

Impact of Education on Economic Growth: Analyzing the Relationship and Key Factors

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Abstract

The role of education is very important in the life of individuals. It is instrumental in reducing poverty, addressing inequalities, and improving health and social status. It is an integral part of life and a cornerstone of success, providing opportunities for personal and professional advancement. For instance, it broadens an individual's mind and enhances critical thinking. The study analyzes the positive impact of education and its beneficial effect on the economy growth. The analysis is based on time series data from the period of 1991–2023. The data is obtained from the website of World Development Indicators. Various econometric methods, including Ordinary Least Squares, Autoregressive Distributed Lag models, Unit Root, Bound, and Long-Run Bound Tests, were employed for the analysis. The findings indicate a direct relationship between the growth of the economy and education. As literacy rates improve, a larger proportion of the population gains access to employment opportunities, thereby contributing to an increase in Gross Domestic Product.

Keywords: Education, Economic Growth, Autoregressive Distributed Lag Model

Introduction

Education is widely recognized as a fundamental pillar for both personal and societal development. It plays a critical role in shaping an individual's skills, knowledge, and abilities, which ultimately contribute to the economic advancement of a nation (Samadkulov, 2024; Van Le et al., 2024). A positive relationship has been found in many studies between the growth of the economy and education, as education enhances human capital, promotes innovation, and drives productivity. As countries

continue to invest in education, understanding how education influences economic growth becomes increasingly important. This study aims to explore the direct and indirect effects of education on economic growth, examining the key variables involved and how they interconnect to foster sustainable economic development (Duwal & Suwal, 2024; Khan et al., 2024).

Economic growth refers to the process of achieving good growth in an inflation adjusted basket of goods and services in a fiscal year that is produced in an economy during one year. Typically, the percentage method is used by the analyst to measure the growth rate of real and nominal gross products (Afonso & Blanco-Arana, 2024; Azzahra et al., 2024). Education is an integral part of life and a cornerstone of success, providing opportunities for personal and professional advancement. For instance, it broadens an individual's mind and enhances critical thinking (Adeoye, 2024; Maneejuk & Yamaka, 2021).

It equips students with the tools to plan effectively in various fields and pursue higher goals, ultimately contributing to their success. Education not only improves individual satisfaction but also benefits the broader community (Ali et al., 2021; Hussain et al., 2021; Olufemi & Omorogiuwa, 2024). Similarly, the growth of per capita products reflects the improvements in the overall standard of living and individual productivity. So, as becomes more productive population can grow the economy at a faster pace and improve the living standards of the economy (Chen et al., 2024; Gallardo-Albarrán, 2024).

Education plays a vital role in building human capabilities and fostering economic growth through the acquisition of knowledge and skills. It is instrumental in reducing poverty, addressing inequalities, and improving health and social status (Ali et al., 2022; Suwandaru et al., 2021 Tung & Hoang, 2024). Through education spending, nations may reduce socioeconomic inequality, end the cycle of poverty, and promote sustainable development, all of which contribute to long-term economic growth and stability (Nwoke et al., 2024; Singh, 2024).

Education has a crucial role in alleviating poverty in developing nations by giving people access to better employment possibilities and raising

their standard of living. In developing countries, education has two particularly significant impacts:

1. It enables individuals to make more sustainable choices, thereby contributing to the creation of a better and more livable world.
2. It accelerates overall progress by equipping people with the tools needed for economic and social development.

So, these two impacts underscore the importance of education as a driver of both individual empowerment and national development, especially in the context of developing economies (Bengtsson et al., 2018; Smepllass et al., 2024).

Research Question

The study will aim to answer the following questions: How do education spending, inflation (GDP deflator), and GDP per capita growth influence the annual GDP growth of a country?

Objectives of this Study

The objective of this study is to analyze the relationship between education spending, inflation (GDP deflator), and GDP per capita growth on overall GDP annual growth. By examining these factors, the study aims to provide insights into how each contributes to economic development and sustainable growth. So, this scenario aims to highlight the significance of education that positively affects the growth of the economy in Pakistan. Specifically, the study aims to determine whether the effects of education on the growth of the economy are positive or negative.

Hypothesis

The study has the following hypothesis: Increased spending on education, a controlled inflation rate (GDP deflator), and higher GDP per capita growth positively influence the GDP country annual growth.

