

Effects of Mnemo-Tech on Performance in Plant Physiology Concepts among Secondary School Biology Slow Learners in Zaria Education Zone, Kaduna State, Nigeria

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Abstract

This study investigated the Effects of Mnemo-Tech on Performance in Plant Physiology Concepts among Secondary School Biology Slow Learners in Kaduna State, Nigeria. The study adopted a pretest, posttest and post-posttest quasi-experimental and control group design. The population in the 2024/2025 academic session comprised all 8,439 senior secondary school Biology students in Zaria Education Zone. A sample consisting of 172 students was randomly selected from two co-educational schools in Zaria Education Zone, of which 50 students who consistently scored below average in three consecutive examinations were identified and selected as the sample for the study. The Experimental Group was exposed to the Mnemo-Tech instructional strategy while the control group was taught using the lecture method. An instrument was used for this study, namely: Plant Physiology Performance Test, which was validated by four experts with a minimum qualification of PhD from the Department of Science Education and Department of Psychology of Ahmadu Bello University, Zaria. The reliability index for PPPT was calculated using Pearson's Product Moment Coefficient (PPMC) formula was used to compute the reliability of which was found to be 0.61. Two research Objectives, two Research Questions and two Null hypotheses were formulated to guide the study. Independent-samples t-test statistics were used to test the null hypotheses at a $P < 0.05$ level of significance. Findings, among others, revealed that there is a significant difference between the mean academic performance of slow learners taught Plant Physiology Concept using Mnemo-Tech with those taught same concepts using Lecture Method in favour of the experimental group. The observed difference is in favour of experimental group exposed to Mnemo-Tech, indicating that Mnemo-Tech was found to be more effective in improving students' performance in plant physiology among others. The researcher thus concluded that exposure to Mnemo-Tech was found to be helpful in enhancing students' performance and interest level in Plant Physiology. It was therefore recommended, among others, that Biology teachers should make use of Mnemo-Tech to teach plant physiology concepts in secondary schools in order to enhance their academic performance.

Keywords: Mnemo-Tech, Performance, Plant, Physiology, Biology, Slow Learners

Introduction

Biology is one of the science subjects that occupy a significant position in the senior secondary school curriculum. Muoneme (2015) defines Biology as a natural science concerned with the study of life and living organisms including their structure, function, growth, evolution, distribution and taxonomy. Umoh (2015) further defines Biology as a branch of science that is concerned with the characteristics and behaviour of organisms, how species and individual come into existence, and the interaction they have with their environment. Biology plays a vital role in providing knowledge of relevant concepts about living and non-living things and developing skills and attitudes. According to Olajide (2015), Biology is a practical subject which equips students with appropriate skills and concepts useful in solving day-to-day life problems. To further emphasize its significance, Abubakar (2017) had observed that Biology as a discipline has contributed tremendously to financial, physical and aesthetic benefits of humanity and to nation building. The areas of contributions of Biology include: Medicine, Aquaculture, Crime detection, Forestry, Genetic Engineering, Ecology, Parasitology, Biochemistry, Physiology, and Molecular Biology has made Biology subject to become a central focus in most human activities including solutions to the problem of food security, environmental pollution, population explosion, radiation, disease, health, hygiene, family life, poverty eradication, management and conservation of natural resources as well as Biotechnology and ethics to mention a few. The objectives of learning Biology at senior secondary school level

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include students having adequate laboratory and field skills in Biology in general and plant physiology in particular. Muoneme (2015) observed that teaching plant physiology at secondary schools in Nigeria has not been very impressive due to poor teaching instructional strategies used. Gali (2018) stated that the poor teaching strategies employed by a number of teachers affect the performance of the students in the subject. Dallatu (2019) observed that teaching Biology using teacher-centered strategy such as lecture method does not encourage the students to participate fully in the classroom activities and hence, students perform poorly in Biology concepts. In fact, the failure rate in Biology is even more alarming when compared with Chemistry and Physics despite its popularity among science students. Dallatu (2019) noted that, a review of students' enrolment in science subject at senior secondary schools level in Nigeria shows that more students register for Biology than any other science subject but their academic performance in the subject is comparatively lower at SSCE when compared with other science subjects. Over the years, the performance of students in Biology in public examination has been fluctuating. Nsofor (2019) observed that the low academic performance of students in Biology has been a major concern to parents, teachers, government and the general public. With reference to Nigeria, a recent analysis by the West African Examination Council (WAEC) Chief Examiner's Report from 2020-2025 revealed that only between 41-45% of students pass Biology At the national level annually. The low performance rate cuts across all states of the federation including Kaduna State where the percentage of students that failed Biology were higher than those who passed Biology at the credit level, only in 2019 that the percentage of students that passed Biology at credit level was higher than those who failed it. Tables 1 and 2 shows students' performance from 2020-2025 Nationally and in Kaduna State.

