KIU Journal of Social Sciences Copyright©2018
Kampala International University ISSN: *2413-9580*; 4(1): 105–114

Effects of Computer-Assisted Instruction (CAI) on Students' Achievement and Interest in Secondary School Physics in Jos North Local Government Area of Plateau State, Nigeria.

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Abstract. The study investigated the Effects of Computer–assisted Instruction, (CAI) on Students' achievement and interest in Secondary School Physics in Jos North Local Government Area, Plateau State. This study was motivated because of the prevalence of poor students' performance in physics which was due to defective method of teaching used by teachers. The design used in this study was quasi-experimental design. Specifically the pretest posttest control group design. The sample of the study comprised of eighty five (85) SS2 physics students in Jos north local government area of plateau state Nigeria. Three research questions and four hypotheses were formulated to guide the study. Two instruments namely physics achievement test (PAT) and physics interest questionnaire (PIQ) were used to collected data for the study. The PAT consisted of 40-items which is developed based on the concept of units and measurements, motion, vectors, projectile and simple harmonic motion while PIQ consisted of 16-items. The two instruments were validated by two experts a Prof. of physics education from the department of science and technology education university of Jos and a senior lecturer from Test and Measurement Unit in the Department of Educational Foundation all in the University of Jos. The reliabilities of the two instruments PAT and PIQ was computed and the indexes stood at 0.85 and 0.88 respectively. Data collected for the study were analyzed with the used of simple percentages, t-test and analysis of variance (ANOVA) using SPSS version 22. The findings of the study revealed that the use of CAI helped in enhancing students' achievement in physics, helped in improving students interest in physics. The findings also showed that conventional lecture method does not help in enhancing students' achievement in physics. The results of the hypotheses tested revealed that there was significant difference between the mean achievement scores of posttest and the mean achievement scores of pretest of experimental group, There was no significant difference between the pre-test and posttest physics achievement mean scores of students in control and the experimental groups, There was no significant difference between the post-test achievement mean scores of the experimental group and There was no significant difference between the pretest and posttest physics achievement scores of male and female in the experimental group. The study then recommended among others that workshops should be organized for physics teachers so as to educate them on the use of computer assisted instruction. These workshops should be held periodically for freshly recruited teachers.

Keywords: Physics, Computer-Assisted Instruction, Achievement and Interest.

1. Introduction

Physics is a natural science that involves the study of the properties of matter, energy and motion. It is also a natural science that deals with the practical application of laws and principles of science concepts. The application of physics via technology is crucial for providing the infrastructural resources needed by a nation. In October 2005, stakeholders, including physicists, met in South Africa to consider the role physics plays in generating sustainable future for developing countries in Africa. This clearly shows the relevance of physics for the economic development of all nations. Physics being the most basic of sciences, its concepts and techniques underpin the progress of all other branches of science. For instance, thorough understanding of quantum mechanics is necessary for chemists and material scientists to understand the structure of an atom in the universe (Mankilik & Josiah, 2013).

According to Boyo (2010) physics is becoming increasingly inter-disciplinary, as physicists work with experts in other fields to understand and solve a wide range of problems confronting the society. This mean that physics being a cross-cutting discipline has industrial applications in many sectors of the economy such as health, energy, agriculture, water as well as information and communication technology. However, despite the contributions of physics to the society, the performance of secondary school students in science generally and Physics in particular keeps declining. Also over the years, performance in Science subjects including physics has been dwindling. Samuel (2015) found that in 2002, 2003 and 2004 the percentages of candidates who passed West African School Certificate Examination (WASCE) at credit level and above (grades 1-6) in physics were 30.3%, 42.1% and 30.2% respectively. The implication of this persistent poor performance of students in Physics is that a great percentage of them fail to get grades that will take them to higher institutions for studies. This has been a source of concern to well-meaning Nigerians, parents, researchers and science educators. Thus, researchers in science education in Nigeria have continued to seek for ways of improving the situation and maximizing meaningful learning of Physics by the students. This poor performance in physics has been attributed to the used of defective methods of teaching. This calls for the use modern technologies like computer to improved the teaching and learning of physics.

