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Effects of Reflective Discussion Strategy on the Academic Performance of Senior Secondary Physics Students of Jos Metropolis of Plateau State.

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ABSTRACT: This research examined the Effects of reflective discussion strategy on the academic performance of senior secondary physics students of Jos metropolis of Plateau State.Nigeria. The purpose of the study are to determine the mean performance score of SS II students taught with reflective discussion strategy and those taught using normal conventional method, determine the mean performance score of male and female SS II students taught with reflective discussion strategy, compare and evaluate the academic performance and learning outcomes of students who have been exposed to the reflective discussion teaching strategy with those taught using conventional teaching method and investigate whether there are any statistically significant gender-based differences in the effectiveness of the reflective discussion teaching strategy, focusing on learning outcomes and engagement. Four research questions and two null hypotheses were generated to guide the study. The design of the study was a descriptive survey research design. The study population comprised two (2) Senior Secondary Schools in Jos North LGA of Plateau State. The sample for the study constituted two senior secondary schools randomly selected out of the sixty-four (64) secondary schools in the study area. Simple random sampling technique was used to select sampled students, where twenty-six (26) and twenty-seven (27) students respectively formed the control group taught with conventional lecture method and the experimental group taught using reflective discussion strategy. The instrument used to collect data was the Physics Performance Test (PPT). Descriptive statistics such as mean and standard deviation was used to answer the research questions, while inferential statistics which was independent sample t-test was used to test the hypotheses at 0.05 level of significance. There was no significant difference between the performance scores of male and female students taught Physics with the reflective discussion strategy. This implies that gender does not influence students' performance. There was a significant difference between the performance scores of students taught Physics using conventional methods and those taught using the reflective discussion strategy. The results of our study clearly demonstrate that the reflective discussion strategy led to significantly better learning outcomes compared to the conventional method of teaching. Reflective discussions encourage students to actively participate in the learning process, critically analyze information, and apply their knowledge, which can enhance their understanding and retention of the material. These findings emphasize the importance of innovative teaching strategies that foster student engagement and participation in the classroom.

KEYNOTES: REFLECTIVE DISCUSSION STRATEGY, AND PERFORMANCE

I. INTRODUCTION

Physics is the study of matter and the movement of that matter through the space and time of the universe. It is one of the fundamental sciences and covers a huge range of subjects. Physics is a science subject that students often find very difficult and this is why students always have low performance in the subject. According to Aina and Akintunde (2016) students usually perform very poorly in Physics in all levels of education. One major reason for this poor academic performance might not be separated from the abstract nature of the course as observed by Adeyemo (2015). The teaching of Physics in schools has not been encouraging due to this abstract nature of the subject that is why the use of discussion method is needed to facilitate students' learning of Physics. Physics is an important and fundamental branch of science that seeks to understand the behaviour of matter and energy in the universe. In technology, Physics has played a critical role in developing many modern technologies such as computers, smartphones, lasers, GPS, and medical equipment. By understanding the fundamental principles of the universe, physicists have been able to develop new materials, technologies and applications that have transformed our lives. Physics is essential for understanding energy and its many forms such as thermal, kinetic, and potential energy. This knowledge has led to the development of renewable energy sources such as wind, solar, and hydroelectric power as well as new energy storage technologies. Physics has also had a major impact on medicine from the development of X-rays and MRI machines to the use of radiation therapy to treat cancer.

Physics principles are used to study the mechanics of the human body, the Physics of fluids and gasses, and the behaviour of electromagnetic waves in biological systems. Physics plays a critical role in space exploration by helping scientists to understand the behavior of celestial bodies, the nature of dark matter and dark energy and the principles of rocket propulsion. In environmental science, Physics is also important for studying the environment including climate change, atmospheric science and the behaviour of natural phenomena such as earthquakes and volcanoes. Reflective Discussion strategy encourages the students to learn on their own without constant help from the teacher. It encourages students to think and talk about what they have observed, heard or read (Callutheran, 2017).

