



Effects of Cooperative Learning Strategy on Students' Academic Achievement in Physics

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Abstract: *The study examined effects of cooperative learning strategy on Students' Academic Achievement in work, energy and power in 12YBE secondary schools of Gasabo district. This study employed quasi-experimental design, using non-equivalent quasi-experimental design. Purposive sampling technique was used to select two schools for the study. One intact class in each school was used as the control group and the other class as the experimental group. The sample size consisted of 200 students comprising 94 in the control group and 106 in the experimental group. The experimental group was taught work, energy and power using cooperative learning (learning together) while the control group was taught using the traditional way of teaching work, energy and power. Research instrument used for the study for data collection was Physics Achievement Test (PAT). The instrument was developed by the researcher in order to measure the rate of students' academic achievement in physics. The instrument was administered to the students before treatment to determine the level of knowledge about the subject matter (pre-test). Then, the same instrument administered again after the treatment had been given to obtain the post test scores. The scores of the students were analysed using mean and standard deviation. The hypotheses were tested at .05 level of significance using t-test. The study found that Cooperative learning method enhances active student participation and interaction. This quality led to significant learning effect in Physics. It was recommended that science teachers should be encouraged to adopt cooperative teaching/learning strategy so as to enhance active students' participation in scientific operation.*

Keyword: *Effects, Cooperative, Learning, Students, Academic, Achievement*

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1. Introduction

In order to teach effectively, the teachers must have sufficient knowledge about the students, in addition to the knowledge about the subject and appropriate methods of teaching. Modern researcher indicates that if proper and suitable methods and techniques are used, even the students of less intelligence can easily learn. Modern researchers indicate four models of instruction that can lead to high student achievement. These include Direct Instruction, Cooperative Learning, Mastery Learning and Project-Based Instruction. (Gilakjani,

2012).. Cooperation is working together to accomplish shared goals within cooperative situation, Individuals seek outcomes that are beneficial to themselves and to all other group members. Cooperative learning is the instructional use of small groups so that students work together to maximize their own and each other's learning (Gillies & Boyle, 2010). The terms group learning and cooperative learning are often used as if they mean the same thing. In fact, group work means several students working together and working together does not necessarily involve corporation. Cooperative learning is an arrangement in which students work in mixed ability groups and are rewarded on the basis of

the success of the group as a whole (Pateşan, Balagiu, & Zechia, 2016). Cooperative learning activities are carefully structured learning activities in which students are held accountable for their contribution, participation and learning. Students are also provided incentives to work as team in teaching others and learning from others (Hung, 2019). through interaction, students learn to interrogate issues, share ideas, clarify differences, and construct new understanding and new ways of thinking (Molla & Muche, 2018). The purpose of the current study was to investigate the effects of cooperative learning on student's achievement in physics among senior two students. In this study, cooperative learning means to work and learn in groups and obtain the results on the basis of group performance.

From the beginning of time teachers of the world have been trying to figure out the best way to teach their pupils. Different practices have been tried, many have failed and others have succeeded. One teaching strategy that continued to be questioned by teachers is that of cooperative learning. When group work is announced in a classroom many teachers might hear sighs, complaints, or possibly, rejoicing. Cooperative learning is a teaching practice that breaks students into groups of 3-4 with each student having a particular role within the group (Johnson-Johnson, 1999). There are many advantages to cooperative learning over individual learning based on the different dynamics that a cooperative learning group can offer. To use this strategy correctly, certain structure is needed which will be discussed. Cooperative learning has advantages over individual work, including social interaction, transfer of ideas, and group leadership skills. Using cooperative learning is more advantageous than individual learning, if used correctly (Davis, 1999, Giraud, 1997, Johnson, Johnson, 1999, 2009, Gömleksiz, 2007, Doris & Harcourt, 2019, Eshetu, Gebeyehu, & Alemu 2015).