Literature Review

Numerous studies have emphasized the critical role that education role is very important in fostering human capital, increasing productivity, and driving innovation, all of which collectively contribute to economic development. This review identifies gaps in the research and offers a basis for comprehending how education affects economic performance by examining a variety of theoretical frameworks and empirical data.

Ramos and Mourelle (2018) explored the positive effects of education and the growth of the economy in the region of Spain by taking data from secondary sources during the period 1971- 2013. The study employed techniques such as regression of threshold and transition of smooth regression along with the Perron Unit Root Test for analysis. Variables such as enrollment of education ratios in middle and high levels, GDP, and capital in physical labor force form were considered variables of independence while economic growth was treated as the dependent variable. The results indicated that both secondary and tertiary education play a significant role in driving economic growth and emphasized the importance of accounting for non-linearities in the analysis.

Dawadi, Giri, and Simkhada (2020) examined the negative effects of education during the season of COVID-19. This study utilized primary data from 2020, referencing the UNESCO report, which indicated that 1.6 billion children across 191 countries were severely affected by the closure of educational institutions. The results revealed the negative effects of the pandemic on the learning environment widening the gap in students learning and innovative skills.

Ali et al. (2021) examined the positive effects of education on the growth of the economy in Pakistan by using secondary sources of data from the period 1989–2021. The study employed two dependent variables like log of GDP (IGDP), education and explanatory variable is literacy rate. For analysis, the model of vector autoregressive and causality test of Granger were utilized. In the end, the study showed that education is a fundamental factor in explaining the development and education levels of a country. However, the causality result showed direct relationship not found in literacy and GDP, although a positive relationship was observed between literacy rates and growth of economy.

Hussain et al. (2021) explored education impact on enhancing business opportunities for female entrepreneurs involved in advertising firms affiliated with both private and public TV channels in Pakistan. The study was based on primary data collected during the COVID-19 pandemic in June 2020. For analysis, the Chi-square test was employed to examine the relationship between academic qualifications and business opportunities. Data was gathered from various TV channels, including GEO News and

PTV News. The results indicated that women with lower education levels, working as media practitioners in advertisements, receive fewer opportunities compared to their male counterparts. In contrast, educated women can access more lucrative opportunities in the media industry. Education enables women to think creatively, solve problems effectively, critically evaluate business concepts, lead projects, and seize opportunities.

Nosheen et al. (2021) explored the means to achieve the goal of women's empowerment. The study utilized primary data collected from various districts of Pakistan, including District Dera Ghazi Khan (DGK) and districts in Southern Punjab. The age group of women surveyed ranged from 14 to 65 years. The Ordinary Least Squares (OLS) technique was employed for analysis. Women's empowerment was used as the dependent variable, while factors such as age, health, and women's education were considered independent variables influencing empowerment. The study concluded that women's empowerment is a multidimensional process that requires the education of household heads and the elimination of traditional, outdated community norms.

Ali et al. (2022) examined the positive impact of education on endogenous and physical capital growth in Pakistan economy by using secondary data sources from the period 1990–2020. For analysis, the study employed the model of augmented dickey-fuller and the distributed lag model of non-linear autoregressive. In this study, GDP, enrollment in schools, and physical capital were considered outcome variables, while inflation, fixed form of capital formation, and trade were treated as predictor variables. The findings revealed that inflation has a significant negative impact on GDP. The study concluded that increasing trade and education enrollment could positively contribute to boosting GDP.

Nasir et al. (2022) investigated the positive impact of education on industrialization, unemployment and growth of economic factors. And examining how these factors are interconnected. Data for the study were gathered from the source of world development indicators and the Survey of Economy of Pakistan. In the analysis, industrialization, poverty, unemployment, and education were considered input variables and outcome variable GDP. The study employed techniques such as the

Autoregressive Distributed Lag (ARDL) model, Unit Root Test, and Bound Testing. The results revealed cointegration in short and long-term phases between the variables, with a statistically significant positive relationship between the growth of the economy and factors such as industrial growth and fixed capital formation.

Ali, Sardar, and Latif (2023) examined the major obstacles to economic development and growth using time series data spanning the period 1987–2021. The study considered variables such as poverty, capital formation, and education as independent variables, with economic growth as the dependent variable. Analytical techniques, including the Autoregressive Distributed Lag (ARDL) model and Unit Root Test, were employed. The results concluded that increased education significantly contributes to higher economic growth.

