EFFECTS OF COOPERATIVE LEARNING STRATEGY ON THE ACHIEVEMENT OF SENIOR SECONDARY SCHOOL PHYSICS STUDENTS IN JOS SOUTH, PLATEAU STATE

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Abstract
This study investigated the effects of cooperative learning strategy on achievement of senior secondary school physics students in Jos South, Plateau State. To guide this study, three hypotheses were formulated and tested at 0.05 level of significance. The study employed a pre-test- post-test quasi-experimental design. This means that a pre-test post-test was given to both control and experimental groups. The population of study was made up of 980 SS II physics students in Plateau State, from where a sample of 68 students were purposively selected two secondary schools. The instruments used for the collection of data was Physics Achievement Test (PAT). All the data collected was analysed using paired t-test statistics and analysis of variance (ANOVA). The major findings of the study were: the students in cooperative learning group performed higher than those in traditional classroom learning group; there was also an insignificant difference in performance between the male and female students in the cooperative learning group. Based on the findings, it was recommended that cooperative learning strategy should be adopted by all secondary school Physics teachers as an effective learning strategy in order to improve students' performance.
Keywords: **Physics, Cooperative Learning Strategy, Academic Achievement.**

Introduction
Physics is the branch of science concerned with the properties of matter and energy and the relationship between them. It is based on mathematics and traditionally includes mechanics, optics, electricity, magnetism, acoustics, and heat. Modern physics, based on quantum theory, includes atomic, nuclear, particle, and solid-state studies. It can also embrace applied fields such as geophysics and meteorology. The support of physics education and research in all countries is important because: physics is an exciting intellectual adventure that inspires young people and expands the frontiers of our knowledge about nature. Physics is the most basic of the physical sciences. From chemistry and geology through to biology and cosmology, we understand science in terms of the concepts developed in physics. Not only this, but many of the tools on which the advances of science and technology depend are direct products of physics.

The interests and concerns of physicists have always formed the basis of future technology. In medicine we use X-rays, radioisotope and nuclear magnetic resonance imaging. In addition, laser, electron microscopes, synchrotron radiation, and electronics all depend on advances made in physics. Despite all these advances, the interest of students in physics and their performance in WAEC and NECO examinations has been very poor. For example, in the S.S.C.E of May/June 2012, Physics recorded only 13.8% passes with Distinction and Credit grades, while 59.6% of the total number of candidates (n= 381,506) candidates failed (Musa & Dauda, 2014). In the examinations taken in June 2014 by 618,119 students, 14.2% passed at Distinction and Credit levels in Physics. The failure was 56.3% for Physics (WAEC, 2014). This could be attributed to lack of laboratory equipment, poor teacher quality and defective strategy for teaching Physics.

Cooperative learning is a teaching strategy in which students work together in small teams and use a number of activities to achieve stated objectives and improve their understanding of subject matter. It takes many forms of definitions, but most cooperative approaches involve small, heterogeneous groups, usually of four or five members, working together towards a group task in which each member is individually accountable for part of an outcome that cannot be completed unless the members work together. Students learning goals may be structured to promote cooperative, competitive or individualistic efforts. Cooperative learning has been well documented in the educational research as a successful pedagogy to improve students' academic achievement. Attitudes and values of learners are formed through social interaction.

Borich (2004) noted that most of our attitudes and values are formed by discussing what we know or think with others. Continuing, in this manner, we exchange our information and knowledge with that of others who have acquired their knowledge in different ways. This exchange shapes our views and perspectives. Our attitudes and values are among the most important outcomes of schooling (Borich, 2004). They provide the framework for guiding our actions outside the classroom. Cooperative learning is important in helping learners acquire from the curriculum the basic cooperative attitudes and values they need to think independently inside and outside of the classroom. They acquire this by providing help and cooperation to each other, sharing resources, and encouraging each other's efforts. As a result, group members who work in cooperative groups outperform students who work by themselves or in competition with each other (as seen in competitive conventional classrooms) (Johnson & Johnson, 2004). Cooperative learning is one of the two ways of organizing the learning environment of a classroom, the other being competitive. Cooperative learning establishes a community in which students can get help and support from other group members immediately in a non-competitive learning environment, just raising their hands and waiting for the right answers to be given.