Table 1: WAEC Examination National Result for Biology from 2020-2025, Nigeria

Year	No Registered	No. with A ₁ -C ₆	% with A ₁ -C ₆	No with D ₇ -F ₉	% with D ₇ -F ₉
2020	863,729	345,492	40.01	518,237	59.99
2021	869,643	382,411	43.97	487,232	56.03
2022	742,567	329,624	44.39	412,943	55.61
2023	1,608,123	777,660	45.41	830,463	54.89
2024	1,737,707	864,234	43.48	873,473	56.52
2025	1,985,640	991,772	41.18	993,868	58.82

Source: West African Examination Council, (2025) Annual Report

Table 2: WAEC Examination Result for Biology from 2020-2025 in Kaduna State

Year	No Registered	No. with A ₁ -C ₆	% with A ₁ -C ₆	No with D ₇ -F ₉	% with D ₇ -F ₉
2020	188,880	88,390	46.45	90,398	53.55
2021	190,398	95,394	50.11	84,984	49.89
2022	199,253	81,325	40.35	98,928	59.65
2023	176,925	80,463	43.16	96,462	56.84
2024	178,473	81,345	46.33	97,128	53.67
2025	195,244	98,333	45.45	96,911	54.55

Source: West African Examination Council, Kaduna Office (2025)

The percentages of students that failed Biology were higher than those who passed Biology at Credit level. This continuous increase in low performance of students in Biology at WAEC has been attributed to the teacher-centred method of teaching employed by Biology teachers. The teachers' method of teaching, such as the lecture method, has been a major source of students' poor academic performance in Biology, which is one of the most common methods of teaching science in the secondary schools. According to Lawal (2015), this is a method of teaching which emphasises "talk and chalk" in the teaching of science subjects. According to her, more than 80% of the scientific information and principles are delivered as lectures because of easy coverage of the school syllabus. It is characterised by a one-way flow of information from the teacher who is always active to the students who are always passive. Obeka (2015) opined that the lecture method in its true nature is not effective for science teaching. Muoneme (2016) observed that the use of the lecture method of teaching in science teaching leads to rote learning, which consequently lead to missing essential part of science learning. However, this method of teaching should not be totally discouraged. However, this method of teaching should not be totally discouraged because it has its own place in the teaching and learning process. The secondary school students need technique

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that will enable them to acquire knowledge that will assist in better performance and retention competency such as Mnemonic. The “Word Menomonic” according to Mastropieri and Scruggs (2016) is derived from the Greek goddess of memory - Mnemosyne, and means “memory enhancing”. Mnemo-Tech are systematic procedures designed to improve the memory. The main idea of Mnemo-Tech is application in developing better ways to encode (take in) information, so that it will be much easier to retrieve (remember). Example of Mnemo-Tech that facilitate teaching and learning of Biology concept includes: King “Phillip, come out for goodness sake” it is a typical acrostic Mnemonics used for classifying of organisms such that, King stand for kingdom, ‘Phillip’ stand for phylum. ‘come’ stand for class, ‘out’ stand for order, ‘for’ stand for family, ‘goodness’ stand for genus and ‘sake’ stand for species”. ‘FARM B’ is used to remember the classes of vertebrate animals such as fish, amphibians, reptiles, mammals and birds. Other examples include, poem, puzzle, keywords easier and is related to their previous learning in the environment. They are fun, easy to learn and use as well as very economical in terms of implementation. Once they are taught to students, the students can use and adapt the tools for the rest of their lives to keep important information from slipping through their fingers. Levin (2017) asserted that Mnemo-Tech has been shown to significantly aid in recall, retention and understanding throughout the curriculum of science, social science, mathematics, language arts and foreign languages. Use of Mnemo-Tech is a highly effective way to help students with and without learning disabilities to recall and retrieve new information taught. Its use has been promoted as a way to assist especially those students with learning difficulties such as slow learners. Such learners often fail to develop knowledge, skills, and self-regulation necessary to succeed in key subject areas, and teachers do not take cognisance of this problem in their classroom (Usman, 2015). The mere total negligence of slow learners has been considered responsible for their poor academic performance in Biology.

