. This was due to the 'extend' phase in the 7Es Instructional Model, which responsible for the transfer knowledge.

The findings of this research would be used by the Kenyan curriculum developers (KICD) to come up with the physics curriculum using the 7Es Instructional Model.

Teachers Service Commission (TSC) will find this research useful in providing in-service for the teachers, as William and sang, (2018) notes that teachers in Kenya needed continuous training, in their study to determine the influence of the continuous professional development programs (PDP) in implementing the curriculum in north rift counties.

Universities and teacher training colleges will use the findings of this research to train science teachers to-be on how to use the 7Es Instructional model to influence the learning outcomes.

The school administrators will use findings of this research to offer support needed by teachers of physics such as learning materials, in order to implement the 7es model.

The teachers of physics in the schools participated in the study would benefit from the findings of the study, which they could adopt in their teaching profession, as well other teachers of Physics, could adopt the use of 7Es Instructional Model in their teaching following the success of the Model.

Finally, findings of this research added to literature, on the application of the 7Es Instructional Model in influencing the academic achievement of the learners of physics as well as helping them acquire the science process skills, in Kiambu County, Kenya.

2.0 RELATED LITERATURE

Literature was reviewed on the strategies of improving the performance in learners of Physics. Several scholars of scholars highlighted causes of low achievement in Physics, and lack of interest in Physics by female learners. Sciences process skills were highlighted by several scholars (Anjugam & Chellamani,

2024; Gizaw & Sota, 2023; Kurniawan et al., 2020; Suman, 2022a) as of essence especially for the 21st century skills acquisition. Most of the scholars had evaluated the presences or absence of the SPS in learners, however literature on the strategies to develop these skills in the learners was scarce or not clearly identified, since scholars generally stated that leaners centered teaching approaches improve the learners' SPS. It was evident from the reviewed literature that increase in SPS increases the learners' achievement, critical and creative thinking, problem solving skills, learners' attitude towards Physics.

The literature reviewed showed that 7Es Instructional Model has recently become of big interest to scholars of science, as it was vigorously researched. Several scholars have shown how effective the 7Es Instructional Model is in increasing the learners' achievement in

Physics, the SPS of learners of Physics, the critical and creative thinking skills, the problem solving skills and bridging the gender gap. However, the 7Es Instructional Model has been studied independently on its effect of the achievement and the SPS. This study therefore investigated the effect on the achievement of Physics and the SPS of learners concurrently.

3.0 METHODOLOGY

3.1 Research Design

The research design that was applied in this study was the quasi-experimental research design. A quasi-experimental research design is quantitative, where data is collected by measuring both the variables using instruments in order to establish the relationship between the two variables, which enabled the testing of the objectives (Creswell, 2009). In the study, pre-test and post-test were used to collect data from learners of form one Physics. Two (2) mixed day schools in Thika East Sub-County, Kiambu County, which were two streamed were involved in the study, where one was randomly assigned as control group, containing 127 learners and the other the experimental group, containing 120 learners. The experimental group had 61 female learners and 59 male learners.

The pretests were given to control and experimental groups, to set the base line for evaluation after intervention, as well as evaluate whether the two groups were equal at beginning of the experiment, (Majka & Poland, 2024). The two groups were given a posttest, after six weeks of teaching the experimental group using 7Es-Instructional Model, and control group was taught using the traditional method. The posttest was used to determine the influence the 7Es Instructional Model had on the achievement of form two Physics learners.

3.2 Research Methodology

The method of this study was a quantitative research method. The data was collected from the learners to investigate the influence of the 7Es Instructional Model on the learners' achievement and Basic Science Process Skills by gender. A quasi-experimental design was employed, and pre-test and post-test instruments were used to collect data. two schools were purposively selected in Thika-East Sub-County Kiambu County, so as to get schools with the materials required for the experiment, such as availability of the electricity, projectors and computers. Out of the two schools selected, one school was randomly assigned control group and the other experimental group.