Academic achievements of students have been found to be enhanced by the use of cooperative learning, (Emma & Mary, 2005). Mohammed and Zaki (2010) found that cooperative learning gains are not limited to a particular ability level or sex but to all who engage in it. Bulama, (2003) and Bashir, (2005) stated that, the fact that cooperative learning has been linked to increase in the academic achievement of learners at all ability levels is another reason for its use. Therefore, it is very important to allow students to reflect their own ideas, prepare an environment giving them a chance to discuss their learning with other students and their teachers (Sagam & Millar, 2006). Teachers must do more than just teach students a certain body of facts, they must direct students to have the ability to become increasingly self-dependent, self-directed and depend less on the teacher.

Science education in Nigeria has undergone many reforms. In recent years, a number of studies have investigated the teaching of Science subjects among which Physics is a core science subject. Science teaching and learning today is to a great extent focused on activities by which the learner acquires facts, rules and action sequences (Kpangban & Ajaja, 2007). There are different methods adopted by an individual in the teaching of physics. In some, the teacher does all the talking and tends to disseminate the message that physics is a bundle of facts, a collection of right answers determined by authority. A different method presents science as a set of opinions constructed from and supported by personal observations.

Students' understanding of Physics and the learning strategies that are consequently employed evolve throughout their school time. The way Physics is taught over the years of schooling is likely to affect students' understanding of the subject and consequently how they relate to science. For

example, Yusuf (2005) reported that students exposed to cooperative learning method achieved significantly better than those exposed to individualized method of teaching. In a similar study conducted on 155 organic chemistry students, Olatoye et al (2011) found that the treatment (cooperative learning) was effective in enhancing students' achievement in organic chemistry. Thus, the Physics learning experiences provided by teachers are very important. The way Physics is presented to students will inevitably affect its understanding and consequently how they relate to science in general.

Evidence from research works in Nigeria indicated that very little research efforts had been directed at cooperative learning in physics. This approach has been highly recommended for teaching at all levels, as stated by the Federal Government of Nigeria (FGN, 2004) in the National Policy on Education. This, therefore, tends to suggest that as most teachers are not sensitized on the advantages of the use of cooperative learning, it is believed that the manner in which most schooling occurs may not be teaching students to become aware of their own learning, to think critically and to derive their own pattern of thought and meaning from content presented through interaction as a result of cooperative learning. It was in attempt to bridge the gap on the knowledge of the effects of cooperative learning strategy on achievement of senior secondary school physics students' using Jos south, Plateau state, that this study was carried out. In the study, attempt was made to find out the effects of cooperative learning strategy on senior secondary school (SS11) students' achievement in physics concepts and also to determine whether the achievement was sex biased.

For some time now, it has been observed that Nigerian Students and especially those in Plateau State have problems with understanding physics. Students expect the teacher to be the vessel of knowledge with very limited input from them. In everyday interaction, it was very evident that many students just relied on the teacher and did very little or no work outside the classroom setting. As a result, they sometimes could not demonstrate a clear understanding of the subject matter and did not arrive at their own potential. It was the researcher's opinion that various teaching strategies would result in differences in student academic achievement in physics. It seemed that learning at secondary schools needed to be more student centred to ensure greater students understanding of physics concepts. In recent years however, evidence abounds showing that cooperative learning strategy tends to give students better ways of understanding concepts especially in subjects like the social sciences. Ibrahim (2003) stressed that when students work in group, they tend to understand each other better than when a teacher teaches them.

Similarly, there is growing concern in all parts of this country over a decline in the quality of students who enrol in physics in tertiary institutions as well as their performance in WAEC examinations (Omoshehin, 2004). Also, a number of factors have been identified by previous researchers as contributing to this decline. Smithers (2006) noted that the study of physics in schools and universities is spiralling into decline as many teenagers believe it is too difficult. Sillitto and MacKinnon (2000) noted that physics has an image of being both 'difficult' and 'boring'. Williams et al (2003) observed the major general reasons for students finding physics uninteresting are that it is seen as difficult and irrelevant: physics deals with abstract concepts and students find these concepts difficult to grasp.

