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Research Article

Effect of Cartoons and Comics Integrated Instruction on Students' Academic Achievement in Secondary School Physics in Kiambu Sub-County, Kiambu County, Kenya

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Abstract
Secondary school students in Kiambu sub-county have been achieving lower scores in KCSE than the average national mean score between 2012 and 2016. This low achievement is also reflected in the national KCSE physics mean score. This study addresses cartoon and comics integrated interaction (CII) learning in physics and how it can bring about better learning of concepts, theories, and laws. The study sought to compare the student achievement in physics in CII and NCI. A quasi-experimental research design was used. The target population for this study comprised form two students in public secondary schools in Kiambu sub-county. Stratified random sampling was used to sample boys, girls, and mixed schools and two schools randomly sampled from each category of schools and one assigned the experimental group and the other in the control group. Form two class in the selected secondary schools were purposively used in the study. Data was collected using students assessment tests (SATs), teachers and student interview schedules. The collected data was analysed using both descriptive and inferential statistics and presented in the form of notes, numerals, tables, and graphics. Statistical analysis using the paired t-test at a 95% confidence interval revealed $0.000 < p < 0.05$. The alternative hypothesis which states that the use of CII affects student achievement was accepted. The findings of this study revealed that students who are taught with CII score highly compared to those in NCI. This study recommended the use of cartoons and comics integrated instruction by physics teachers to improve learning.
Keywords: Achievement, Cartoon and Comic Integrated Instruction, Student Achievement.

1. Introduction

The academic achievement of most learners in physics at the Kenya Certificate of Secondary Education (KCSE) is below average and is perennially poor (Karue and Amukowa, 2013; Uside *et al.,* 2013; Njoroge *et al.,* 2014). In addition, it is observed that physics registers a high standard deviation in KCSE due to the big gap between high and low achievers (Karue and Amukowa, 2013; Uside *et al.,* 2013). Some of the factors that lead to low student achievement in physics include; heavy workloads and poor conditions and terms of service for teachers, students' negative towards the subject, teacher-centred teaching approaches, inadequate variety of teaching and learning materials, and inadequate mastery of the difficult and core content by some teachers (Muraya and Kimamo, 2011).

Even with the different available teaching methods in science, some teachers do not make science lessons interesting and attract more students (Chepkorir *et al.,* 2014). Chepkorir *et al.,* (2014) further argue that the teachers incorporate a few teaching aids, mainly charts and laboratory apparatus, thus learners are not really excited to go to science lessons, except perhaps for the change of learning environment. The teaching methods used by teachers during classroom teaching contribute a lot to the attitude and achievement of the learners in a particular subject. Njoroge *et al.,* (2014) argue that most science teachers in Kenya prefer the expository teaching approach which is not very effective in passing on conceptual knowledge and science process skills that are part of quality physics teaching (Njoroge *et al.,* 2014). Musasia (2012) explains that practical work improves performance, skills acquisition, and helps in changing the attitude of learners. The

fundamental purpose of practical work in secondary school science subjects is to help students make links between the real world of objects, materials, and events and the abstract world of thought and ideas (Abrahams and Millar, 2008). However, learners are not always engaged in some practical lessons. In addition, a few practical lessons stimulate interplay between observations and ideas during the practical activity. This reduces creativity and the freedom of exploration intended for practical lessons. Learning materials used, like student textbooks, are very plain and hard to understand for an average learner (Aina and Adedo, 2013). Cartoons and comics have been used mainly for entertainment and satire. Learners are more likely to be engaged and motivated to learn through the use of cartoons and comics in teaching algebra lessons (Toh, 2009). Baker (2011) argues that comics help to bridge the gap between students who enter the classroom setting with literacy skills that are below their peers.

1.1. Problem Statement

Most instructional materials used in the teaching and learning of physics in secondary schools in Kenya contain static text and still boring pictures in textbooks and charts. On the other hand, the teaching strategies used are mostly teacher-centred. These strategies used give the learners a few opportunities to participate in the learning process. Studies show that there is a significant difference in the achievement of students taught using improvised instructional material and those taught without any instructional aids.