A pretest was given to the both schools. The Physics teacher in the experimental group was trained on the use of the 7Es Instructional Model. Then the was the experimental group was taught pressure, a topic in form one Physics, using the 7Es Instructional Model for six weeks, while the control group was taught using the traditional model. After the six weeks, the two groups were given a posttest, which was marked and analyzed. The two schools which were chosen for study, were both teaching the topic pressure at the time of the experiment, hence the choice of the topic for the study. The training schedule/manual for the Physics teacher on the use of the 7Es Instructional Model is attached at the appendices. The results obtained from the tests were analyzed to establish the impact of use of 7Es Instructional Model, on.

3.3 Research Instruments

Pretest and Posttest were the instruments used in this study, to collect of data. This study being a quasi-experimental, achievement tests were developed to evaluate level of the academic achievement of the learners of Physic.

3.4 Data Collection Techniques

Permit from the national commission of science, technology and innovation (NACOSTI) and a written letter from Kenyatta University were obtained before going to the field. Before scheduling the dates for the research in each school, the researcher visited schools before that date to plan with the school principle and the physics teacher. The results of scores of pretests and posttests were recorded on the sheet provided to the teachers by the researcher. These scores were entered into the excess for data cleaning and analysis by the researcher.

3.5 Data Analysis

The scores obtained from the pretests and posttests for both experimental group and control group were analyzed using the SPSS computer software. The influence of the use of the 7Es Instructional Model in the Physics achievement and on the strength of the Basic Science Process Skills analyzed using the inferential statistics. The inferential statistics which were analyzed at the level of confidence at $\alpha = 0.05$ to establish the discrepancies between the mean scores of control group and experimental group.

4.0 RESULTS

Both inferential and descriptive statistics was used to analyze data obtained from control group and experimental group. To compare, explain as well as summarize the results, descriptive statistics was used in terms of mean scores and standard deviation were used.

In order to determine whether two groups differed significantly among themselves, inferential statistics; t-test at $\alpha=0.05$ was used. The results are shown below.

4.1 Pre-test Scores

This part present Physics leaners' results in pretests, evaluating Physics achievement, strength of SPS and gender responsiveness to learning.

The learners' scores from control group and experimental group in academic test, were entered into excel, cleaned, converted into percentages and analyzed and analyzed using

4.1.1 Comparing academic achievement means in pre-test

Table 1.1: Descriptive Statistics

Group	N	Mean	Std. Deviation	Std. Error Mean
control group	127	28.90	11.127	.987
experimental group	120	28.74	12.632	1.153

the SPSS. Below are the results.

International Journal of Science and Engineering Applications
Volume 14-Issue 09, 128 – 134, 2025, ISSN:- 2319 - 7560
DOI: 10.7753/IJSEA1409.1014

According to table 1.0, the students' scores in Physics pre-test for control group with 127 participants, (M = 29.50, SD = 14.741) and that of experimental group with 120 participants, (M = 28.08, SD = 17.876) was slightly different. In order to determine whether two groups differed significantly at beginning of the experiment, the results were run through the t-test using independent sample t-test. Table 4.2 below shows results obtained.

4.1.2 T-test comparing academic achievement in pre-test

Table 1.2: Inferential Statistics

Levene's Test for Equality of Variances			T-test for Equality of Means			
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Equal variances assumed	8.20	.005	.103	245	.918	.156
Equal variances not assumed			.103	237	.918	.156

4.2 Post-tests scores

Both experimental group (group taught using7Es Instructional Model) and control group (group taught the traditional way), received a post-test at the end of the six weeks. This test was meant to evaluate the physics achievement and the level of the strength of SPS for group taught using 7Es-Instructional Model and group taught traditional methods.

Results were analyzed to compere mean differences in two groups and how male and female responded to learning using 7Es Instructional model. The results were as shown below.

4.2.1 Comparing academic achievement means in post-test

The table 1.3 below shows the descriptive statistics of the Physics mean scores in post-test for control and experimental group.