1.1 Purpose of the study

The general purpose of the study was to determine whether cooperative learning strategy has effect on the academic achievement of students in Physics, using the concept of elasticity. In order to achieve this, the study disintegrates the purpose of the study in specific terms as follows;

1. To determine the achievement of the students taught Physics (work, power and energy) with traditional method (Control Group)
2. To determine the achievement of students taught Physics (work, power and energy) with cooperative learning strategy (Experimental Group)
3. To determine the difference in the academic achievement of students in both experimental group and control group

4. To determine the relationship between students' pre-test and post-test scores in the experimental group

1.2 Research Questions

In order to guide the study the following questions were posed.

1. What is the academic achievement of students taught physics with traditional method (Control Group)?
2. What is the academic achievement of students taught Elasticity with cooperative learning strategy (Experimental Group)?
3. What is the difference in the academic achievement of students in both experimental group and control group?
4. What is the relationship that exist between students' pre-test and post-test scores in the experimental group?

1.3 Hypotheses

H₀: There is no difference between academic achievement of students who are taught using cooperative learning (experimental group) and those who are taught using conventional methods (control group) in physics.

H₁: There is a difference in academic achievement between academic achievements of students who are taught using cooperative learning and those who are taught using conventional methods in physics.

2. Literature Review

Cooperative learning methods are instructional programs in which students work in small groups to help one another master academic content (Kagan & Kagan, 2009). Cohen (2015) defined cooperative learning as students working together in a group small enough that everyone can participate in a collective task that has been assigned. Abdulzeez (2011) asserted that cooperative learning is a pedagogical technique that makes students work together in small and mixed groups on a structured learning task with the aim of maximizing each other's learning. Similarly, cooperative learning advocates values such as equality, equity, solidarity, social responsibility, work for mutual benefit and the common good, trusting, caring relationships, viewing situations from all perspectives, and unconditional worth of self and diverse others (Johnson & Johnson, 1999).

According to Johnson & Johnson (2009), cooperative learning is more than just asking students to sit and work together. Cooperative learning method is viewed as a special form of small group teaching, which is in contrast to traditional group teaching (Kagan & Kagan, 2009; Schmalenbach, 2018). This means that Cooperative learning put together active learning and social learning via peer interaction in small groups on

academic tasks” (Davidson & Major, 2014). As for Rolheiser et al., (2004), the emphasis on learning together and the structuring of social processes is what differentiates cooperative learning from traditional group work. Research has identified some components that mediate the effectiveness of cooperative learning, such as positive interdependence, individual accountability, promote interaction, interpersonal and small group skills, and group processing (Kagan & Kagan, 2009).

The usage of cooperative learning strategy engages every member of the classroom into small groups performing specific tasks together. Students are forced to develop social relationship skills that creates a room for innovation and problem solving. It is well understood that science related subjects, especially physics, are occupied with problem solving tasks, cooperative learning strategy helps students to solve problems collectively which may lead to maximal academic achievement. Most students are faced with challenges of inability to confront problems individually because they may believe they do not possess required skill. But when working together collectively, the teacher will notice the positive contribution of such students. By this they gain confidence to solve similar problems independently.

Cooperative learning makes use of varied techniques which are learning together and alone constructive controversy group, investigation, jigsaw procedure, Student Team Achievement Division (STAD), complex instruction, cooperative learning structures and cooperative integrated reading and composition. Cooperative learning is one of the most recent and fruitful areas of research; theory and practices in learning. It denotes students functioning together to attain the objectives and the instructional events that organize the students’ joint effort (Gomlekzic, 2007).

Cooperative learning has numerous advantages. Cooperative learning promotes higher learners’ academic achievement than competitive or individualistic learning, helps in the development of positive relationships among learners, and the provision of experiences that develop both good learning skills and social skills. Also, Ho and Boo, (2007) conducted research titled exploring the effectiveness of cooperative learning in Physics classrooms, the results showed that the use of cooperative learning does increase students’ academic achievement, helps students to achieve a better understanding of physics concepts, and increases students’ motivation to learn. Similar results were found by (Doris & Harcourt, 2019) in their work and recommended that cooperative learning helps to produce: higher achievement, increase retention, more positive relationship, higher self-esteem and better attitude towards the teachers.