The author held that a teacher or student initiates the discussion by asking a question that requires the students to reflect on an internet, film, experiences, read or recorded stories or illustrations. The author explained that as students question and recreate information and events or story, they clarify their thoughts and feelings. Students need to possess more than just knowledge and skills; they need to know how to learn, how to enable learning, to be self-aware and self- critique, to construct their own meanings and perspectives, as well as to consider contexts and experiences in light of learning. 'Masella, 2011; Dall'Alba, 2019; Tsang, 2015; Tsang, 2017 upheld reflective discussion strategy of teaching and added that teaching for imparting knowledge and skills is no longer adequate, rather it is "teaching to enable learning" that must be employed. The Author added that reflective discussion helps students to achieve better result in Physics as it deals with the process of teaching and learning whereby students are made to work together in small groups to maximize their own and each other's learning towards achieving shared leaning goals. Therefore, carrying out this study on introductory Physics would help according to Eze (2019). Poor teaching methods like rote memorization, expository teaching, drilling of students, and lecture methods, which prevail in teaching Physics should be avoided or minimized by teachers for academic performance of students in Physics to improve. Eze further said expository or lecture method, is teacher-centered. This problem can be curbed if students are given the opportunity to learn Physics using reflective discussion strategy which is child-centered or learner- friendly (Bot & Nwamaka, 2014).

For an excellent academic performance, any teaching method that employs reflective discussion, according to Wustl (2018) is more rewarding. The author stressed that using reflective discussion strategy allows the student to think critically. Wustl further says that teachers establish rapport with their students, they can demonstrate that they appreciate their contributions at the same time challenge them to think more deeply and to articulate their ideas more clearly. Wustl held that frequent questions whether asked by the teacher or by the students, provide a means of measuring learning and exploring in-depth the key concepts of the course. Beer and Probst (2012) stated that when students are taught using reflective discussion strategy they are engaged. When they are active constructors of their knowledge, then they are likely to take ownership, to discover relevance, and to ask why not. They are more likely to feel inspired when they count more of their answers. Studies on academic performance have shown that student's performance is not only a function of their cognitive ability but can also be influenced by factors like gender, school type, school facilities, class size among others. However, this study intends to examine the effect of reflective discussion strategy on students' academic performance in Physics in relation to gender. This is because studies have found that gender is one of the variables which affects students' academic performance in different areas of human learning. Studies Mkpanang (2016), Mcphee Bates and Donnelly (2011) found that boys performed better than girls in Physics. These are at variance with the findings of Ogunleye and Babjide (2011) who obtained a non-significant difference in the academic performance of male and female students in Physics. In view of the conflicting findings, it becomes imperative for more research to find out exactly the effect of gender on students' academic performance in Physics as a result of reflective discussion strategy. However, the researcher is not aware of any research on effects of reflective discussion strategy on students' academic performance in Physics in Jos North L.G.A of Plateau State, hence the need for this study.

II. STATEMENT OF THE PROBLEM

The aim of Physics in senior secondary school is to prepare students to acquire basic literacy in Physics for functional living in the society as well as stimulating and enhancing creativity, acquiring essential skills and attitude as preparation for technological application of Physics. It will also leverage them to read courses like engineering astronomy, geography computer sciences among others. Students' performance in West Africa Senior Secondary Certificate Examination (WASSCE) and Senior Secondary Certificate Examination (SSCE) in physics has remained poor over the years. The West African Examination Council (WAEC) and National Examination Council (NECO) Chief Examiners' Reports (WAEC and NECO 2015-2021) showed that only 31% in 2015 and 2016, 25% in 2017, 43% in 2018 and 2019, 57% in 2020 and 37% in 2021 got at least credit pass in the subject while the rest failed.

These frustrated results in sciences particularly in physics created concern as each falling below 45% except 2020 even with the desire for students, parents and educators to achieve higher academic success. The Chief Examiners Report of WAEC (2015) paper 2 indicated that student's performance was lower as compared to the previous years. He stated that most of the candidates were unable to: relate the principle of latent heat of vaporization to the preservation of tomatoes in most jute bag, differentiate between loudness and intensity, explain why ships are usually refilled with sand and water after they are emptied off their cargo, state the reason why horizontal component of the velocity of a projectile remains the same at every point of its flight, explain the significance of de-Broglie wave equation. The performance of the candidates was slightly better than that of the same examination in 2014. Candidature of 658,393 recorded a raw mean score of 19 and a standard deviation of 09.90 as against a raw mean score of 16 and a standard deviation of 08.77 recorded in the May/June 2014 WASSCE with a candidature of 685,669.Categorically speaking, all the concepts pointed out could have been achieved if only there was more room for reflective discussion strategy of teaching, that way the students will relate what was theoretically stated into a more practical and realistic application. It was also clear that some of the concepts pointed out were not far from SS II concepts and partly SS III concepts.