Table 1.3: Descriptive Statistics

Group	N	Mean	Std. Deviation	Std. Error Mean
control group	127	28.9	11.127	.987
experimental group	120	55.2	17.034	1.555

The mean for the experimental group (55.28, SD = 17.034) in posttest was higher than mean score of control group (28.90, SD = 11.127). To find out if this difference in the means in two groups was statistically significant, the posttest scores were run through the t-test.

4.2.2 T-test for academic achievement in post-test

Table 1.4: Inferential Statistics

Levene's Test for Equality of Variances			T-test for Equality of Means			
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Equal variances assumed	.331	.566	12.05	244	.000	25.696
Equal variances not assumed			12.04	242.000		25.696

From table 1.4, the t-value of 12.05, at 244 degree of freedom, is higher than critical- value of 1.984. P-value of 0.000 is also less than the level of significance, α=0.05. This imply that there was statistically significant difference between the means of the experimental group and the control group in the posttest. Hence the experimental group did better in Physics achievement posttest, compared to control group.

The t-value (0.103) is less than critical-value (1.984) at significant level of 0.05 and 237 degrees of freedom. This shows that there was no statistical significant difference between mean scores of control group between the control group and experimental group. Using probability value, P-value (0.918) is greater than significance level (0.05), indicating that there was no statistically significance difference between achievement mean scores of both control group and treatment group.

5.0 DISCUSSION OF RESULTS

In pretests, results show that groups in control and experimental were equal. This is because level significance (α= 0.05) was exceeded for both Physics achievement (P-value=0.156) and level of strength of SPS (0.768). T-value was less than critical-value 1.1984) as well, in achievement (0.103) and strength of SPS (1.290). This indicated that there was no statistical significant difference in mean scores of control group and experimental group.

This outcome was important since pretest was meant to test whether learners in both groups were at same level at beginning of intervention. To establish baseline was crucial role of pretesting, as well as provide allow starting point to be quantified, so as to give a benchmark for comparing during with post-tests (Majka & Poland, 2024). After post- test were given to both control group and experimental group, experimental group scored higher than control group. In academic achievement in Physics, learners in experimental group had a higher mean score (55.28) than control group (28.90). Independence samples t-tests (12.05 > critical-value 1.984) showed that these mean scores in post tests were statistically significantly difference. Two groups were also found to differ after intervention, since P-value (0.000) was less than level of significance, 0.05.

Therefore, upon use of 7Es Instructional Model, learners' achievement in Physics improved. This confirmed by Villacrusis and Teresa, (2021) who found out in their experiment that learners' achievement and retention in science subjects is improved when 7Es Instructional Model is used in learning. Achievement in Chemistry was also found to improve when 7Es model was used by Uzezi and Oluyemi, (2024). In Biology, students' achievement was found to improve upon use of 7Es-Instructional Model in Nigeria by Abdullahi, Asniza and Muzirah, (2021) and in Kenya by Cherono, (2021).

Students who are instructed using 7Es-Instructional Model perform better than those who are instructed using convectional or traditional method (Uzezi & Oluyemi, 2024).

Hence this research found out that students who were taught using 7Es Instructional Model in Thika-East Kiambu County, had improvement in Physics achievement. Elicit and extend phases of this model, may have enabled improvement of achievement. This is because teacher was able to identify misconceptions in learners during elicit phase. These misconceptions interfere with understanding of Physics concepts. If they are identified and eliminated before actual learning of concept begin, then learner forms intended understanding of Physics concept, Gyampoh et al., (2020). Extend phase may have enabled learners in experimental group to score better in strength of Science Process Skills. This is because, concepts can better be applied during experiments, if the learner could relate with real life situations Sharma, (2018). These findings support claim that when learners are taught using 7Es Instructional Model, their learning outcomes in science improve. This study confirmed that learners' achievement in Physics and SPS increased upon use of 7Es Model, in Kiambu County.

There was unavailable related literature to show how learning of Physics was affected by 7Es Instructional Model, in Kiambu County Kenya, before this study was carried out.