Although these problems may not be rooted in the method of instruction only, the way students are taught, may perhaps greatly affect their performance. Therefore, a study on adopting an alternative method of teaching is necessary in order to contribute in searching for answers to these problems. In the same vein, the West African Senior Secondary Certificate Examination Chief examiner's report (2008) showed that lack of

understanding of the fundamental concepts of physics contributed to the abysmal performance of students in physics examinations. It is in view of this therefore, that the researcher decided to investigate the effects of cooperative learning strategy on achievement of senior secondary school physics students in Jos South, Plateau State.

Purpose of the study

The general purpose of this study was to investigate the effects of cooperative learning strategy on achievement of senior secondary school physics students in Jos south, Plateau State.

The specific objectives of this study are;

1. to find out if there is any difference between pre-test and post-test achievement scores of students in physics using cooperative learning strategy and conventional method of teaching.
2. to determine if any difference exist between special science secondary school students and public secondary school students in terms of achievement using cooperative learning strategy.
3. to investigate if any difference exists between male and female students in their achievement in physics using cooperative learning strategy.
4. to investigate if group assignments will improve students understanding of physics as compared with individualistic assignment.

Research questions

The following research questions were formulated to guide the study;

1. What are SS2 students' level of achievement in physics before and after exposure to cooperative learning strategy and conventional lecture method of teaching in Jos south?
2. To what extent do students of private secondary schools differ from those of public secondary schools in their achievement using cooperative learning strategy?
3. What is the difference between male and female students in their achievement in physics when teaching using cooperative learning strategy?
4. Does group assignments improve students understanding of physics compared to individual assignments?

Hypotheses

The following hypotheses were formulated and tested at 0.05level of significance:

1. There is no significant difference in the pre-test and post-test achievement scores of students in physics using cooperative learning strategy and Conventional teaching method.
2. There is no significant difference in students' achievement between private secondary schools and public secondary school students using cooperative learning strategy.
3. There is no significant difference between male and female students' achievement scores in physics when taught using cooperative learning strategy.
4. There is no significant difference in the achievement scores between group assignments and individualistic assignment of students using cooperative learning strategy.

Methodology

This study adopted a pre-test- post-test group control design. This means that a pre-test post-test group control design was given to both control and experimental groups in which independent variables were manipulated to see their effects on the dependent variables. While the experimental group was subjected to treatment using cooperative learning strategy, the control group was exposed to lecture method. Experimental groups were taught selected topics in physics using cooperative learning strategy, while control groups were taught the same topics using the lecture method. Pre-test was administered to both groups before the commencement of the treatment. Treatment was administered for a period of

six weeks after which a post-test was administered. The design is symbolically represented as:

Experimental Group $\rightarrow O_1$ X O_2

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Control Group $\rightarrow O_3$ O_4

Where;

O_1=Pre test for Experimental group
O_2=Post test for Experimental group
X=Treatment
O_3=Pre test for control group
O_4=Post test for control group

The population of the study was 980 senior secondary school two (SS II) physics students in Jos South, Plateau State. The SSII, were preferred because at this stage, they had covered enough topics in physics and were not facing any external examination like NECO or WAEC. Samples of 68 SSII students were used from two senior secondary schools which were purposively selected to participate in the study. They were chosen purposively because physics is taught in all the schools and they all take physics at WAEC and NECO examinations. Out of the total population of 980, a sample of 68 students from intact groups was used. The sample represented 6.94% of the entire population. Sixty-eight (68) students were randomly selected from the two schools, 33 students were used as control group and 35 students as experimental group. All the 35 students in the experimental group were further divided into expert groups of 4 each. The researcher conducted the teaching in each of the 2 schools in both the experimental and control groups and gave the experimental group orientation on the basic skills of cooperative learning strategy before the commencement of the teaching.

The data collecting instrument was the Physics Achievement Test (PAT). The researcher, based on the contents of the physics concepts taught, constructed the Physics Achievement Test (PAT). The test was made up of 40 multiple choice items and covered all the areas of the concepts taught. The questions were on aspects of physics contained in SS2 syllabus. All the 40 items contained in the PAT were drawn from the West African Examination Council (WAEC) past question papers. The selection was done within a twelve year range (2005-2014). Each multiple-choice item consisted of four options lettered A-D of one key and three distracters. A 40- item Physics Achievement Test (PAT) was designed to measure the achievement of SS2 physics students and each correct answer attracted two marks totalling 80 marks altogether. The 40-item Physics Achievement Test (PAT) was constructed from three identified difficult topics/areas in the curriculum for SSII. The 40-item multiple choice questions were made up of four options lettered A-D based on three content areas that were covered. The areas were optics, waves and sound. The questions were to measure the students' achievement on the three major topics at SSII level. The PAT was used for both pre-test and post-test.