The development of computer technologies has totally changed the methods of teaching and learning. In this present era, programmed instructions were introduced and different learning theories were presented through different programs. The computer assisted instruction, which is the most advanced and sophisticated form of programmed instructions, was introduced in the education systems which make tremendous changes in the teaching and learning process. Researches conducted on the use of Computer-Assisted Instruction (CAI) in different parts of the world have indicated that it helps in students' achievement. Computers are the most pretty and valuable gift of science and technology to mankind. It has made miracles in almost all aspects of life. In the present era, there is no corner of human life which remained untouched by the computer. Just like other fields of life, computers are used in education discipline in different ways including the actual work of teaching. Computer Assisted Instructions are types of instructions with the help of computers, which are one step in advance in the use of teaching machines. Computer is one step ahead of other teaching machines because it can perform more and multiple tasks as compared to teaching machines like Information and Communication Technology (ICT). The CAI is not the use of Microcomputer in education but it is the type of instructions in which course contents are provided to the learner at their own pace that is a learner-centered and activity-based. The CAI is an interactive system in which students can gain according to their own abilities and skills (Mangal & Mangal, 2011).

Conventional teaching is concerned with the teacher being the controller of the learning environment. Power and responsibility are held by the teacher and they play the role of instructor (in the form of lectures) and decision maker (in regards to curriculum content and specific outcomes).

Interest is often thought of as a process that contributes to learning and achievement. That is, being interested in a topic is a mental resource that enhances learning, which then leads to better performance and achievement. Research has demonstrated that both situational and individual interest promote attention, recall, task persistence, and effort (Gilbert, 2006). In their meta-analysis of over 150 studies that examined the relationship between interest and performance. Benson (2001) found that individual interest was correlated with both academic and laboratory performance (rs = 0.31 and 0.27, respectively). From this perspective, then, interest appears to play a very important role in learning and academic achievement.

Researchers over the years have shown that there is gender difference in terms of performance in physics. For example, Orji (2002) found out that "boys clearly perform better than girls in Physics examinations". Based on the issues identified, this study was designed to investigate the effect of Computer Assisted Instruction (CAI) on Students' Achievement and Interest in Secondary School Physics in Jos North Local Government Area, Plateau State.

2. Statement of the Problem

There are a lot of challenges facing teaching and learning of physics among Nigerian secondary schools. Some of the challenges according to Orji (2002) include poor performance in Physics, shortage of science teachers in quality and quantity, inadequate laboratory equipment and facilities, poor motivated teaching strategies and shortage of suitable Physics textbooks. Pilli (2008) observed lack of interest in physics by students due to preconceived ideas that physics is a difficult subject has affected the enrolment and performance of students in physics. Deleon (2005) conducted a research on the relationship between classroom control and students' performance; his findings revealed that teachers who are sufficiently equipped with strategies that assist in classroom control adequately would automatically enable the students have full concentration and lead to positive academic performance of the students.

Currently, there is problem of low achievement among Nigerian secondary school Students particularly in Physics. Underachievement is a greater problem from the economic and social point of view because it involves wastage of human and economic resources. It is also a problem from the learner's point of view as it causes emotional unrest and psychological tension. The problem of underachievement is linked to some other serious problems in the education system such as the lack of interest of students in the learning process. Osuagwu (2011) reported that the breakdown of May/June SSCE 2010/11 examination reveals the poor performance of students in WAEC and NECO exams in recent time has resulted in an average failure rate of 72 per cent, 74per cent, 74 per cent and 75 per cent in 2008, 2009, 2010 and 2011 respectively. The implication is that little or no learning of concepts takes place in the lives of the learners. This trend has been attributed mainly to the ineffective methods of teaching employed by physics teachers when teaching physics. Research indicates that the conventional method of teaching identified as being ineffective, is still being employed in teaching physics instead of Information Computer Technology (ICT) which is learner friendly (Boyo,2010). There are many reasons for the low achievement in physics but experts suggest that the main reason is that physics is taught with the autocratic strategies (conventional method) and new methods of teaching physics such as CAI are totally rejected. This situation calls for a change in the teaching method of physics. The Computer assisted instructions are the modern teaching methods identified in literature. This can help improve students' learning and also help in promoting students interest in physics. Despite the relevance of CAI in promoting teaching and learning of physics, researched on the use of computer assisted instruction seems to be limited in Jos North Local Government Area of Plateau State. This problem prompted the researchers to investigate Effects of Computer-Assisted Instruction (CAI) on Students' Achievement and Interest in Secondary School Physics in Jos North Local Government Area of Plateau State, Nigeria.