Having stated the areas of weakness The Chief Examiner went further to suggest remedy for the weaknesses in students. One important point he captured was the suggestion for teachers to demand for explanations to enable candidates apply fundamental principles of Physics. This can only be achieved if the teacher employs the reflective discussion strategy of teaching. The Chief Examiner also suggested that teachers should attend coordination meetings to improve their teaching method. This is not also far from adopting the reflective discussion strategy of teaching. Against this background, there is a need to search for a new teaching method that will likely enhance students' performance in Physics. The new teaching method that was hoped to benefit student learning in Physics is reflective discussion strategy. Since there are no studies conducted involving the use of reflective discussion strategy in Physics in Jos North, this study tends to investigate the effect of reflective discussion strategy on students' performance in Physics among Senior Secondary II students of Jos North Local Government Area of Plateau State.

PURPOSE OF THE STUDY

The main objective of this study is to examine the effects of reflective discussion strategy on students' performance in Physics in Jos North. Specifically, the study intends to:

1. determine the mean performance score of SS II students taught with reflective discussion strategy and those taught using normal conventional method.
2. determine the mean performance score of male and female SS II students taught with reflective discussion strategy.
3. compare and evaluate the academic performance and learning outcomes of students who have been exposed to the reflective discussion teaching strategy with those taught using conventional teaching methods.
4. investigate whether there are any statistically significant gender-based differences in the effectiveness of the reflective discussion teaching strategy, focusing on learning outcomes and engagement.

RESEARCH QUESTIONS

The relevant research questions related to this study are:

1. What is the mean performance score of SS II students taught with reflective discussion strategy and those taught using normal conventional method?
2. What is the mean performance score of male and female SS II students taught with reflective discussion strategy?
3. What is the academic performance of students who have been exposed to the reflective discussion teaching strategy compared to those taught using conventional teaching methods?
4. Are there any statistically significant gender-based differences in the effectiveness of the reflective discussion teaching strategy while focusing on learning outcomes and engagements?

RESEARCH HYPOTHESES

1. There is no significant difference between the mean performance score of SS II students taught with reflective discussion strategy and those taught using normal conventional method.
2. There is no significant difference between the mean performance score of male and female SS II students taught with reflective discussion method?

III. METHODOLOGY

This study employed the quasi-experimental research design. The design was considered appropriate for the study because it aimed to establish a cause-and-effect relationship between an independent and dependent variable. It involved getting data from two groups of students, that is the experimental group and the control group. A pretest was given to both groups before any treatment was administered so as to determine students' entry behavior. After treatment had been administered, a post-test was then given to both groups. The aim of this design was to compare the scores of the two selected schools in Jos North Local Government Area. The population of the study consisted of all senior secondary schools in Jos North Local Government Area of plateau state. Jos North had a total number of ninety-four (94) senior secondary schools, sixty-eight (68) were privately owned and twenty six (26) were public schools, and all SS II students offered Physics in the study area. This gave a total estimate of about 5,238 students in the locality.

The sample for the study constituted of two senior secondary schools randomly selected out of the sixty-four (64) secondary schools in the study area. Simple random sampling technique was used for the sample selection. Using simple random sampling techniques, every member of the group had an equal chance of being selected as a member of a sample of the groups. GSS Nassarawa and GSS Kyan Rikkos were chosen from eight schools using a simple random technique. The sample size consists of twenty-six (26) and twenty-seven (27) students respectively from the two mixed schools in Jos-North education zone representing fourteen (14) males and twelve (12) females from the first school, and fourteen (16) males and eleven (11) females from the second school that was sampled.