Slow learners are a set of students who are generally slow in learning and backwards in retention ability. According to Singh (2024), slow learners are those students whose cognitive abilities are below average. This is to say that their learning abilities are generally slow, and they are learners who are not disabled but trying to cope with their academic studies. Shaw, Grimes and Bulman (2025) also see slow learners as students who learn more slowly than their peers, yet they do not have disability requiring special education. Graffin (2018) observed that slow learners are those who fail to learn at the same rate as the majority of other pupils learn, whose failure cannot be explained by the presence of any handicap condition, even if such a condition is present in such a learner. Slow learners is a mild word for “backward” or mentally retarded and educationally subnormal, which is due to their background, mental ability, illiterate parents, culture problem, avoidance of parents in early childhood; sometimes, mental illness causes slow learning (Khan, 2018). Several factors may account for slow learning in Biology. Shiyabade (2021) listed a good number of them, which include: lack of emotional growth, lack of a secure environment, limited opportunities for learning, absenteeism from school, untrained teachers and teaching methods. She stressed that personnel and teaching methods have often limited their academic progress and that if such students are given proper attention through the provision of a special method of teaching, their academic performance could be enhanced. According to Ogenyi (2024), slow learners could further be identified through their speech defects, language development (broken sentences), verbal abilities, short sentences, grammatically incorrect sentences, child behaviour, spelling mistakes, no interaction with other children in the classroom discussion and lack of interest in the subject. Mstem (2016) had reported that teaching methods affect students’ responses and determine whether they are interested, motivated, and involved in a lesson in such a way as to engage and determine good learning. What constitutes good teaching and learning of school subjects is the use of appropriate method of teaching. To teach slow learners in order to enhance their interest, the researcher will use Mnemo-Tech since it aids memory and helps the students to construct their knowledge.

World Health Organization (WHO, 2017) defined gender as the range of characteristics pertaining to, and differentiating between masculinity and femininity. Depending on the context, these characteristics may include biological sex, that is the state of being male, female, or an interest sex variation, sex based social structures; gender roles or gender identity. According to Heinemann (2025) some societies have specific genders besides “man” and “woman” such as hyras of South Asia, Hawaiian Malm “who occupy a place in the middle” between male and female, or the Ojibwelkwekaazo “men who choose to function as women” or iniikaazo “women who function as men. These are all recognised as third genders. Others, according to Trever (2016) include the non-binary genders “those who are having two or more genders, having no gender

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or having fluctuating gender identity. Jon and Wanus (2016) maintained that recognition of non-binary genders is still somewhat new to mainstream Western culture. But in the case of Nigeria, it is only male and female that are recognised in the context of gender. Various studies have been carried out in science education to ascertain the influence of gender as regard to the academic performance of students. For example, Suleiman (2017) found no gender disparity in the academic performance of students exposed to the demonstration teaching method in science. Danjuma (2017) reported that boys performed better than girls in science, technology and mathematics. Wakili (2017) reported a significant difference by gender in science achievement in favour of boys. Other studies, like Atadoga and Lakpini (2016), Obeka (2016), confirmed the superiority of female students' performance over male students. Ahmed (2016), who researched gender difference in students' acquisition of formal reasoning ability, concluded that there was no significant difference between male and female performance in genetics using learning cycle teaching strategy. Therefore, the present study will find out the effects of Mnemo-Tech on the performance of slow learners in plant physiology concepts among secondary school Biology students in Zaria, Kaduna State

Objectives of the Study

This study was guided by the following objectives, which are to:

1. determine the effect of Mnemo-Tech on the academic performance of slow learners in Plant Physiology concepts among secondary school Biology students.
2. examine the effect of Mnemo-Tech on the performance of male and female slow learners in Plant Physiology concepts among secondary school Biology students

Research Questions

The following research questions are set to guide the study:

1. What is the difference between the mean performance scores of slow learners taught Plant Physiology concepts using Mnemo-Tech and those taught using lecture method?
2. What is the difference between the mean scores of male and female slow learners taught using Mnemo-Tech?