Adeoye (2024) examined the importance of education by adopting innovative skills. It is the process of undergoing a transformative shift driven by technological advancements and societal changes. This scenario aims to prepare the students for future challenges. The traditional educational methods decreased the speed of development not only at the national level but also at the global level. The study also explores the need for educators and policymakers to adapt to technological advancement and improve employment activities that foster the qualities of creativity and flexibility in student success. It also highlights both the challenges that shaping the future importance of technical innovation and preparing students for the upcoming challenges that are faced by emerging economies.

Significance of the Study

The significance of study lies its potential that highlight the important role of education and its positive effects. The positive spending of economic factors not only increases the speed of economic growth of drives factors. But also analyzing how the investment in the education sector controls the inflation rate. The positive impact of growth per capita products on GDP growth (AL-Mutairi et al., 2024; Savandha et al., 2024). So, for policymakers it provides valuable insights in Pakistan. Understanding this kind of relationship can help to inform decisions, promote sustainable economic development and improve productivity

growth overall of the economy. And enhance quality of life overall of all individuals. Furthermore, for developing economies, the findings could serve as a guide to improve their economic performance through strategic investments in education departments.

Data and Methodology

This section discusses the data sources, briefly describes selected variables, and provides appropriate econometric techniques for analyzing chosen data.

Data Sources

This article has used world development Indicators data from the website via secondary source to analyze the education impact on economic growth that focusing on expenditure of government on education, Inflation GDP Deflator, GDP Per Capita Growth variables such as in Pakistan from the period from 1991 to 2023 for empirical for all variables. The outcome is economic growth is used for its GDP annual growth. The relationship can be framed as follows:

GDP Annual Growth = f (Education spending, Inflation GDP Deflator, GDP Per Capita Growth)

Where the level of education shows human capital development which indicates labor becomes more skilled and productive. So, the improvement in skilled workforce learning leads to higher economic profit and output which increases the growth of GDP (Edwards-Fapohunda, 2024; Saroj et al., 2024).

To measure the level of price changes in the economy the GDP deflator is used. The higher level of inflation reduces the purchasing power and stability point of the economy and potentially lowers the gross domestic product growth. Lower inflation increases the support system of economic stability and growth and more efficient allocation of economic resources. The Per Capita growth shows the standard of living improvements in an efficient way (Abdullayevic & Olimjon o'g'li, 2024; Ail & Asfaw, 2023; Sinha, 2023). So, the Higher per capita growth of domestic products indicates the productive capacity of individuals in a valuable way that directly affect economy overall domestic product growth.

Methodology

The researcher will proceed by applying the following econometric techniques that is time series data based. The first task is to check the data's stationarity. The augmented Dickey-Fuller (ADF) test is used to determine the stationarity of time series data furthermore, the ADF equation is expanded by including the lagged value of dependent variables.

ADF is based on the model

$$\Delta Y_t = \alpha + \beta_1 Y_{t-1} + (\rho - 1) Y_{t-1} + \delta \Delta Y_{t-1} + \epsilon_t \dots\dots\dots (a)$$

If every variable included in the model is integrated to degree one, a simple OLS method will be employed. If the selected variable is mixed integrated then the Autoregressive Distributed Lag Method will be used for co-integration analysis to check short and long relationships in variables of output and input.

The selected variables have the stationarity of I (0) & I (1) then used this methodology. However, the technique of ARDL cannot be applied if all variables are higher order stationarity. Another approach to finding the long-term relationship between the variables is the technique of error correction.

Specification form of the Model

The recent study considers GDP Annual growth as output variable. The variables that are in input forms included are Education Expenditure of Government, Inflation GDP Deflator, and GDP Per Capita Growth. To analyze these variables together the study finds how other economic factors and government spending on education sectors combined influence the overall economic growth.

Following equation will work for this study:

$$GAG = \beta_0 + \beta_1 GEE + \beta_2 IGD + \beta_3 GPG + \epsilon$$

Here, GDPg = GDP growth rate, GEE = Government Expenditure on Education, IGD = Inflation GDP Deflator, GPG = GDP Per Capita Growth, LFPR, β_0 = the value of intercept, the variables coefficients are $\beta_1 + \beta_2 + \beta_3$. To analyze the positive effects of education on the growth of the economy is the main aims of the model.