Table 1: Schools Sampling Frame for Secondary Schools in Jos North LGA

S/N	School	Sample	Male	Female
1.	A	26	14	12
2.	B	27	16	11
	Total	53		

Simple random sampling technique was used for the sample selection. Using simple random sampling techniques, every member of the group had an equal chance of being selected as a member of a sample of the group. Some criteria used in selecting schools was based on: School infrastructure, well equipped laboratory equipment for practical and experimental analysis. School had presented students for external examinations like the West African Examination Council, NECO etc. School had a population of at least 25 students in sciences. The instrument for data collection that was used in this study is Physics Performance Test (PPT).. The Physics Performance Test (PPT) was divided into two (2) sections namely; A and B. Section A was called students bio data which consisted of the name of school, class and gender of the students. Section B consisted of fourty (40) objective test items. Each item had four (4) options A, B, C and D. 100 marks was allocated (that is, 2.5 marks for each objective question). Fifty-three (53) copies of the test items was produced. Physics Performance Test (PPT) was developed from the topic "Projectiles" for the study based on Physics curriculum and past WAEC/NECO examination. PPT was used to measure the performance of students in both pre-test and post-test.

In the course of this research work, Experimental Group (EG) and the Control Group (CG) were pre-tested using Physics Performance Test (PPT) to ascertain their group equivalence on the level of understanding of the research topic at the start of the study. Students from the experimental group were taught using the reflective discussion strategy of teaching while the control group the same concepts were taught using the normal conventional method of teaching for a period of four weeks. After the treatment both groups were post-tested using the same instrument, which was reshuffled to make it look different. The mean scores of the two groups collected were subjected to independent t-test statistics to determine their Performance level for all research hypotheses.

IV. RESULTS

Research Question One: What is the mean performance score of SS II students taught with reflective discussion strategy and those taught using normal conventional methods?

Table 2: Summary of Mean Performance Scores and Standard Deviation of Students in Experimental and Control Groups

Groups	N	Pre-test		Post-test		Mean Difference
		Mean	S.D	Mean	S.D	
Control	26	45.77	7.641	51.63	7.174	5.86
Experimental	27	49.72	6.443	59.07	6.904	9.35

Table 1 shows the mean performance scores of students thought with normal convectional method (control group) and the reflective discussion strategy (experimental group). At pre-test and post-test, the control group obtained a mean score of 45.77 and 51.63 respectively, while the experimental group obtained a mean score of 49.72 and 59.01 respectively. The mean difference of the control group was 5.86 while the experimental group had a mean difference of 9.35. Therefore, this shows that use of reflective discussion strategy in teaching Physics concepts better improves students' achievement.

Research Question Two : What is the mean performance sore of male and female SS II students taught with reflective discussion strategy?

Table 3: Summary of Post-test Mean performance scores of Male and Female students in Experimental group

Gender	N	Mean	S.D	Mean Difference
Male	16	60.62	7.932	
Female	11	56.82	4.485	3.8
Total	**27**			

Table 2 reveals the mean performance scores of Male and Female students of the experimental group at post-test. The males obtained a mean score of 60.62 while the Females obtained a mean score of 56.82. From the above results the mean difference obtained was 3.8 which is a relatively high mean score that indicates there is a relatively high performance score of male and female SS2 students taught with reflective discussion strategy alone.

Research Question Three : What is the academic performance of students who have been exposed to the reflective discussion teaching strategy compared to those taught using conventional teaching methods?

Table 4: Summary of Academic performance of Students exposed to reflective discussion teaching strategy compared to Conventional teaching methods

Groups	N	Pre-Test		Post-Test		Mean Difference
		Mean	S.D	Mean	S.D	
Control	26	45.77	7.641	51.63	7.174	5.86
Experimental	27	49.72	6.443	59.07	6.904	9.35

The results of the analysis from table 3 shows that students (male and female) exposed to reflective discussion teaching strategy had a mean of 59.07 at post-test, while students exposed to conventional teaching methods had a mean of 51.63. Congruently, students exposed to reflective discussion teaching strategy had a higher mean than the students exposed to conventional teaching methods. This further means that the academic performance of students is relatively affected by reflective discussion teaching strategy compared to the conventional teaching methods.

Research Question Four : Are there any statistically significant gender-based differences in the effectiveness of the reflective discussion teaching strategy while focusing on learning outcomes and engagements?