Null Hypotheses

The following null hypotheses were tested at $p < 0.05$ level of significance.

H₀₁: There is no significant difference between academic performance mean scores of slow learners taught plant physiology concept using Mnemo-Tech and those taught using Lecture Method among secondary school Biology students

H₀₂: There is no significant difference between the mean academic performance scores of male and female slow learners taught Plant Physiology concept using Mnemo-Tech among secondary school Biology students

Research Design

This study employed a pretest, posttest and post-posttest quasi-experimental control group design. A pretest (O₁) was administered to the groups to determine their equivalence using the Plant Physiology Performance Test (PPPT). The essence of the pretest is to ensure that the experimental and control groups were not differently significant in their ability levels before the treatments.

Population of the Study

The population for the study consists of all Senior Secondary School Two (SS 2) students from all the public coeducational schools in Zaria Education Zone of Kaduna State. The total population of SS 2 students as at 2025 was 8,439 (Zaria Education Zone, 2025). This number includes 4853 males and 3586 females in 29 schools.

Sample and Sampling Technique

From the 29 public schools that made up the population, four schools were randomly selected based on location and gender. The four schools were subjected to a pretest, and the data obtained were subjected to statistical analysis using ANOVA and Scheffe's test. ANOVA was used to determine the existence of any significant difference in four schools, while Scheffe's test was used to separate the schools and determine which schools were comparable. The two schools with similar mean scores were selected as sample for the study. Since the research requires one experimental group and one control group, simple random technique by balloting was used to assign the two groups into experimental and control groups, respectively. An intact class was used in each of the two schools selected; GSS Tudun Jukun, comprising 88 subjects, was

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assigned to the experimental group and GSS Zaria, comprising 84 subjects, was assigned to the control group. The sample of the study comprised all the identified slow learners in the educational schools. The slow learners were identified and purposively selected based on gender by their teachers from three consecutive examinations recorded in Biology. Among the 172 SS II students in both schools, 50 students who consistently scored below average in three consecutive examinations were identified as slow learners (Subramanian, 2012). Details of the sample are shown in Table 3

Sample for the Study

S/N	Type	No of Students Present	No of Slow Learners		
			Male	Female	Total
1.	Experimental	88	08	12	20
2.	Control	84	12	18	30
	Total	172	20	30	50

Instrumentation

An instrument called Plant Physiology Performance Test (PPPT) was adapted from Muoneme (2016) derived from Plant Physiology concepts using the National Biology Curriculum for Senior Secondary (NERDC) to determine the academic performance and retention ability of students. The Plant Physiology Performance Test (PPPT) comprised of 40 choice objective test items each with four alternatives (A-D) from which the students were to select the correct answer. One mark was allocated for each question answered correctly. The test items covered the content units of the topics selected for the study. The instrument Plant Physiology Performance test (PPPT) was given to experts and one experienced secondary school Biology Teacher to validate the items of the instrument. A pilot test was conducted involving the students of Government Secondary School Jama'a, which is within the population but not part of the sample schools. This is to control the possibility of information of the instruments leaking to the study subjects. The purpose of the pilot testing is to determine the reliability of the instrument. The students were pretested and after two weeks, the posttest was administered to the students. The test-retest method of two weeks in line with Tuckman (1975) and Sambo (2008) was employed. Pearson Product-Moment Correlation Co-efficient (PPMC) was used to determine the reliability. Data collected from the pilot testing were used for item analysis and the reliability of the instrument was determined using the test-retest method. The scores were subjected to Pearson's Product-Moment Correlation Coefficient (PPMC) and a reliability value of 0.61.