Three senior lecturers from Department of Science and Technology Education, University of Jos and three teachers from the sample schools, teaching physics validated the PAT and the marking scheme. These experts gave both face and content validity of the instruments such as, the conformity of the test items with subject specification, clarity and appropriateness of the items, in terms of level of reading difficulty, ability of the items to actually test basic ideas in optics, waves and sound, and possible errors in the suggested answers. Based on the critique and suggestions from the judges, the researcher made amendments such as reframing some of the items. After the suggestions given by experts, the instrument was considered valid for the study.

Test and retest method was adopted in determining the reliability of the PAT. Pearson-product moment correlation coefficient was used to test the reliability of the instrument in addition to programmed computer analysis. To determine the reliability of the PAT, a pilot study was conducted in one secondary school in Jos North, The reliability coefficient was found to be .84

Results

Data collected for this study were presented and analysed based on the research questions and hypotheses for the study.

Research Question One

What are SS 2 students' level of achievement in physics before and after exposure to cooperative learning strategy and conventional lecture method of teaching in Jos south?

The results showing the achievement scores of the students taught using cooperative learning strategy and those taught using conventional lecture method are as shown in Table 3.

Table 3: Analysis of SS2 Students Achievement in Physics Before and After Exposure to Cooperative Learning Strategy

Achievement Level	Range Scores Percentage	Before N	After N
High	60-100	1 (2.86)	29 (82.86)
Moderate	50-59	5 (14.29)	5 (14.29)
Low	0-49	29 (82.86)	1 (2.86)

The analysis in table 3 shows that before students were exposed to cooperative learning strategy only one (1) representing 2.86% was at high achievement level, but when exposed to cooperative learning strategy 29 students representing 82.86% moved to the high achievement level. Before exposure to cooperative learning strategy 5 students representing 14.29% were at the moderate achievement level but same percentage remained after exposure to cooperative learning strategy 29 students representing 82.86% were at low achievement level but after exposure to cooperative learning strategy 1 student representing 2.86% moved to the low achievement level. This implies that cooperative learning strategy helped in enhancing student's achievement in Physics when compared to conventional lecture method.

Table 4: Analysis of SS2 Students Achievement in Physics Before and After Exposure to Conventional Lecture Method

Achievement Level	Range Scores Percentage	Before N	After N	%
High	60-100	-	4	12.12
Moderate	50-59	-	6	18.18
Low	0-49	33 100	23	69.70

The analysis in table 4 shows that before students were expose to conventional lecture method non were at high achievement level, but when exposed to conventional lecture method 4 students representing 12.12% moved to the high achievement level. Before exposure, none were at moderate achievement level but when exposure to conventional lecture method 6 students representing 18.18% moved to moderate achievement level. Before exposure 33 students representing 100% were at low

achievement level but after exposure to conventional lecture method 23 students representing 69.70% moved to low achievement level.

Research Question Two

To what extent do student of private secondary schools differ from those of public secondary school in their achievement using cooperation learning strategy?

Table 5: Analysis of SS2 Student School Type Achievement using Cooperation Learning Strategy

School Type	N	%	SD	Mean Gain
Private	35	67.09	9.89	
Public	33	44.70	10.67	22.39
Total	68			

The analysis in table 5 shows that the mean achievement scores of private school student (x=67.09, 9.89) is greater than their counterpart in public school (x=44.70, 10.67).The mean gain 22.39 in favour of the private school, this implies that private schools students (experimental group) performed better than the public school student (control group) when exposed to cooperative learning strategy in physics.

Research Question Three

What is the difference between male and female students in their achievement in physics when taught using cooperative learning strategy?

Table 6: Mean Analysis of Posttest Achievement Scores of Experimental Group Based on Gender

Gender	N	%	SD	Mean Gain
Male	14	68.79	8.50	
Female	21	65. 90	10.77	2.89
Total	35			

Table 6 shows that the mean achievement scores of male students (68.79, 8.50) were slightly greater than their female counterparts (65.90, 10.77). This could be seen on the table from mean gain of 2.89 in favour of the male.