Therefore, these findings helped in understanding how important it was teaching Physics using 7Es Instructional model, whereby learners' academic achievement were improved.

6.0 CONCLUSION

According to data analysis, learners in treatment group scored higher (M=55.28, SD=17.034) than leaners in control group (M=28.90, SD=11.127) in posttest. This implied that students taught using 7Es-Instructional Model did better in the Physics achievement than the ones taught using the conventional method. This was because mean scores of two groups differed statistically significantly, with P-value at 0.000 where $\alpha = 0.05$. t-value (12.05) was as well greater than critical value (1.984) at degree of freedom at 244. These two groups were at same level of achievement at beginning of experiment, as it was shown in the pretests. Two groups were not statistically significantly different. This was because P-value which was 0.918 was greater than $\alpha=0.05$, and t-value (0.103) was less than critical-value of 1.984.

Therefore, treatment group and control group were equal in Physics achievement at beginning of experiment as per pretests, but at end of the six weeks of the use of 7Es instructional Model on experimental group, there was statistical significant difference in two groups. Therefore, use of 7Es Instructional Model in learning of Physics, improved achievement of physics learners in Kiambu county.

7.0 RECOMMENDATIONS

Based on findings and conclusions of this research, researcher provided following recommendations for various stakeholders and other fellow researchers.

(i) Teachers of Physics recommended to embrace use of the 7Es-Instructional Model in teaching Physics, to improve the learner's achievement, basic science process skills and motivate both male and female learners.

(ii) The KICD recommended to use 7Es Instructional Model to develop Physics syllabus and teaching materials.

(iii) The TSC recommended to put a system in place for training of teachers of Physics and science on use of 7Es Instructional Model in learning of Physics, as part of the teacher program development.

(iv) The CEMASTEA, this is a public education institution which was established in the year 2003, in Kenya, with the intention of providing and coordinating In-Service Education and Training (INSET) to teachers of Science and Mathematics. Therefore, this model can be used to provide in-service directly to teachers, which in turn will help the learners.

8.0 SUGGESTIONS FOR FURTHER STUDY

The following are the suggestions of the studies that can be further carried out.

i. A study on effects of 7Es-Instructional Model on the critical thinking and retention of Physics concepts in learners of Physics is recommended.

ii. So as to generalize effects of using 7Es Instructional Model in learning of Physics across all learners of different abilities, a research of the same on national schools and extra-county schools is recommended, since this study was restricted to county schools only.

iii. Impact of 7Es Instructional Model in Kenya has been carried out in Biology and Physics, other studies in Chemistry and Mathematics are needed to conclude that the 7Es Instructional Model influence the STEM subjects equally.

ACKNOWLEDGMENT

I am grateful to the almighty God, for the love, provision and guidance throughout this study and in my life. I am highly grateful to my little babies who I love so much Adelle and Alvin. They were patience with me being glued to my laptop as I typed this work, the time I could have played with them and given them the attention they needed. I thank them so much for understanding, and the support they gave by cheering me up. I acknowledge my supervisors and mentors Dr. Waititu and Dr. Kariuki. I thank them for guiding me and mentoring me throughout my study, and making a smooth process. I would like to appreciate Prof. Maundu, Prof.Odigi, Dr. Orando, Dr. Mugo, Dr. Muindi, Dr. Miheso and many others in Kenyatta University for take me through the course work. I deeply appreciate and may god bless them. I acknowledge my parents, brothers and friends for inspiration. I must thank my good friend madam Ann, for having inspired and offered help whenever I needed. I appreciate you. I would like to recognize the entire Educational Communication and Technology departmental for the good service and help offered whenever I needed it.

REFERENCES

[1] Abdullahi, S., Asniza, I. N., & Muzirah, M. (2021). Effect of 7E Instructional Strategy on The Achievement and Retention of Students in Bıology in Public Secondary Schools in Adamawa State, Nigeria. Journal of Turkish Science Education, 4(18), 748–764.