Unlike traditional teaching methods, which includes one-way verbal communication without discussion, questioning, or immediate practice (Gömleksiz, 2007), cooperative learning strategies include not only verbal communication to deliver instructions but also sharing ideas and practical demonstration in the classroom. However, educators have gradually incorporated

cooperative learning into the classrooms (Kolawole, 2008). They realized that learners learn best when they actively participate in the subject matter. It encourages students to engage in meaningful conversation and listening, as well as writing and reading content and ideas related to the subject matter. In their studies, they discovered that students who were taught using the cooperative learning strategy performed better than students who were taught using the traditional method of teaching. Through consultation in a cooperative learning environment, students can learn from their colleagues (Bloom, 2009; Slavin, 1996).

Furthermore, empirical evidence on the use of cooperative learning strategy shows that cooperative learning strategy improves learners’ academic performance in Physics. (Cottle & Hart, 1996; Fong & Kwen, 2007; Gambari & Yusuf, 2014; Ho & Boo, 2007; Kolawole, 2008) and (Doris & Harcourt, 2019) all found that cooperative learning is result-oriented in all science subjects. However, it has also been reported that it is not significantly more effective than individualistic instructional strategies and traditional classroom instruction. Sogoni (2017) discovered that students who were taught using the cooperative learning strategy had a better understanding of the content than students who were taught using the lecture method in a study. Similarly, Eshetu, Gebeyehu, & Alemu (2015) found that students enjoyed cooperative learning and performed better as a result of the intervention.

Researchers over the years have been interested in finding relevant solutions to the problem of low performance recorded in physics (Iroegbu, 2004). It was revealed that the achievement of students has become worrisome to the generality of the people, most especially physics educators and researchers (Akinlaye, 1998). Generally, the students’ poor performance in Physics is alarming and if this is not checked may jeopardize the placement chances of students in tertiary institution, not only in Physics education but also in other science related subjects (Gambari & Yusuf, 2014). This has serious implications for national development, security, economy, and manpower for a nation with a vision of transforming the country into a knowledge-based middle-income country, thereby reducing poverty, health problems and making the nation united and democratic. This vision had three cross-cutting areas of gender, natural resources & environment and culture, science & technology (JICA, 2012; MINEDUC, 2015). Various studies have found that the odds can be traced back to the teaching method used in physics classes (Adegoke, 2011; Eshetu et al., 2015)

3. Methodology

The study adopted a quasi-experimental research design. This means that the students were assigned to experimental and control groups at random. The

prototype of quasi experimental design used in this study is shown below.

Pre-test		Treatment		Post-test
Experimental group	0 ₁	X		0 ₂
Control group	0 ₁			0 ₄

The study used cluster random sampling to select two 12YBE secondary schools in Gasabo district. As a result, all the S2 students in the two selected schools were used. In the two selected schools there were total of 200 S2 students. From the sample, the researcher randomly assigned a total of 96 science students to control groups who were taught work, power and energy with traditional/lecture method. Also, 104 students were randomly assigned to experimental group who were taught with cooperative learning strategy. The achievement test (pre-test and post-test) associated with the "work, power, and energy" unit was developed in order to collect data for this study. The pre-test was administered in both the experimental and control group of students of senior two in the selected schools. This enabled the researcher to know the level of students which helped the researcher to establish the prior knowledge before intervening. After, an experimental group received the treatment for a period of four weeks and control taught by means of traditional approach, a post-test was given to both experimental and control groups to obtain the post test scores.

The achievement test contained 50 multiple choice items of which each of the item carries one mark. Two experts from the department of science education at the University Of Rwanda College Of Education (UR-CE)

Table 1: Academic achievements of students taught Elasticity with traditional method (Control Group)

Control group	N	Mean	SD	Mean gain	Percent gain
Pre-test	95	11.6827	2.55527		
Post-test	95	17.5481	3.06524	5.8654	23.4616