Research Question Four

Does group assignment improve students understanding of physics compared to individual assignments?

Table 7: Analysis of Posttest Mean Achievement Scores of Group and Individual Assignments

Assignment Type	N	%	SD	Mean Gain
Group	35	76.86	13.45	
Individual	33	60.00	11.18	16.86
Total	68			

Table 7 shows that the mean achievement scores of students that were exposed to group assignment (76.86, 13.45) was greater than those that were exposed to individualistic assignment (X=60.0, S2=11.18). This implies that group assignment was better or more effective than the individualistic assignment in Physics.

Hypotheses

There are many statistical tools used in testing hypotheses in educational research but in this study t-test and analysis of variance (ANOVA) was used to test the hypotheses stated.

Hypothesis One

There is no significant difference in the pre-test and post-test achievement scores of students in Physics using cooperative learning strategy and conventional lecture method.

Table 8: Analysis of variance (ANOVA) of Pre-test and Post-test on Student's Achievement of Experimental and Control Groups

Source of Variation	df	SS	MS	F-cal.	F-tab.	Decision
Between	3	22218.81	7406.27	83.25		Rejected
Within	132	11742.12	88.96		2.60	
Total	135	33960.93	251.56			

P<0.05

Since F-ratio (83.25) calculated was greater than F-ratio (2.60) from table 8 at 0.05 level of significance and F (3,132) degree of freedom. The implication is that there was significant difference between the pre-test and post-test physics achievement mean scores of students in experimental and the control groups.

Hypothesis Two

There is no significant difference in student's achievement between private and public secondary school student taught using cooperative learning strategy.

Table 9: t-test Analysis of Posttest of Students Achievement scores in Private and Public Schools Taught using Cooperative learning Strategy

School Type	N	%	S	t-cal.	t-tab.	df	Decision
Private	35	67.09	9.89				
Public	33	44.70	10.67	8.96	1.98	66	Rejected
Total	68						

P<0.05

Table 9 indicates that the calculated t-value (8.96) was greater than the critical t-value (1.98) from the table at 0.05 level of significance and 66 degree of freedom, Hence the null hypotheses was rejected meaning that there is significant difference between the student's achievement in private school and those in public secondary school physics.

Hypothesis Three

There is no significant difference between male and female students' achievement scores in physics when taught using cooperative learning strategy.

Table 10: t-test Analysis of Posttest Achievement Scores of Experimental Group based on Gender

Gender	N	%	S	t-cal.	t-tab.	df	Decision
Male	14	68.79	8.50		2.02	33	Retained

Female	21	65.90	10.77	0.88
Total	35			

P < 0.05

Table 10 indicates that the calculated t-value was 0.88 and the critical t-value from table was 2.02 at 0.05 level of significance and 33 degree of freedom. This implies that the mean achievement scores in physics of male students (68.79) was significantly different from the mean achievement scores of female students (65.90) who were both taught using cooperative learning strategy.

Hypothesis Four

There is no significant difference in the achievement scores between group assignments and individualistic assignment of students using cooperative learning strategy.

Table 11: t-test Analysis of Posttest of Students Achievement in Physics of the Experimental and Control Groups Based on Assignment Type

Assignment Type	N	%	SD	t-cal.	t-tab.	df	Decision
Group	35	76.86	13.45	5.63		66	
Individual	33	60.00	11.18		1.98		Rejected
Total	68						

P<0.05

Table 11 indicates that the calculated t-value (5.63) was greater than the critical t-value (1.98) from table at 0.05 level of significance and 66 degree of freedom. This implies that there is significant difference between group assignment (76.86) and individualistic assignment (60.0) of the experimental group and control group.

Discussion

This study is most significant in that it has moved studies on cooperative learning a step further. The findings of this study have demonstrated the effectiveness of cooperative learning in the teaching and learning of physics at the secondary school level of education. Initial research efforts on cooperative learning had been centred on the use of the subject as a whole and not some specialized areas of a subject. Again, the study compared how gender and school type influenced students' scores in cooperative classes. The combination of variables helped to determine the interaction between and among the variables in influencing students test scores in physics.