Cartoons and comics can function as an improvised instructional teaching and learning aid. They capture students' attention during learning. They inspire cooperation, increase attentiveness, and awaken interest from learns during the process of instruction. Most efforts made in improving learner achievement and the teaching of physics have been geared towards digitization of the learning process. There has been a lot of focus on developing and providing digital content for use in schools to improve the instructional process and media. Many studies have focused on computer-assisted instruction and its effect on the learning environment and achievement.

1.2. Research Objective

To establish the difference in the achievement of students taught using cartoon and comic integrated instruction (CII) and those taught using non-cartoon integrated instruction (NCI).

1.3. Research Hypothesis

There is no significant difference in the achievement between learners taught using CII and those taught using NCI.

2. Literature Review

Previous studies have shown that teaching methods that use innovative teaching and learning resources lead to improvement in student academic achievement than traditional materials and methods. Akamca *et al.,* (2009) in their study on the effects of computer-aided concept cartoons on learning outcomes among 4th-grade science and technology class found that concept cartoon-based learning atmosphere affected students' achievement positively. Results of this study showed that using concept cartoons has a positive effect on students' science achievement and correcting misconceptions.

Köse (2013) in their study on effects of cartoons on students' achievement and attitudes in biology teaching (endocrine system) among secondary school students found out that the presentation of cartoons gave an obvious advantage as a learning aid, based on the presence of specific scientific knowledge in a popular form that is enjoyed by most students. Results obtained from their interview questions supported it. It showed that cartoons-based approaches help students easily understand, learn, and retain the subject matter taught.

2.1. Theoretical Framework

This study is based on the constructivist theory of learning by Jean Piaget. The theory emphasizes the active involvement of learners in constructing knowledge for themselves and building new ideas and concepts based on current knowledge and prior experiences. Under this theory, students acquire knowledge by constructing it mentally during their interaction with their immediate environment. Later, they can be able to put these experiences into relationships. A constructivist teacher takes advantage of students' own experiences to develop challenging problems that will engage students in learning. The role of the teacher is to plan an active learning environment and look for signals from learners that can trigger learning. The teacher is not an authority but a facilitator of learning by guiding and supporting learners as they construct knowledge. Learners participate in hands-on activities, raise questions about the topic that interests them, and determine how to go about the inquiry process and apply the knowledge learned in new situations.

3. Research Design

The study adopted a quasi-experimental design, which involves a non-random pre-selection approach of a sample on which a particular variable is tested. Therefore, the sample is selected arbitrarily. This provides convenience in the sample selection process. In the context of this study, it was important to achieve its objectives while at the same time ensuring that it did not lead to significant inconvenience to the targeted schools or the population of students. The quasi-experimental research design used the quantitative research method.

3.1. Research Instruments

The study used students' assessment tests to collect data. They were used to test the physics achievement of the learner before the treatment was given to the experimental group (pre-test) and after (post-test). The pre-test covered reflection at curved surfaces. The post-test covered Hooke's law. The student assessment tests were used to obtain the scores of the students in the pre-test and post-test.

4. Data Analysis, Results, and Discussions

The main objective of this study was to establish the difference in the achievement of students taught using cartoon and comic integrated instruction (CII) and those taught using non-cartoon integrated instruction (NCI). To achieve this, the treatment was given to the experimental group, and the control group was taught using conventional methods during their physics lessons on Hooke's law.

4.1. Students' Achievement in the Pre-test and Post-test in the Control Group

The results presented in Table 1 were extracted from the scores of the learners from the three schools that formed the control group in the pre-test and the post-test.

Table 1. Percentage mean score for the control group in pre-test and post-test.

School	4	5	6
Pre-test mean score	41.2	37.4	27.1
Post-test mean score	42.0	36.7	25.4

The results of the pre-test and post-test scores of the learners in the control group revealed that the learners in two of the three schools scored better in the pre-test than in the post-test. The mean pre-test score was high in school 5 and 6 by 0.7% and 1.7% respectively. However, it is worth noting that in school 4, the learners scored slightly higher in the post-test than in the pre-test. Figure 1 shows that the except for school 4, the bar representing the post-test score in school 5 and 6 is slightly lower.