Administration of Treatment

The experimental group were taught using Mnemo-Tech by the researcher. A pretest was administered to the students before the commencement of the teaching. The researcher used a lesson plan to teach plant physiology concepts for six weeks. Each lesson lasted for 70 minutes. The post-test was administered immediately after all the lessons had been taught, and two weeks later, the same group were tested with the same instrument as a post-post test to determine students' performance ability of the concept taught. The control group were taught the same concepts by the researcher using lecture method alone. The posttest was administered immediately after all the lessons had been taught for six weeks.

Procedure for Data Collection

After teaching the experimental and control groups for a period of six weeks, a post-test using the Plant Physiology Performance Test (PPPT) was administered by the researcher. The same test was administered. The PPPT were marked and scored over 40 and each correct response attracted one mark. After marking the scripts of the two schools collected, the scores were recorded accordingly based on the experimental group as well as the control group. Male and female scores and responses were coded accordingly because gender is involved in the study. After sorting out the scores, the data were subjected to analysis.

Presentation of Results

Answering Research Questions and Hypotheses Testing

This section answered the two research questions from the study with descriptive statistics of mean, mean difference, mean ranks, and mean rank difference of the data collected formed the statistics used and interpreted. The two null hypotheses were tested using inferential statistics at $\alpha \leq 0.05$ levels of significance. Hypotheses involving mean performance scores were tested as parametric data and tested using a t-test.

Research Question One: What is the difference between the mean performance scores of slow learners taught Plant Physiology concept using Mnemo-Tech and those taught using the lecture method?

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Table 3: Mean and Standard Deviation of Post-test Scores of Students in the Experimental and Control Groups

Groups	N	Mean	Std. Deviation	Mean Difference
Experimental	20	14.25	2.67	1.82
Control Group	30	12.43	3.18	

The result in Table 3 showed that differences exist in the mean scores of students when taught plant physiology concepts using Mnemo-tech. Mean scores of 14.25 and 12.43 was obtained with a mean difference of 1.82 in favour of students in the experimental group. The table revealed that students exposed to Mnemo-tech performed better than their counterparts taught plant physiology concepts using lecture method. To determine whether the mean difference is significant or not, hypothesis one was tested at $\alpha \leq 0.05$ as presented in Table 4.

Null Hypothesis One: There is no significant difference between academic performance mean scores of slow learners taught plant physiology concept using Mnemo-Tech and those taught using Lecture Method among secondary school Biology students.

Table 4: Independent Samples t-test Analysis of Mean Performance Scores between Experimental and Control Groups

Group	N	Mean	Std. Dev.	df	t	p	Remark	Decision
Experimental	20	14.25	2.67	48	2.11	0.04	Significant	Ho ₁ Rejected
Control	30	12.43	3.18					

Significant at $p < 0.05$ level

Table 4 revealed that significant difference exists between the performance mean scores of students in the experimental and control groups, $t(2.11)$, $p = 0.04$, which is less than 0.05 level of significance at 48 degree of freedom. The experimental and control groups recorded a mean scores of 14.25 and 12.43 respectively. Therefore, the null hypothesis which stated that there is no significant difference between academic performance mean scores of slow learners taught plant physiology concept using Mnemo-Tech and those taught using Lecture Method among secondary school Biology students is hereby rejected. This implies that students' scores were enhanced after exposure to Mnemo-tech implying that the Mnemo-tech is more effective in improving students' performance in plant physiology concepts than the lecture method.

Research Question Two: What is the difference between the mean scores of performance among male and female slow learners taught using Mnemo-Tech?

Table 5: Mean and Standard Deviation of Posttest Scores of Male and Female Slow Learners in the Experimental Group

Groups	N	Mean	Std. Deviation	Mean Difference
Male	8	14.63	2.50	0.63
Female	12	14.00	2.86	

The result in Table 5 showed that differences exist in the mean scores of male and female slow learners when taught plant physiology concepts using Mnemo-tech. Mean scores of 14.63 and 14.00 was obtained with a mean difference of 0.63 in favour of male slow learners in the experimental group. The table revealed that male slow learners exposed to Mnemo-tech performed better than their female counterparts taught same concepts using Mnemo-Tech. To determine whether the mean difference is significant or not, hypothesis two was tested at $\alpha \leq 0.05$ as presented in Table 6.