Table 5: Summary of Post-test Gender-based Differences in the Effectiveness of the Reflective Discussion Teaching Strategy while Focusing on Learning Outcomes

Gender	N	Mean	S.D	Mean Difference	S.D Error Mean
Male	16	60.62	7.932		1.982
				3.8	
Female	11	56.82	4.485		1.353
	27				

The Table above shows the gender-based differences in the effectiveness of the reflective discussion teaching strategy while focusing on learning. The table reveals that males exposed to reflective discussion teaching strategy while focusing on learning outcomes had a mean of 60.62 and a standard deviation of 7.932 while females had a mean of 56.82 and standard deviation of 4.485. From the above results the mean difference obtained was 3.8 which shows a very significant difference in the performance score and it therefore implies that the male understood the reflective discussion strategy of teaching better than the females as proven from the learning outcomes.

Hypothesis One : There is no significant difference between the mean performance score of SS II students taught with reflective discussion strategy and those taught using normal convectional method.

Table 6: Summary of t-test Analysis of Post-test Mean Performance Scores of Experimental and Control Group

Groups	N	Post-test		Df.	t-cal	p-value	Decision
		Mean	S.D				
Control	26	51.63	7174				
				51	3.85	0.001	Significant
Experimental	27	59.07	6.904				

Table 3 shows the difference between the mean performance scores of students in control (taught using the conventional method) and experimental (taught using the reflective discussion strategy) group at post-test. From the table above the control group obtained a mean performance score of 51.63 while the experimental group obtained a mean performance score of 59.07. The table further revealed that the calculated t value is 3.85 and a significant value of 0.001 which is less than the p value of 0.05. Therefore, the null hypothesis is hereby rejected. This implies that there is a significant difference between the post-test mean performance scores of the experimental and control group in the senior secondary schools of Jos North L.G.A, Plateau State.

Hypothesis Two : There is no significant difference between the mean performance score of male and female SS II students taught with reflective discussion strategy?

Table 7: Summary of Post-test Mean Performance Score of Male and Female Students of Experimental Group

Gender	N	Mean	Df	t_{cal}	p-value	Decision
Male	16	60.62				
			25	1.44	0.163	Significant
Female	11	56.82				
Total	**27**					

From Table 4 above the mean performance scores of male and female students are 60.62 and 56.82 respectively. The table further revealed that the calculated t value (t-cal) is 1.44 with a significant value (p-value) of 0.163 which is greater than the p value of 0.05. The hypothesis is hereby accepted. This implies that there is no significant difference between the post-test mean performance scores of male and female students taught using

The reflective discussion strategy (experimental group) in senior secondary schools of Jos North L.G.A, Plateau State.

V. DISCUSSION

The aim of this study was to examine the effects of the Reflective Discussion Strategy on students' performance in Physics in Jos North of Plateau State. The findings on research question one revealed that students taught using reflective discussion strategy achieved better than those taught with normal conventional method. The results of our study clearly demonstrate that the reflective discussion strategy led to significantly better learning outcomes compared to the conventional method of teaching. This aligns with the study of Smith (2012) who stressed the effectiveness of the reflectiveness discussion strategy and also it aligns with the work of Brookfield & Preskil (2015), who highlighted that one of the most challenging teaching methods which is leading discussion, can be one of the most rewarding, he highlighted this because, it gives the students the room to think critically. Reflective discussions encourage students to actively participate in the learning process, critically analyze information, and apply their knowledge, which can enhance their understanding and retention of the material. These findings emphasize the importance of innovative teaching strategies that foster student engagement and participation in the classroom.

From the findings on research question two, interestingly, our study found no significant difference between male and female students when taught using the reflective discussion strategy. This result contradicts some earlier studies that reported gender-based variations in learning outcomes (Stoet & Geary, 2013). The absence of a gender effect in our study suggests that the reflective discussion strategy is equitable and equally beneficial for both male and female students. This is a positive outcome as it promotes inclusivity and removes potential gender-based disparities in the learning environment. In terms of learning outcomes according to research question three, the significant difference observed between the reflective discussion strategy and the conventional teaching method underscores the potential of active learning strategies in enhancing education. Educators should consider incorporating reflective discussions into their teaching practices to promote student engagement and improve learning outcomes. These findings have practical implications for curriculum development and pedagogical approaches, particularly in subjects where critical thinking and deep understanding are paramount. Research question four gives a positive response to the lack of a gender difference in the effectiveness of the reflective discussion strategy, highlighting the importance of promoting an inclusive educational environment that caters to the needs of all students, irrespective of their gender. This finding challenges stereotypes about gender-based variations in learning styles and abilities and emphasizes the importance of equal opportunities in education.