[2] Abubakar, M. B. (2020). Impact of instructional materials on students' academic performance in Physics, in Sokoto-Nigeria. IOP Conference Series: Earth and Environmental Science, 476(1). https://doi.org/10.1088/1755-1315/476/1/012071

[3] Acar, O. A., & Tuncdogan, A. (2019). Using the inquiry-based learning approach to enhance student innovativeness: a conceptual model Using the inquiry-based learning approach to enhance student innovativeness: a conceptual model. Teaching in Higher Education, 0(0), 1–15. https://doi.org/10.1080/13562517.2018.1516636

[4] Afolabi, F., & Olajuyigbe, A. O. (2018). Bridging gender gap in physics classrooms: Do teaching approaches matters? KIU Journal of Social Sciences, 4(2), 69–80.
[5] Akimi Engku Ismail, E. M. S., & Mohd Matore, M. E. E. (2024). Strategies for Mastering Science Process Skills and Manipulative Skills in Practical Work. International Journal of Academic Research in Progressive Education and Development, 13(2), 503–514. https://doi.org/10.6007/ijarped/v13-i2/21256
[6] Amini, R., & Usmeldi. (2020). The development of teaching materials uses an inductive- based 7E learning cycle for elementary school students. Journal of Physics: Conference Series, 1521(4). https://doi.org/10.1088/1742-6596/1521/4/042114
[7] Amunga, J., & Musasia, A. M. (2021). The Gender STEM Gap and Its Impact on Sustainable Development Goals and the Big Four Agenda in Kenya: A Synthesis of Literature. International Journal of Contemporary Educatio, 4(1), 1–12. https://doi.org/10.11114/ijce.v4i1.5042
[8] Anjugam, R., & Chellamani, K. (2024). Science Process Skills: A Trend Analysis of Research. The International Journal of Indian Psychology, 12(1), 772–781. https://doi.org/10.25215/1201.073
[9] Different Test Formats: A Research from the Perspective of Cognitive Styles. Journal of Education in Science, Environment and Health, 6(3), 220–230. https://doi.org/10.21891/jeseh.703442
[10] Balaoro, M. J. B. (2024). Enhancing Scientific Skills among Students Through Engaging in Active Learning Activities. United International Journal for Research & Technology, 05(07), 242–251.
[11] Balta, N. (2018). The Effect of 7E Learning Cycle on Learning in Science Teaching: A meta- Analysis Study. European Journal of Educational Research, 5(2), 61–72. https://doi.org/10.12973/eu-jer.5.2.61
[12] Beichumila, F., Bahati, B., & Kafanabo, E. (2022). Students' Acquisition of Science Process Skills in Chemistry through Computer Simulations and Animations in Secondary Schools in Tanzania. 21(3), 166–195.
[13] Bossmann, A. B., & Sandner, A. (2023). Women in physics in Germany: Current developments and actions taken toward equal opportunities. AIP Conference Proceedings, 3040(1), 10–11. https://doi.org/10.1063/5.0176070
[14] Bradley, C., Allred, J., & Zeidan, M. (2019). Visualizing Physics Questions. Educationconf, 164–172.
[15] Cherono Juliana, S. D. and K. S. (2021). Effect of 7E Learning Cycle Model on Students' Academic Achievement in Biology in Secondary Schools in Chesumei Subcounty, Kenya. African Journal of Education, Science and Technology, 6(3), 1–4.
[16] Creswell, J. W. (2009). Research Design. In Notes and Queries (3rd ed., Vols. s4-I, Issue 25). SAGE Publications, Inc. https://doi.org/10.1093/nq/s4-I.25.577-c
[17] Daniel, E., Ugochukwu, J., & Solomon, H. (2024). P hysics Teachers' Qualification and Students' Academic Performance in External Examinations: A Case Study of Senior Secondary Schools in Isiala-Ngwa North Local Government Area, Abia State, Nigeria. 14(3), 56–68. https://doi.org/10.9790/7388-1403035665
[18] Department for Education, B. I. T. (2020). Applying Behavioural Insights to increase female students' uptake of STEM subjects at A Level (Issue November).