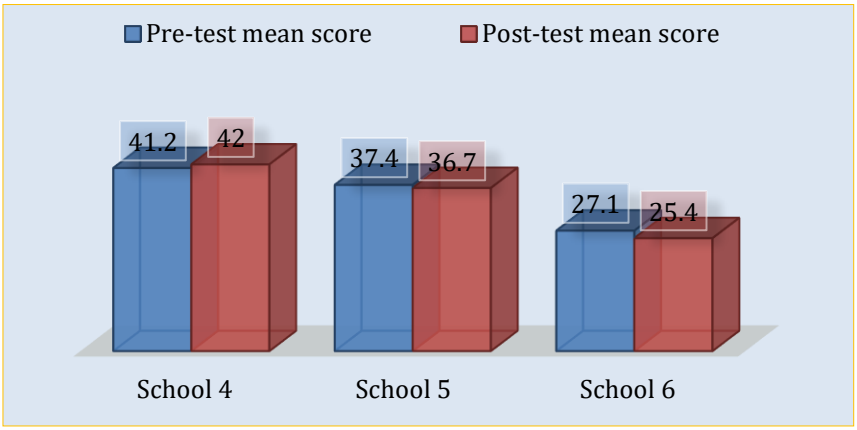

Figure 1. Percentage mean score for the control group in pre-test and post-test.

In addition, the average percentage mean score in the pre-test and post-test for the learners in the control group was 35.25% and 34.73% respectively. Table 2 shows the percentage mean score and the standard deviation for the control group in the pre-test and the post-test.

Table 2. Paired sample statistics for the control group.

Paired samples test		Mean	N	Standard deviation	Standard error mean
Pair 1	Combined_control_group_post_test	34.73	137	17.68	1.51
	Combined_control_group_pre_test	35.25	137	17.96	1.53

Despite the difference in the mean of the percentage score in the pre-test and the post-test of the control group, the mean is not a sufficient statistical measure of a significant relationship between two variables. Therefore, a paired t-test was conducted to determine whether there was any significant difference in achievement in the pre-test and the post-test of the control group. Table 3 shows the summary of the sample paired t-test at a 95% confidence interval (CI) to compare the correlation significance of the two sets of means in the control group.

Table 3. Paired sample t-test for the control group.

Paired samples test		**Paired differences**		**Standard error mean**	**95% confidence interval of the difference**				
		Mean	**SD**		**Lower**	**Upper**	**t**	**df**	**Sig. (2-tailed)**
Pair 1	Combined_control_group_post_test-Combined_control_group_pre_test	-0.52	12.57	1.07	-2.64	1.61	0.48	136	0.63

From the score, there is evidence that the score in the pre-test is not significantly higher than the score in the post-test of the control group ($t = 0.48$, $df = 136$, $p > 0.05$, 2-tailed). Therefore, the difference in the pre-test and the post-test scores is not considered to be a significant difference.

4.2. Learners' Achievement in the Pre-test and Post-test in the Experimental Group

This section compares the achievement of the learners in the CCI lessons. The learners in the experimental were taught Hooke's law with the teacher integrating cartoons and comics in their lessons. The mean percentage score of the learners in the experimental group in the pre-test and post-test are summarised in Table 4.

Table 4. Percentage mean score for the experimental group in pre-test and post-test.

School	**1**	**2**	**3**
Pre-test mean score	42.5	34.6	15.4
Post-test mean score	58.1	42.4	27.2

From Table 4, it is evident that in the three schools that were in the experimental group, the learners' percentage mean score is higher in the post-test than in the pre-test. The highest difference was in school 1 where the difference in the mean score between the pre-test score and the post-test score is -16.5% whereas in school 2 the learners scored with a relatively lower difference in the pre-test and post-test scores of -7.8%. Figure 3 shows the graphical illustration of the difference in the mean score in the schools in the experimental group. The bar in the graph that represents the percentage mean score is higher than the one for the pre-test in all the schools.