Econometric Analysis

The Econometric Analysis of this section is based on descriptive and econometric analysis, which provides a functional connection between the variables of input and output. The econometric analysis combines both descriptive and econometric techniques to establish a functional relationship between the variables of input and output.

The description analysis focuses on summarizing and describing the data related to the key variables providing a clear understanding of the patterns and trends and indicating relationships in the dataset. To summarize the data for each variable over time descriptive statistics are used. The econometric model is used to estimate the relationship between outcome and predictor variables. Furthermore, the analysis employs regression analysis such as ordinary least squares to estimate the impact of education spending on the growth of the economy. For valuable insights, the study used hypotheses that provide the magnitude and direction of the relationships. So, combining these two approaches the analysis provides a comprehensive overview of each explanatory variable that has a direct effect on the growth of the economy of Pakistan. The results of this econometric analysis shape the recommendations for policy adjustments and strategic investments that aim to boost economic performance.

Results and Discussion

Descriptive Analysis

The whole set of data is based on 33 yearly observations from 1991-2023. Descriptive analysis of variables, i.e., GDP Annual Growth rate (GAG), Government Expenditure on Education (GEE), Inflation GDP Deflator (IGD), and GDP Per Capita Growth (GCG) is explained in Table

Table 1

Descriptive Analysis

Variable.	N	M	SD	Mini.	Maxi	Skewe.	Kurti.
GAG	33	3.998	2.124	1.274	7.831	0.281	2.948
GEE	33	2.169	0.383	1.443	3.022	0.13	2.515
IGD	33	10.96	11.27	.922	68.01	4.121	21.33
GPG	33	1.643	2.14	3.039	5.202	0.097	2.341

Note: N= Observation, M=Mean, SD= Standard Deviation

The values of standard deviation, kurtosis, skewness are shown in the above table. GDP Annual Growth rate, Inflation GDP Deflator (IGD) are leptokurtic, Government Expenditure on Education (GEE), and GDP Per Capita Growth (GCG) are platykurtic because their value is less than 3.

Correlation Matrix

A correlation matrix presents correlation coefficients among multiple variables. Each cell illustrates the correlation between two variables. The matrix is symmetric, which means the values above the diagonal have the same values as those below the diagonal. The diagonal always holds one since the correlation of a variable with itself is consistently perfect.

Table 2

Matrix of Correlation

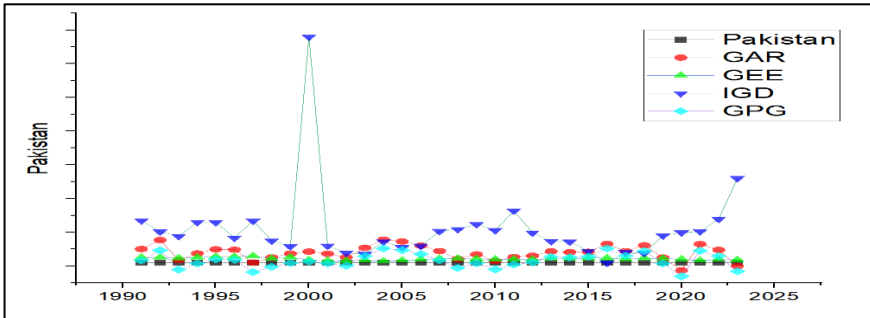
Variable	(a)	(b)	(c)	(d)
(a) GAG	1.000			
(b) GEE	0.113	1.000		
(c) IGD	-0.167	-0.089	1.000	
(d) GPG	0.963	0.176	0.223	1.000

Graph of Time Series

The overtime period growth of the data is represented by the graph of time series. It shows the data of measurements, frequencies, and sales in the overtime period. It can be used to show the pattern of trend in the data for making growth predictions for the financial year. This section is explained in the figure below.