3. Purpose of the Study

The aim of this study was to investigate the Effects of Computer-Assisted Instruction (CAI) on Students' Achievement and Interest in Secondary School Physics in Jos North Local Government Area, Plateau State. However, the specific objectives of this study were to:

(i) determine whether difference exists between CAI and conventional method on students' achievements in Physics.

(ii) find out whether students have interest in physics when taught using CAI.

(iii) determine the effect of CAI on students' achievement in physics, based on gender.

(iv) find out whether the students taught physics using CAI would achieve better than those taught physics using conventional method.

(v) ascertain the effect of CAI on students' interest in physics, based on gender.

4. Research Questions

The following research questions were formulated to guide the study:

- What are SS2 students' levels of Achievement in physics before and after exposure to computer-assisted instruction (CAI)?
- What are the levels of SS2 students' interest in physics before and after exposure to computer-assisted instruction (CAI)?
- What are SS2 students' levels of Achievement in physics before and after exposure to conventional teaching method?

5. Hypotheses

The following hypotheses were formulated and tested at .05 level of significance:

- There is no significant difference between the pre-test and post-test achievement mean scores of experimental group.
- There is no significant difference between the pre-test and post-test physics achievement mean scores of students in control and the experimental groups.
- There is no significant difference between the post-test achievement mean scores of the experimental group.
- There is no significant difference between the pretest and posttest physics achievement scores of male and female in the experimental group.

6. Scope of the Study

This study would be limited to two public secondary schools in Jos North Local Government Area of Plateau State. The choice of these schools was because the schools have insufficient instructional materials and physics teachers. Beside, these schools were equipped with latest computer facilities and the principals of these schools showed their enthusiasm in the study and offered their willingness to facilitate the researcher. The study was limited to SS2 students. The researcher considered that the SS2 are those preparing for WAEC and NECO and they have covered some topics in physics. The study also focused on the concepts of motion, space and time.

7. Methodology

The research design for this study was Quasi-experimental research design, specifically, the non – randomized and non-equivalent control-group design. The actual population of the study comprised of 615 SS2 physics students. The sample of the study comprised of eighty five SS2 Physics students, two groups experimental and control group used in the study. This sample constitute of 13.82% of the entire population. This 13.82% is good enough for an experimental study of this nature. In this study, two instruments were used for data collection namely: Physics Achievement Test (PAT) and Physics Interest Questionnaire (PIQ). The Physics Achievement Test (PAT) which was developed based on WAEC/NECO syllabus in SS2 Physics Curriculum. The instrument was developed on the concepts of space, time, motion, simple harmonic motion and projectile. The Physics Interest Questionnaire (PIQ),

instrument consists of sixteen (16) items. This instrument was developed to find out the level of interest students have when teachers use CAI to teach those concepts. The instrument was validated based on content validity by two experts a professor of Physics Education from the Department of Science and Technology Education and the other from Test and Measurement Unit in the Department of Educational Foundations all in the University of Jos, Nigeria. The reliability co-efficient of the instruments was determined using K-R20 method and it was found to be 0.85 and 0.88 for PAT and PIQ respectively. The treatments were made within the periods of six (6) weeks after which the test (PAT) and (PIQ) was administered immediately with the assistance of the Physics teachers in the two schools. Descriptive and inferential statistics were used to answered and test the hypotheses stated in the study. The descriptive statistics used include simple percentages and mean while the inferential statistics used are t-test and analysis of variance (ANOVA).

8. Results

Research Question One

What are SS2 students' levels of Achievement in physics before and after exposure to computer-assisted instruction (CAI)?

Table 1: Analysis of SS2 Students Achievement in Physics Before and After Exposure to CAI

Achievement Level	Range Scores in %	Before N	%	After N	%
High	60 - 100	-	-	38	80.85
Moderate	45-59	30	63.83	9	19.15
Low	0-39	17	36.17	-	-

The analysis in Table 1 shows that Before students were expose to CAI non were at high Achievement level, but after the exposure to CAI 38 students representing 80.85% moved to high level. Before exposure 30 students representing 63.83% were at moderate Achievement and only 9 students representing 19.15% moved to moderate Achievement level. Before exposure 17 students representing 36.17% were at low Achievement level but after exposure to CAI none moved to low Achievement level. This implies that CAI helped in enhancing students' achievement in physics.