[19] Dolap, S. (2020). Promoting Inquiry Skills for the Improvement of Self-Efficacy Domains in Special Education Pre-Service Teacher Training. 9(2), 201–220.
[20] Eisenkraft, A. (2003). Expanding the 5E Model. The Science Teacher, 70(6), 56–59.
[21] Elby, A., & Yerdelen-Damar, S. (2020). Rethinking the relationship between instructors and physics education researchers. Physical Review Physics Education Research, 16(2), 20151. https://doi.org/10.1103/PhysRevPhysEducRes.16.020151
[22] Erdem, C. (2020). C Hapter O Ne I Ntroduction to 21 St C Entury. October 2019.
[23] Founou, L. L., Yamba, K., Kouamou, V., Asare Yeboah, E. E., Saidy, B., Jawara, L. A., Bah, H., Sambe Ba, B., Aworh, M. K., & Darboe, S. (2023). African women in science and development, bridging the gender gap. World Development Perspectives, 31(September), 100528. https://doi.org/10.1016/j.wdp.2023.100528
[24] Fuwape, I. A., Obafaye, A., Ogunjo, S. T., Sa'Id, R., & Ugonabo, O. (2023). Nigerian women in physics: New and emerging challenges. AIP Conference Proceedings, 3040(1), 17–19. https://doi.org/10.1063/5.0175737
[25] Gizaw, G. G., & Sota, S. S. (2023). Improving Science Process Skills of Students: A Review of Literature. Science Education International, 34(3), 216–224. https://doi.org/10.33828/sei.v34.i3.5
[26] Gonzaga. (2020). Implementation and Evaluation of 7Es Scientific Inquiry through Plant Assay Guide Manual among Grade 9 Science, ... Implementation and Evaluation of 7Es Scientific Inquiry through Plant Assay Guide Manual among. Universal Journal of Educational Research, 8(8). https://doi.org/10.13189/ujer.2020.080824
[27] Gyampoh, A. O., Aidoo, B., Agbenyega, G., Kofi, M., & Amoako, S. K. (2020).
[28] Investigating the Effect of 7e Learning Cycle Model of Inquiry- Based Instruction on Students' Achievement in Science. IOSR Journal of Research & Method in Education (IOSR-JRME), 10(5), 39–44. https://doi.org/10.9790/7388-1005013944
[29] Hammoumi, M. M. El, Bakkali, S., & Youssfi, S. El. (2020). Learner-Centered Teaching: A Case Study of its Implementation in Physics and Chemistry Classes in Moroccan High Schools. European Scientific Journal ESJ, 16(22), 271–286. https://doi.org/10.19044/esj.2020.v16n22p271
[30] Hussain, Z., Mahmood, Z., & Asghar, M. A. (2022). Effects of 7e Models On the Academic Achievement. Benazir Bhutto Shaheed University Lyari – Karachi or Editorial Board of 'BRJHSS' Research Journal, 1(1), 1–20. https://creativecommons.org/licenses/by/4.0/
[31] Indri, O. W., Sarwanto, & Nurosyid, F. (2020). Analysis of high school students' science process skills. Journal of Physics: Conference Series, 1567(3). https://doi.org/10.1088/1742-6596/1567/3/032098
[32] Isma'il, A., & Moriki, U. Y. (2023). Effect of 7E's Instructional Learning Model on Senior Secondary Students' Academic Achievement and Retention in Genetics in Zamfara State, Nigeria. UNIZIK Journal of STM Education, 6(1), 99–108.
[33] Joynes, C., Rossignoli, S., & Amonoo-Kuofi, E. F. (2019). 21st Century Skills: evidence of issues in definition, demand and delivery for development contexts. Connected Learning Alliance, Digital Media and Learning Research Hub. Irvine, CA. August, 1–75.
[34] Kingsley, T., & Anamezie, R. C. (2022). Academic Interest as Predictor of Academic Achievement of Secondary School Physics Students Academic Interest as Predictor of Academic Achievement of Secondary School Physics Students. June.
[35] Komikesari, H., & Anggraini, W. (2021). Analysis of Science Process Skills Using Learning Cycle 7E Analysis of Science Process Skills Using Learning Cycle 7E. Journal of