Figure 1

Time Series Plot of all the Variables



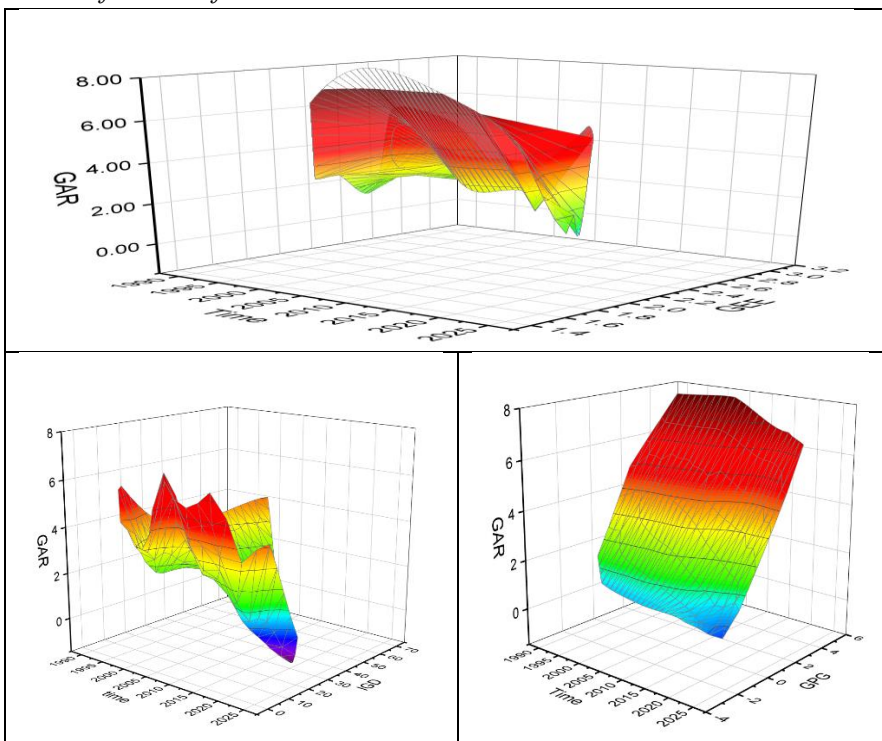
The above plot displays time trends for Pakistan from 1990-2025. The figure shows the exception of a significant GEE rise around 2000 and higher IGD levels after 2020, the majority stay constant. IGD varies more than GAR and GPG, which remain constant. While growth beyond 2020 suggests a change in trend, maybe due to changes in the economy, policy, or environment, the spike may point to an outlier.

3D Plot for All Variables

The explanation of the 3D plot for all variables is shown in figure two.

Figure 2

3D Surface Plot for all variables



The period of the country is shown on the x-axis and the axis of y indicates all the independent variables such as GEE (Government Expenditure on Education), IGD (Inflation GDP Deflator), and GPG (GDP Per Capita Growth), explained and the z-axis indicates dependent variable which is GDP annual growth. In this surface plot, the blue area

shaded explains lower values of the slope coefficients and the red color shows higher values of the slope coefficients. Each point on the surface shows dynamic relationships among these variables over the period 1991-2023. Peaks or valleys on the 3D surface show high or low GDP annual growth rates based on the values of the GEE, IGD, and GPG.

Table 3

ADF Test with level and 1st Difference

Variables	Level	1 ST Differences	Conclusion
GAR	-4.285 (0.0005)	-6.737 (0.0000)	I(0)
GEE	-1.744 (0.4084)	-3.364 (0.0122)	I(1)
IGD	-3.962 (0.0016)	-6.466 (0.0000)	I(0)
GPG	-3.803 (0.0029)	-6.319 (0.0000)	I(0)

To find out if time series data is stationary or not, this research applies the Augmented Dickey-Fuller (ADF) test using the p-value. According to unit root ADF test the stationary variables at the level are GAR, IGD, and GPG and GEE is stationary at 1st difference, so this study uses the distributed lag model of auto regressive to determine all value relationships in both short and long-term phases.

Table 4

OLS Methods

Variable	Coef. (Std. Error)		
GEE (Government Expenditure on Education)	0.362**(0.27)		
IGD (Inflation GDP Deflator)	-0.011**(0.09)		
GPG (GDP Per Capita Growth)	0.981***(0.049)		
Constant	1.48**(0.64)		
Mean DV	3.998	SD DV	2.124
R-squared	0.934	N.	33
F-test	137.55	Prob > F	0.000
AIC	60.488	BIC	66.47

*Note: N= Obs., DV = dependent variable, SD= Standard Deviation, AIC= Akaike Information Criterion, BIC= Bayesian Information Criterion, *** p < .01, ** p < .05, * p < .1*

GPG and GEE positive and IGD negative significantly impact GDP growth, R2 value (0.934) indicates Model fit and overall significance is high (p < 0.0001). The values of AIC of 60.488 and BIC of 66.474 indicate that the model is fit.