Null Hypothesis Two: There is no significant difference between the mean academic performance scores of male and female slow learners taught Plant Physiology concept using Mnemo-Tech among secondary school Biology students.

Table 6: Independent Samples t-test Analysis of Mean Performance Scores of Male and Female Slow Learners in the Experimental Group

Group	N	Mean	Std. Dev.	df	t	p	Remark	Decision
Male	8	14.63	2.50	18	0.50	0.62	Not Sig.	Ho ₄ Retained
Female	12	14.00	2.86					

Significant at $\alpha < 0.05$ level

Table 6 revealed that significant difference does not exists between the performance mean scores of male and female slow learners in the experimental group, $t(18) = 0.50$, $p = 0.62$, which is greater than 0.05 level of significance. The male and female slow learners recorded mean scores of 14.63 and 14.00 respectively. Therefore, the null hypothesis which stated that there is no significant difference between the mean academic performance scores of male and female slow learners



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taught Plant Physiology concept using Mnemo-Tech among secondary school Biology students is thus retained. This implies that scores of both male and female slow learners were enhanced after exposure to Mnemo-tech implying that the Mnemo-tech is effective in improving male and female slow learners' performance in plant physiology concepts thereby making Mnemo-Tech gender friendly.

Discussion of Findings

This study investigated the effects of Mnemo-Tech on interest, performance and retention in plant physiology concepts among secondary school Biology slow learners in Kaduna State, Nigeria. The data collected were analyzed at $P \leq 0.05$ level of significance. The discussion of the results from research questions and null hypotheses are presented as follows:

The first finding of this study indicated that the experimental group had a higher mean performance than their counterparts in the control group. This implies that students' scores were enhanced after exposure to Mnemo-tech implying that the Mnemo-tech is more effective in improving students' performance in plant physiology concepts than the lecture method. This finding is in line with that of Lubi and Polloway (2017) who concluded that mnemonic instructional strategy is effective in improving students' academic performance in science and social studies in students with learning problems particularly slow learners. The finding from this study is also similar with that of Purnamasari (2018) who found that mnemonic strategy can improve students' memory. The results is also similar with that of Istigamah and Ichsan (2021) who concluded that to associate every information in the cognitive structure of humans, one of them is by using Mnemo-Tech. However, the outcome of this study differs from that of Jackson and Osuhack (2022) and Felnor (2018) who recorded no significant difference in performance among students with learning difficulty when taught using Mnemo-Tech. The reason for the deviation in the results could be due to location and teacher factor in handling Mnemo-Tech.

The second finding of this study showed that there is no difference in the performance of male and female slow learners taught Plant Physiology concepts using Mnemo-Tech. This implies that scores of both male and female slow learners were enhanced after exposure to Mnemo-tech implying that the Mnemo-tech is effective in improving male and female slow learners' performance in plant physiology concepts thereby making Mnemo-Tech gender friendly. This result is similar with that of Bala and Kishor (2021) who found no gender when students are taught using Mnemo-Tech instructional strategy. However, the outcome of this study differs from that of Felnor (2018) and Jackson & Osuhack (2022) who recorded no significant difference in performance among male and female students with learning difficulty when taught using Mnemo-Tech. The deviation in the results could be due to location and teacher factors in handling Mnemo-Tech.

Conclusions

The following conclusions were made based on the study:

1. The academic performance of slow learners in Plant Physiology Concept is enhanced when taught using Mnemo-Tech.
2. The mean academic performance of male and female slow learners in plant physiology concept is improved when taught using Mnemo-Tech.

Recommendations

Based on the findings of this study, the following recommendations were made;

1. It is obvious from the findings of this study that exposure to Mnemo-Tech was effective in improving the academic performance of slow learners. Therefore, teaching plant physiology concepts using Mnemo-Tech should be encouraged among secondary school biology teachers to make learning more meaningful and effective.
2. Biology teachers should encourage active participation of both male and female slow learners during the teaching and learning process to reduce boredom and increase performance.
3. Textbook publishers and curriculum planners should produce teachers' guides, students' workbooks and textbooks that would take cognisance of Mnemo-Tech as a teaching strategy for slow learners.

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