Findings based on hypothesis one revealed that there is a significant difference between the post-test mean performance scores of students taught Physics using conventional methods (control group) and those taught using the reflective discussion strategy (experimental group) as the mean score of the experimental group was higher than the control group. This finding agrees with empirical evidence from Abdu-Raheem (2016) which indicated that there was a significant difference between the academic performance of students who were taught using the reflective discussion strategy and those taught with the normal conventional method. Findings based on hypothesis two revealed that there is no significant difference between the post-test mean performance scores of male and female students taught Physics with the reflective discussion strategy (experimental group). This implies that gender does not influence students' performance. This disagrees with what Iweka (2016) and Obiekwe (2018) found as their studies revealed that there was a significant difference between the mean performance scores of male and female students. This implies that no conclusion has been reached on the performance of students based on gender in Physics, hence, the need for more studies. While this study sheds light on the benefits of the reflective discussion strategy, future research should delve deeper into the specific mechanisms through which this method enhances learning outcomes. Additionally, exploring other potential moderating factors, such as prior academic performance or cultural background, could provide further insights into the nuances of effective teaching methods. This research underscores the significance of the reflective discussion strategy in improving educational outcomes and demonstrates its equitable impact on both male and female students. These findings contribute to the ongoing discourse on pedagogical practices and emphasize the need for innovative teaching methods that prioritize student engagement and inclusivity in education.

The study examined the effects of Reflective Discussion Strategy on students' performance in Physics in Jos North. The study was aimed to achieve the following objectives:

1. determine the mean performance score of SS II students taught with reflective discussion strategy and those taught using normal conventional method.
2. determine the mean performance score of male and female SS II students taught with reflective discussion strategy.
3. to compare and evaluate the academic performance and learning outcomes of students who have been exposed to the reflective discussion teaching strategy with those taught using conventional teaching methods.
4. to investigate whether there are any statistically significant gender-based differences in the effectiveness of the reflective discussion teaching method, focusing on learning outcomes and engagement.

Four research questions and two hypotheses guided the study. Quasi-experimental research design was used for the study. The population of the study comprised 53 students from 2 schools within Jos North of Plateau State. The sample size of 2 secondary schools drawn from the population using simple random sampling technique was used. A pre-test and post-test was used to collect data. Data collected was analyzed using mean, standard deviation and t-test. From the analysis carried out on the research questions, the following were revealed that:

1. students taught using reflective discussion strategy achieved better than those taught with normal conventional methods.
2. male students performed better than female students in Physics.
3. student's mathematical scores predict their performance in Physics.

The following findings were made after testing the hypotheses:

1. There was a significant relationship between students' performance mean score in Mathematics and Physics.
2. There was a significant difference between male and female students when taught using the reflective discussion strategy.

VI. CONCLUSION

Based on the findings of this study, it can be concluded that the reflective discussion method alone cannot play a very pivotal role in the learning and comprehension of students. It also demonstrates an imbalance in the impact on both male and female students. These findings contribute to the ongoing discourse on pedagogical practices and emphasize the need for innovative teaching methods that prioritize student engagement and inclusivity in education.

RECOMMENDATIONS

In view of the findings of this study, the researcher hereby recommends that:

1. There should be an investigation on the long-term effects of the reflective discussion method on student learning outcomes. A longitudinal study could track students over several semesters or years to assess whether the benefits observed explore variations of the reflective discussion method. For example, compare it with other active learning approaches or hybrid methods to determine which is most effective in specific educational contexts or for different subject areas.
2. Schools should examine the impact of instructor training and proficiency in implementing the reflective discussion method. Investigate whether the effectiveness of this teaching approach is influenced by the instructor's pedagogical skills and experience.
3. The school should investigate how cultural factors may influence the effectiveness of the reflective discussion method. Explore whether the approach is equally effective in diverse cultural and educational settings, or if modifications are necessary to adapt it to different contexts.
4. The school and teachers should implement surveys, interviews, or qualitative assessments to gain insights into student perceptions of the reflective discussion method. Understand how students perceive their own engagement and learning experiences in this teaching approach.

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