The most suitable technique of estimation are ARDL. When variables that are stationary at level and first difference. The bound test is first step process to examine the relationship among variables in long-run exist or not. The ECM analysis was used to know the short-run. Coefficient's performance of economic growth in the table below have been stated:

ARDL Bound Test

Once the ARDL equation for the model has been established, the next step is bound test that is applied to determine the relations of all values in the long-run. This test is specifically applied to variables with lags, and the resulting F-statistics value is crucial in concluding.

Table 5

Bound Test Values

Test of statistic	Long run values	K
F of statistic	6.358	3

Bounds Critical Value

Significance rate	I (0)-Bound	I (1)-Bound
At rate of 10 %	(2.45)	(3.52)
At rate of 5 %	(2.86)	(4.01)
At rate of 2.5 %	(3.25)	(4.49)
At rate of 1 %	(3.74)	(5.06)

The results shown above in Table five represent the F-statistic value is (6.358) that exceeds the value of the upper bound that is I(1) bound at all significance levels. So, in this case, we reject the null hypothesis (Ho)

indicates that the long-run relation of all variables is not present. So, it suggests that there is a long-run cointegration relationship in this model exists.

Table 6

Regression of ARDL

ARDL (1,1,1,1) Regression		Sample mean:	1992-2023
No of obsr :32			
D.GAG	Coef. (Std.Err)		
ADJ			
GAG L1	-0.069**(0.064)		
LR	Coefficient of Long-Run Relationship		
GEE	0.908**(1.484)		
IGD	-0.016**(0.070)		
GPG	1.190***(0.395)		
SR	Coefficient of Short Run Relationship		
GEE D1.	0.102**(0.147)		
IGD D1.	-0.001***(0.003)		
GPG (D1).	0.942***(0.063)		
_cons	-0.065**(0.254)		
R-squared.	=	0.9966	Adj R-squared. =
			0.9957
Log likelihood.	=	14.40195	Root MSE. =
			0.1781

*** *p* less than .01, ** *p* less than .05, * *p* less than .1

In the above table GEE and GPG have positive and IGD negative effects in short and long-term phases of economic growth in Pakistan. We can say that a 1 percent increase in GEE and GPG will bring 0.908, 1.190 increase in GAG and the value IGD 0.016 decrease GAG. That in line results are with Abdelgany et al. (2024); Ali et al. (2021-2023); Bhatti et al. (2024); Haider et al. (2024); Nosheen et al. (2021); Van Le et al. (2024). The R2 value shows that the model is a good fit because it explains 99.66 percent of the variance in the outcome variable. The lower value root MSE and higher value of log likelihood (0.17 and 14.40) show that the model is a good fit. The long run equilibrium is 0.069 indicates the adjustment speed in form of long-run.

Conclusion and Policy Implications

The summary of the research overall explains data overview of time series and positive effects of education on the growth of the economy of Pakistan from the period 1991 to 2023. To determine the data's stationarity (ADF) techniques of unit root are used. The GDP Annual Growth rate (GAG) is the outcome variable in log form. The input variables are Government Expenditure on Education (GEE), Inflation GDP Deflator (IGD), GDP Per Capita Growth (GPG). It suggests that GEE, GPG affect positive on economy growth. and it is concluded that education plays an important role in the life of individuals. Through education, a person's skills are enhanced, enabling them to contribute significantly to economic development. Therefore, it can be affirmed that it has a direct effect on education and growth of economy. The Important policy implications are following:

- Policymakers should prioritize strategies that boost GDP per capita growth, such as improving productivity, fostering innovation, and enhancing workforce skills.
- Effective monetary policies are necessary to help Pakistan manage its inflation problem and boost education spending, as stable investments in these areas drive economic growth.
- Furthermore, more spending on education should be optimized to ensure long-term economic growth by targeting efficiency and effectiveness, while maintaining moderate inflation to support overall economic stability.

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