Hypothesis Ho1 sought to find out whether there were statistically significant differences in students Physics achievement scores between students who are taught using Cooperative Learning Strategy and those taught using Conventional lecture Methods. In the findings of this study, the Ho1 was rejected. These findings support earlier studies that concluded that the use of the cooperative learning strategy improved achievement scores compared to the conventional teaching methods (Hanze & Berger, 2007).

The results further confirm Borich (2004) who also reported that students taught using cooperative learning strategy tend to perform better. The findings of this study also agree with a number of researches works that have been carried out on the efficacy of Cooperative learning in Nigeria. Such studies include those of Ukwungwu (2000). Adeyemi (2002). Omoshehin (2003) and Ibrahim (2003) investigated the effects of a training programme in cooperative learning of pre-service teachers' classroom practice and pupils' learning outcomes in social Sciences. It was the conclusion of all these studies that cooperative learning strategies seem more useful than other instructional strategies. The research is in total agreement with these positions.

The findings of this study showed that there was no significant difference in Physics achievement scores between boys and girls when taught by the use of cooperative learning strategy. It was further found that both girls and boys performed significantly better when exposed to cooperative learning strategy than those who were taught through conventional teaching methods. Balfakih (2003), Adeyemi (2008) Kost, Pollock and Finkelstein (2009) and Oludipe (2012) reported no significant difference between male and female students' performance when taught using cooperative learning strategy.

All students irrespective of their gender benefited in about the same margin from the use of cooperative learning strategy. This perhaps may be the reason why no significant difference was found in performance between the male and female students on the use of cooperative learning strategy. By definition, if one group changes in a similar amount as another group, there will be no significant difference between them. What matters most in cooperative learning is role expectations and responsibilities. Borich (2004) noted that the success of a cooperative learning activity depends on your communication of role expectations and responsibilities and modelling them where necessary. These, the teacher teaching cooperative classes with equal male and female students did by explaining the following: the assignment given, the collaborative goal to be achieved, individual student accountability, inter-group cooperation, criteria for success and specific cooperative behaviours expected. Once the students began work, the teacher observed the various groups and helped solve any problems that emerged. Although non-significant interaction effects on achievement were found between sex and performance, sex and method, ability and method, and among sex, method and ability, it is believed that the higher thought processes as required for higher achievement, are induced by the interaction with one another more than with the traditional treatment from books and classroom teachers. This, again, may have contributed to the noticeable significant difference in performance scores between students in the cooperative classroom and those in the traditional classroom. Student-student interaction constitutes the majority of time and activity during cooperative learning. It is generally believed by researchers that an essential ingredient of cooperative learning is each learner's desire to facilitate the task performance of fellow group members.

In addition, there is a significant difference in the performance of those who did class assignments together and those who did the assignments individually. This confirms that working together in a group to do assignments and group work enhances students' leaning ability and improves their academic performances better than doing it alone. This is because it gives the students sense of belonging and they are motivated to work so that they are not left out in the group work.

Conclusion

From the findings of this study, the following conclusions were reached: -

1. Cooperative learning strategy is an effective teaching method in physics since the findings of this study confirms that it leads to high achievement of the subject.
2. Cooperative learning strategy also reduces gender disparities in physics achievement.
3. Cooperative learning strategy is effective in the teaching and learning of physics in secondary schools. This strategy has positive effects on students' achievement and retention of physics concepts.
4. Academic achievement of physics concepts is related to the use of instructional strategies employed to teach them.
5. Academic achievement of biology concepts can be enhanced by the use of effective instructional strategy.
6. Finally, physics teachers should note that cooperative learning enhances

motivation, interest, achievement and Interaction with other learners.

Recommendations

Based on this study, the following recommendations were proffered:

- Physics curriculum developers should include the teaching of physics using cooperative learning strategy as part of the teacher education syllabus during the training of physics teachers. This makes it part of the curriculum which may address the problem of dismal performance in the subject.
- Teachers should be encouraged by education stakeholders such as the federal ministry of education (FME) to use cooperative learning strategy in teaching Physics. However, it should be used to the topics where it is applicable.
- During in-service training of teachers organized by the Ministry of Education, such as STAN, the use of cooperative learning strategy in teaching physics should be incorporated. This is because the quality of teachers and the kind of training they have is a major determinant of the quality of education in any nation.

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