Research Question Two

What are the levels of SS2 students' interest in physics before and after exposure to computer-assisted instruction (CAI)?

Table 2a: Analysis of SS2 Students Interest in Physics Before Exposure to CAI

S/N	Statement	Before		Total	□	Remarks
		HI(4)	HNI(3)			
1.	Teaching physics using CAI Have interest makes it interested	164	18	182	3.87	Have interest
2.	I become motivated in physics when my teacher uses CAI.	136	39	175	3.72	Have interest
3.	the way my teacher uses audiovisual makes me like the subject	88	75	163	3.47	Have no interest
4.	I enjoyed the teaching of my teacher when he uses CAI	132	42	174	3.70	Have interest
5.	The use of CAI as a teaching method by my teacher makes me understand the subject.	128	45	173	3.68	Have interest
6.	Teaching physics using CAI makes me busy, I have interest in the subject.	136	39	175	3.72	Have interest
7.	Teaching physics using CAI help me to remember very well	132	42	174	3.70	Have interest

8.	using CAI help to cover topics on time	132	42	174	3.70	Have interest
9.	my level of understanding rise up via teaching using CAI.	108	60	168	3.57	Have interest
10.	physics become very simple when my teacher uses CAI.	120	51	171	3.64	Have interest
11.	I am more interested in CAI because it involves the use of my five senses	116	54	170	3.62	Have interest
12.	When my teacher uses CAI I learn physics better.	128	45	173	3.68	Have interest
13.	The use of CAI by my teacher makes the class noisy that makes me hate the subject.	56	99	155	3.30	Have no interest
14.	Because of the activities involved when my teacher uses CAI, I dislike the subject.	40	111	151	3.21	Have no interest
15.	I learned very slowly when my teacher uses CAI.	44	108	152	3.23	Have no interest
16.	Physics become more difficult when my teacher uses CAI.	48	105	153	3.20	Have no interest

Table 2b: Analysis of SS2 Students Interest in Physics After Exposure to CAI

S/N	Statement	Before		Total	□	Remarks
		HI(4)	HNI(3)			
1.	Teaching physics using CAI Have interest makes it interested	172	12	184	3.91	Have interest
2.	I become motivated in physics when my teacher uses CAI.	168	12	180	3.83	Have interest
3.	the way my teacher uses audiovisual makes me like the subject	160	21	181	3.85	Have interest
4.	I enjoyed the teaching of my teacher when he uses CAI	160	21	181	3.85	Have interest
5.	The use of CAI as a teaching method by my teacher makes me understand the subject.	164	18	182	3.87	Have interest
6.	Teaching physics using CAI makes me busy, I have interest in the subject.	160	21	181	3.85	Have interest
7.	Teaching physics using CAI help me to remember very well	164	18	182	3.87	Have interest
8.	using CAI help to cover topics on time	168	15	183	3.89	Have interest
9.	my level of understanding rise up via teaching using CAI.	160	21	181	3.85	Have interest
10.	physics become very simple when my teacher uses CAI.	160	21	181	3.85	Have interest
11.	I am more interested in CAI because it involves the use of my five senses	168	15	183	3.89	Have interest
12.	When my teacher uses CAI I learn physics better.	164	18	182	3.87	Have interest
13.	The use of CAI by my teacher makes the class noisy that makes me hate the subject.	52	103	155	3.30	Have no interest
14.	Because of the activities involved when my teacher uses CAI, I dislike the subject.	40	111	151	3.21	Have no interest
15.	I learned very slowly when my teacher uses CAI.	44	108	152	3.23	Have no interest
16.	Physics become more difficult when my teacher uses CAI.	44	108	152	3.23	Have no interest

The analysis in Table 2a and 2b shows Before students were expose to CAI items 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12 have interest in physics with 3.50 and above mean scores while After exposure to CAI items 1-12 have interest in physics with 3.50 and above mean scores. However, before and after students were expose to CAI items 13-16 have no interest in physics with below 3.50 mean scores. This implies that CAI helped in improving students' interest in physics.