Table 1 shows the mean scores for the control group as (Mean=11.6827) and Standard Deviation (SD=2.55527) in the pre-test is lower than that of post –test scores (Mean=17.5482) and standard deviation (SD=3.06524) with a mean difference of 5.8654. This implies that

faced the instrument and validated its content. The reliability coefficient was calculated using split half coefficient to split the test into halves with the same level of difficulties. The reliability coefficient obtained was 0.963 suggesting that there is a strong correlation between test halves (25 odd numbered items and 25 even numbered items). This means that the part one items have the same level of difficulty as part two items. Therefore, the 25 items of part one used as pre-test while the other part with 25 items used as post-test. To measure the internal consistence of the pre-test and post-test, Cronbach’s alpha coefficient was used. The data that were collected from the study were analysed using mean and standard deviation. The hypotheses were tested at .05 level of significance using t-test. This test was performed to determine whether there is a significant difference between physics students’ achievement of the cooperative learning method and that of the traditional method approach students before(pre-test) and after (post-test) exposing them to the treatment.

4. Results and Discussion

Research Question 1: What is the academic achievement of students taught work, power, and energy with traditional method (Control Group)?

lecture method of teaching enhance students’ academic achievement in Physics to some certain extent.

Research Question 2: What is the academic achievement of students taught Elasticity with cooperative learning strategy (Experimental Group)?

Table 2: Academic achievements of students taught Elasticity with cooperative learning strategy (Experimental Group)

Experimental group	N	Mean	SD	Mean gain	Percent gain
Pre-test	104	11.4632	2.92025	10.8631	
Post-test	104	22.3263	2.44271		43.4524

Table 2 shows the academic achievement of students who were taught Physics using the cooperative teaching method. According to the table, the experimental group’s pre-test mean and standard deviation scores were 11.4632 and 2.92025, respectively. However, after the

treatment, the mean and standard deviation scores increased to 22.3263 and 2.44271, respectively. The mean difference was 10.8631, and the mean percent gain was 43.4524.

Research Question 3: What is the difference in the academic achievement of students in both experimental group and control group?

Table 3: Difference in the academic achievement of students in both experimental group and control group

Group	N	Post-test	Mean difference	Mean gain	Percent gain
Control group	104	17.5481	4.7782	5.8654	23.4616
		22.3263		10.8631	
Experimental group	95				43.4524

Table 3 compares the academic achievement of students in the experimental and control groups and shows that there is difference in their academic achievement when comparing the post-test score. The mean difference between the post-tests of both groups was 4.7782 in favour of the experimental group. This demonstrates that those who were exposed to cooperative

teaching/learning method performed better than those who were taught using the traditional/lecture method.

Research Question 4: What is the relationship that exists between students' pre-test and post-test scores in the experimental group?

Table 4: Relationship that exists between students' pre-test and post-test scores in the experimental group

		Posttest	pretest
Posttest	Pearson Correlation	1	-.040
	Sig. (2-tailed)		.572
	N	199	199
Pretest	Pearson Correlation	.653**	1
	Sig. (2-tailed)	.000	
	N	199	199

** . Correlation is significant at the 0.01 level (2-tailed).

Table 4 depicts the relationship that exists between the experimental group's pre-test and post-test scores. The obtained r value was approximately 0.65. This means that the relationship between the experimental group's pre-test and post-test scores is positive. In other words, the cooperative teaching method moderates student performance. The students' performance was not influenced by prior knowledge or intelligence. The cooperative teaching and learning method provides understanding of the concept of work, power and energy at a nearly equal level.

The independent samples t-test was used to see whether the differences in the groups' academic achievement were statistically significant. With a 95% confidence interval, the following null hypothesis (H_0) was tested: There is no difference between academic achievement of students who are taught using cooperative learning (experimental group) and those who are taught using conventional methods (control group) in classes of physics.

Table 5: Independent sample t-test on the pre-test mean scores of experimental and control group

Groups	S.D	N	Mean	t-value	df	sig
Experimental group	2.92025	94	11.4632	.575	197	.079
Control group	2.55527	104	11.6827			

Table 5 shows that the scores for the experimental group ($M=11.4632$; $SD=2.92025$) and the control group ($M=11.6827$; $SD=2.55527$); $t(197)=0.56$; $p=0.079$ were not statistically different. The pre-test results showed that the two groups (experimental and control)

had comparable/similar prior knowledge before the intervention. The results showed that the calculated p-value ($p=0.079$) at 95% confidence interval is greater than the p-value of 0.05, the null hypothesis (H_0) is accepted. On the other hand, the result indicates that

there is no significant difference in the pre-test mean scores of student before the intervention, which means that the students from both control and experimental

group had the same knowledge about the unity of work, power, and energy. Any differences in performance after treatment could therefore be attributed to the treatment.