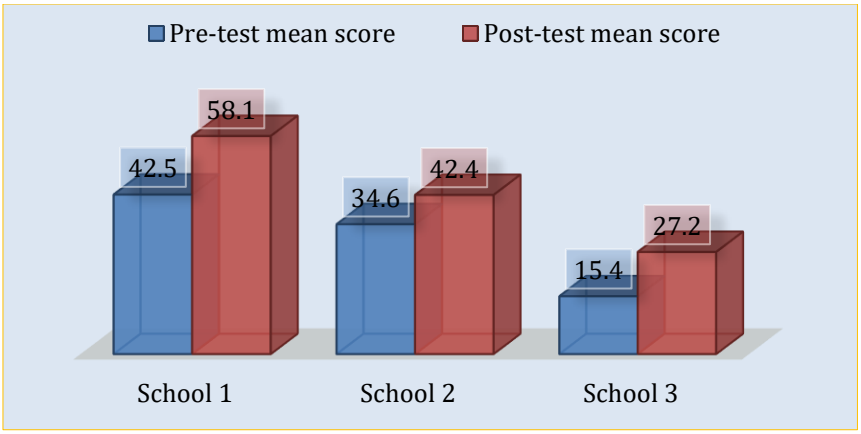

Figure 2. Percentage mean score for the experimental group in pre-test and post-test.

On the other hand, the average percentage mean score of the learners in the experimental group in the pre-test and the post-test was 31.38% and 42.85% respectively as shown in Table 5. The average difference in the mean of the pre-test and the post-test is -11.5%.

Table 5. Paired sample statistics for the experimental group.

Paired samples test		Mean	N	Standard deviation	Standard error mean
Pair 2	Combined_experimental_group_post_test	42.85	128	21.03	1.86
	Combined_ experimental_group_pre_test	31.38	128	18.09	1.60

Further, a sampled pair t-test at 95% CI done to find out if there was any significant difference in the achievement of the students in the experimental group between their scores before and after the treatment was given to them. Table 6 summarises the results of the t-test on the pre-test and post-test scores.

Table 6. Paired sample t-test for the experimental group.

Paired samples test		Paired differences		Standard error mean	95% confidence interval of the difference				
		Mean	SD		Lower	Upper	t	df	Sig. (2-tailed)
Pair 2	Combined_experimental_ group_post_test-Combined_ experimental_group_pre_test	11. 47	12. 76	1. 13	9. 24	13. 7	10. 17	127	.000

From the table, there is very strong evidence that the scores in the post-test are significantly higher than the scores in the pre-test ($t = 10.17$, $df = 127$, $0.00 < p < 0.05$, 2-tailed). The results from the control and experimental groups provide a strong basis for rejecting the null hypothesis. The alternative hypothesis that states that there is a significant difference in the achievement of the learners when they are taught using CCI than those taught using NCI is accepted.

5. Conclusions

The findings of this research study revealed that the integration of cartoons and comics in the teaching and learning process improves student achievement in physics. In addition, the teacher is not the dominant figure in lessons where cartoons are integrated, as the cartoons create a discussion environment in the classroom where the learners learn from each other. Finally, cartoons enhance memory retention, create sustained attention, break the monotony, and create interest and motivation in the subject.

6. Recommendations

Physics teachers should highly consider integrating cartoons and comics in their instruction. They will help them create sustained attention, break the monotony, create interest, increase student motivation in the subject, and make the learning of physics more interesting. In addition, the Kenya Institute of Curriculum Development, which is mandated to develop the education curriculum and recommend instructional materials, should create more resources used in the teaching of physics that includes cartoons and comics. The charts, textbooks, and videos that they develop can be enhanced with cartoons and comics to make them learner-friendly. In addition, KICD should also prepare and design the programs for teacher training courses and in-service of teachers that incorporate the improvised teaching and learning resources. Furthermore, KICD should develop more digital content that contains cartoons and comics. In addition, they can improve on the diagrams in the textbook with cartoons and comics to help the learners develop a relationship with the books, and thereafter the content therein to help teachers facilitate learner-centred lessons.

Declarations

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