Research Question Three

What are SS2 students' levels of Achievement in physics before and after exposure to conventional teaching method?

Table 3: Analysis of SS2 Students Achievement in Physics Before and After Exposure to Conventional Lecture Method.

Achievement Level	Range Scores in %	Before N	%	After N	%
High	60 - 100	-	-	12	31.58
Moderate	45-59	17	44.74	26	68.42
Low	0-39	21	52.26	-	-

The analysis in Table 3 shows Before students were expose to Conventional lecture method non were at high Achievement level, but after the exposure to Conventional lecture method 12 students representing 31.58% moved to high level. Before exposure 17 students representing 44.74% were at moderate Achievement level and 26 students representing 68.42% moved to moderate Achievement level. Before exposure 21 students representing 52.26% were at low Achievement level but after exposure to Conventional lecture method none moved to low Achievement level. This implies that conventional lecture method does not help in enhancing students' achievement in physics when compared to CAI.

Hypothesis One

There is no significant difference between the pre-test and post-test achievement mean scores of experimental group.

Table 4: Analysis of Pretest and Posttest Students Achievement of the Experimental Group

Experimental Group	N	□	S	t-cal.	t-tab.	df	Decision
Pretest	47	41.02	9.48				Rejected Ho_1
Posttest	47	70.09	11.97	13.03	1.98	92	
Total	**94**						

$P < 0.05$

Table 4 indicates that the calculated t-value (13.04) was greater than the critical t-value (1.98) from table at 0.05 level of significance and 92 degree of freedom. This implies that there is significant difference between the mean achievement scores of posttest (70.09) and the mean achievement scores of pretest (41.02) of experimental group.

Hypothesis Two

There is no significant difference between the pre-test and posttest physics achievement mean scores of students in control and the experimental groups.

Table 5: Analysis of Variance (ANOVA) of Pretest and Posttest on Students Achievement of Control and Experimental Groups

Source of Variation	df	SS	MS	F-cal.	F-tab	Decision
Between	3	29884.19	9961.40			Rejected Ho_2
Within	166	15866.42	95.58	104.22	2.60	
Total	**169**	**45750.61**	270.71			

$P < 0.05$

From table 7 Since F-ratio (104.22) calculated was greater than F-ratio (2.60) from table at 0.05 level of significance and F(3,166) degree of freedom. The implication is that there was significant difference between the pretest and posttest physics achievement means score of students in control and the experimental groups.

Hypothesis Three

There is no significant difference between the post-test achievement mean scores of the experimental group.

Table 6: Analysis of Posttest on Students Achievement of the Experimental Group Based on Gender

Experimental Group	N	□	S	t-cal.	t-tab.	df	Decision
Male	23	70.26	11.99				Retain Ho_3
Female	24	69.92	12.72	0.09	2.01	45	
Total	**47**						

P < 0.05

Table 6 indicates the calculated t-value was 0.09 while the critical t-value from table was 2.01 at 0.05 level of significance and 45 degree of freedom. This implies that the mean achievement score in physics of male students (70.26) was not significantly different from the mean achievement score of female students (69.92) who were both taught using computer assisted instruction.

Hypothesis Four

There is no significant difference between the pretest and posttest physics achievement scores of male and female in the experimental group.

Table 7: Analysis of Variance (ANOVA) of Pretest and Posttest on Students Achievement Based on Gender

Source of Variation	df	SS	MS	F-cal.	F-tab.	Decision
Between	3	969965.49	323321.835			Rejected Ho_2
Within	90	60883.74	95.58	104.22	2.60	
Total	**93**	**1030849.23**	270.71			

P < 0.05

Table 7 indicates the calculated F-ratio was 447.94 while the critical F-ratio from table was 2.68 at 0.05 level of significance and F(3,90) degree of freedom. This implies that the mean achievement scores of pretest and posttest of male and female in the experimental group vary significantly different.