Table 6: Independent Samples Test for post-test mean scores of the experimental and control group

Groups	S.D	N	Post-test Means	t-value	df	Sig(p)
Experimental group	2.44271	94	22.3263			
Control group	3.06524	104	17.5481	-12.1	197	.036

The result in Table 6 indicates that the experimental group (M=22.3263; SD=2.44271) and the control group (M=17.5481 SD =3.06524) have statistically significant differences in achievement (post-test scores); $t(197) = -12.1$; $p = 0.036$. The results show that the p-value obtained ($p=0.036$) is less than the p-critical value (0.05) at 95% confidence interval. Since the p-value obtained is less than the p-critical value, the null hypothesis is therefore rejected and alternative hypothesis is then accepted. This means that there is a significance difference in post-test mean scores of students taught with cooperative teaching method and lecture method. The implication of this result is that cooperative teaching and learning methods improves students' academic achievement and understanding of Physics concepts.

Discussion of findings

Students in the control group were given a pre-test and a post-test, and it was discovered that their academic performance improved by 30.4 percent. This suggests that when students were taught Physics in a lecture format, they performed slightly better. The implication of this finding is that students earn achievement in physics no matter how miniature it may be, when they are taught with traditional teaching method (Lecture method). This findings is supported by (Eshetu et al., 2015) who noted that teachers centred methods to an extent have facilitative effects on students' academic achievement. However, Akpan (1999), and Ameh and Dantani (2012) in their separate findings have stated that traditional lecture method of teaching which is the prevailing method of teaching has failed in enhancing participation, especially in science lesson thereby leading to students poor in science subjects.

Also, testing the effect of the treatment on students in the experimental groups, the study found that students in the experiment group had a mean gain of 10.8631. The performance of those in the experimental group increased by 43.45 percent. This is evident that students exposed to cooperative learning or teaching strategy performed at a greater extent than those who were taught with lecture method. The result is expected because Abdullah, Abubakarand & Mahbo (2012), Keramati (2010) noted that teaching strategies, which

promote active students' participation and interaction, highly help students to learn more effectively. Students learn more when they are involved in the learning process in groups or individually. Cooperative teaching strategies condition students to group interactive learning that will eradicate senses of inferiority among students.

Unlike the traditional teaching method which involves a one way verbal communication, unaccompanied by discussion, questioning or immediate practice cooperative learning strategy is not only verbal communication to deliver instructions but also sharing ideas and practical demonstration in the classroom (Gömleksi'z, 2007). The findings of this study confirm the assertion by comparing the post- test mean scores of students in the both groups. Students who were exposed to learning through cooperative means performed significantly better than those who were in the control group. The scientific assumption made on this, proved that the difference that existed between the mean scores of both groups were statistically significant.

5. Conclusion and Recommendations

5.1 Conclusion

Based on the findings, the researcher concludes that:

Cooperative learning method enhances active student participation and interaction. This quality leads to significant learning effect in Physics. Students taught Physics with cooperative teaching method has higher academic achievement than those taught with lecture method of teaching. Cooperative learning also enhances the understanding of the concept of work, power and energy as the learners demonstrated high level of competence in the concept through oral questions and test.

5.2 Recommendation

Based on the findings of the study the researcher recommends accordingly:

1. In general terms, science teachers should be trained in the usage varying methods of

- teaching science so as to boost students learning interest in science subjects.
2. Physics teachers are encouraged to adopt cooperative teaching strategy so as to enhance active students' participation in scientific operation.
 3. Science is the heart of sustainable development in the society. Therefore government should improve their support for secondary school science teaching through the provision of basic facilities that facilitates learning, this lays a good foundation for future science and technological development in the society.

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