Physics: Conference Series. https://doi.org/10.1088/1742-6596/1811/1/012085
[36] Konyango, O. B., Ogeta, N. O., & Otieno, M. (2018). Influence of Resources on Students' Academic Performance in Physics at Secondary Schools in Ugenya Sub- County, Siaya County, Kenya. February 2019. https://doi.org/10.15580/GJER.2018.5.072118101
[37] Kurniawan, W., Pathoni, H., Muliawati, L., & Kurniawan, D. A. (2020). Relationship of Science Process Skills and Critical Thinking of Students in Physics Subject. 8(11), 5581–5588. https://doi.org/10.13189/ujer.2020.081162
[38] Kusuma, A. E. (2021). Analysis of Science Process Skills for Senior High School Students in Banjarmasin. January 2022, 10–16. https://doi.org/10.2991/assehr.k.211219.003
[39] Libata, I. A., Ali, B., & Ismail, H. (2021a). Constructivist Approach to Learning Activity: The Case of Junior Secondary Students' Misconception on the Three States of Matter in Basic Science, Nigeria. Equity Journal of Science and Technology, 8(1), 8–18.
[40] Libata, I. A., Ali, M. N., & Ismail, H. N. (2021b). Testing the Effectiveness of 7E-Inquiry Integrated Module on Learning Achievement of Form Two Basic Science Students with Different Cognitive Level. Universal Journal of Educational Research, 9(2), 398–411. https://doi.org/10.13189/ujer.2021.090216
[41] Lubiano, M. L. D., & Magpantay, M. S. (2021). Enhanced 7E Instructional Model towards Enriching Science Inquiry Skills. International Journal of Research in Education and Science, 630–658. https://doi.org/10.46328/ijres.1963
[42] M. Villacrusis, E., & Teresa R. Beloy, M. (2021). Improving Students Achievement and Retention of Learning in Environmental Science Using 7Es Instructional Model. International Journal of Advanced Research, 9(03), 10–13. https://doi.org/10.21474/ijar01/12546
[43] Magati, A. T., Samson, P., & Ondigi, R. (2024). Students' Attitude and Its Effect On Academic Achievement in Physics Among Secondary Schools in Narok County, Kenya. 2(3), 399–414.
[44] Magomedov, I. A., Murzaev, H. A., & Bagov, A. M. (2020). Influence of Physics-Based Sectors On the Economy. 193–198. https://doi.org/10.15405/epsbs.2020.10.03.23
[45] Majka, M., & Poland, N. T. (2024). Understanding the Importance of Pre and Post- Testing in Research and Evaluation Understanding the Importance of Pre and Post-Testing in Research and Evaluation. July.
[46] Makarova, E., Aeschlimann, B., & Herzog, W. (2019). The Gender Gap in STEM Fields: The Impact of the Gender Stereotype of Math and Science on Secondary Students' Career Aspirations. Frontiers in Education, 4(July). https://doi.org/10.3389/feduc.2019.00060
[47] Makena, J. (2024). Impact of the Level of Scientific Literacy on Academic Achievement in IGCSE Physics in Arusha Region, Tanzania. Graduate Student University of Nairobi Senior Lecturer University of Nairobi. 12(11), 83–94.
[48] Marek, E. A. (2006). The Learning Cycle: February. https://doi.org/10.1119/1.2165443 Marek, E. A. (2015). Why the Learning Cycle? April 2008.
[49] https://doi.org/10.1007/BF03174709
[50] Marfilinda, R., & Indrawati, E. S. (2019). Development and application of learning cycle model on science teaching and learning: a literature review Development and
[51] application of learning cycle model on science teaching and learning: a literature review. https://doi.org/10.1088/1742-6596/1317/1/012207
[52] Marfilinda, R., Rossa, R., & Apfani, S. (2020). The Effect of 7E Learning Cycle Model toward S tudent' s Learning Outcomes of Basic Science Concept. 3(1), 77–87.