9. Discussion of Findings

The analysis in Table 1 shows before students were expose to CAI non were at high Achievement level, but of the exposure to CAI 38 students representing 80.85% moved to high level. Before exposure 30 students representing 63.83% were at moderate Achievement level and only 9 students representing 19.15% moved to moderate Achievement level. Before exposure 17 students representing 36.17% were at low Achievement level but after exposure to CAI none moved to low Achievement level. This implies that CAI helped in enhancing students' achievement in physics. The analysis in Table 2a and 2b shows Before students were expose to CAI items 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12 have interest in physics with 3.50 and above mean scores while After exposure to CAI items 1-12 have interest in physics with 3.50 and above mean scores. However, before and after students were expose to CAI items 13-16 have no interest in physics with below 3.50 mean scores. This implies that CAI helped in improving students' interest in physics. The analysis in Table 3 shows that before students were expose to Conventional lecture method none were at high Achievement level, but after the exposure to Conventional lecture method 12 students representing 31.58% moved to high level. Before exposure 17 students representing 44.74% were at moderate Achievement level and 26 students representing 68.42% moved to moderate Achievement level. Before exposure 21 students representing 52.26% were at low Achievement level but after exposure to Conventional lecture method none moved to low Achievement level. This implies that conventional lecture method does not help in enhancing students' achievement in physics when compared to CAI. This study is in agreement to the findings of Mankilik and Josiah (2013) who opined that students taught physics using CAI had better performance compared to their counterparts in conventional lecture method.

Hypothesis one was rejected on the basis of t-cal > t-tab. The hypothesis sought to find out whether or not difference exists between the pretest and posttest achievement mean scores of students who taught physics using CAI. The result showed that the mean scores of the students in the experimental group increased from pretest (41.02) to posttest (70.09). Hypothesis two was rejected on the basis of F-ratio calculated > F-ratio tabulated. The hypothesis sought to find out whether or not difference exists between the pretest and posttest physics achievement mean scores of students in control and the experimental groups. The result showed that the groups vary significantly different. Hypothesis thee was retain on the basis that t-cal < t-tab. This implies that the mean achievement scores in physics of male students (x= 70.26, S= 11.99) was not significantly different from the mean achievement score of female students (x= 69.92, S= 12.72). The finding (from Table 6) implies that there is no disparity between male and female students' performance, which leads to achievement and interest, when CAI is used as a method of teaching in the physics teaching and learning process. This finding is in line with the assertion of Madu (2004) that there is no gender disparity in science performance, provided that both genders are exposed to the same condition of teaching and learning. When computers and CAI packages are effectively used in teaching physics concepts learning will indeed, be enhanced, and subsequent achievement and interest in the subject will be improved. This observation is in consonance with (Stone, 1991) who conducted in his study that students learn better in classes where a form of computer is used for teaching.

10. Conclusion

The study investigated the effect of computer assisted instruction on students' achievement and interest in secondary school physics in Jos North Local Government Area, Plateau State. This was precipitated by the observed problem of defective methodology employed during interaction by teachers which result in low enrolment and poor performance of students in both internal and external examinations in physics. Furthermore, it provides evidence that the use of CAI promote students' achievement and interest in the classrooms. It also provides support for research studies that validate the use of CAI to facilitate students understanding and achievement towards physics. The result of the study showed that the achievement level of both experimental and control groups of students before treatment were low and there was no significant difference in the achievement of physics concepts. The result further showed that students taught using CAI performed significantly better than their counterpart taught with conventional lecture method. Furthermore, the result of this study revealed that gender had no any effect on the achievement of students taught using CAI, this by implication indicate that CAI promote equal learning opportunities for students in physics. This study had equally found that students level of achievement depends to a large extend on their level of interest and motivation. This is because students who had interest achieved high in physics.

11. Recommendations

In the light of the finding of this study, the following recommendations are made:

- Workshops should be organized for physics teachers so as to educate them on the use of computer assisted instruction. These workshops should be held periodically for freshly recruited teachers.
- Fresher courses for old teachers are suggested for them to keep them acquainted with new innovations.
- Physics teachers should Endeavour to adopt computer assisted instruction method of teaching and learning as their prevalent teaching method.
- Physics students should have access to computers to help them utilize the computer assisted instruction software for effective learning of physics concepts.
- Computer assisted instruction laboratories for the purpose of science teaching and learning should be provided in every secondary school where science subjects are taught. Such

laboratories should be stocked with sufficient computers and subject computer assisted instruction software so as to provide conducive learning environment and for an effective computer assisted instruction implementation.

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