[53] Maskur, R., Latifah, S., Pricilia, A., Walid, A., & Ravanis, K. (2019). Jurnal Pendidikan
[54] Maurice Amutabi. (2019). Competency Based Curriculum (CBC) and the end of an Era in Kenya's Education Sector and Implications for Development: Some Empirical Reflections. Journal of Popular Education in Africa, 3(10), 45–66. https://doi.org/10.46769/jopea.252328004413713081
[55] Mbonyiryivuze, A., Yadav, L. L., Amadalo, M. M., & Info, A. (2021). Students' attitudes towards physics in Nine Years Basic Education in Rwanda. 10(2), 648– 659. https://doi.org/10.11591/ijere.v10i2.21173
[56] Molefe, L., & Aubin, J.-B. (2021). exploring how science process skills blend with the scientific: pre-service teachers' views following fiedwork experience. South African Journal of Education, 41(2). https://doi.org/10.15700/saje.v41n2a1878
[57] Naisianoi, M., Koome, P., & Marima, E. (2020). Influence of teaching and learning materials availability on the development of pupils in upper primary schools in Karunga Zone, Gilgil Sub County. International Journal of Research in Business and Social Science (2147- 4478), 9(5), 294–301. https://doi.org/10.20525/ijrbs.v9i5.864
[58] Naqeeb Ul Khalil Shaheen, M., Jumani, N. B., & Kayani, M. M. (2015). Improving students' achievement in biology using 7E instructional model: An experimental study. Mediterranean Journal of Social Sciences, 6(4S3), 471–481. https://doi.org/10.5901/mjss.2015.v6n4s3p471
[59] Nathan, N., & State, T. (2024). Effects of 7Es and 3Es Instructional Strategies On Secondary School Students' of Biology Performance in Taraba State, Nigeria. 12(4), 276–283. https://doi.org/10.5281/zenodo.14285917
[60] Nicol, C., Gakuba, E., & Habinshuti, G. (2020). An Overview of Learning Cycles in Science Inquiry-based Instruction. African Journal of Educational Studies in Mathematics and Sciences, 16(2), 76–81. https://doi.org/10.4314/ajesms.v16i2.5
[61] Njoka Nazario. (2020). Integration of Investigative Science Process Skill Teaching Strategy on Students' Achievement, Problem Solving, Motivation at Secondary School Physics. Kenyatta University.
[62] Okache, J., & Sesugh, F. (2024). Effects of 7Es Model and Problem-Based Strategy on Performance in Wave Motion among Secondary School Students in Bauchi Metropolis Effects of 7Es Model and Problem-Based Strategy on Performance in Wave Motion among Secondary School Students in Bauchi Metr. March. https://doi.org/10.5281/zenodo.11432175
[63] Okafor, N.; Nwonu, H. (2021). promoting critical thinking skills of secondary school chemestry students' through 7E-learning cycle model. Science and Technology Education-Scholarly Publications, 248. https://ir.unilag.ng/handle/123456789/12134
[64] Okafor, N.; Nwonu, H. (2021). Promoting critical thinking skills of secondary school chemistry students through 7-E learning cycle model. https://ir.unilag.edu.ng/handle/123456789/12134
[65] Okero, E. K., Nyakan, P. O., & Obuba, E. (2021). Influence of Science Process Skills Teaching Approach on Secondary School Students' Achievement in Chemistry in. Journal of Research Innovation and Implications in Education, 5(2), 1–15.
[66] Olumwa, B. (2019). Factors Influencing Girls' Low Enrolment and Poor Performance in Physics in Mfangano Island Ward, homa Bay County, Kenya. (Issue August). University of Nairobi.
[67] Ordu, U. B.-A. (2021). The Role of Teaching and Learning Aids/Methods in a Changing World. Bulgarian Comparative Education Society, 9, 210–216