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Analyzing the impact of higher education on economic growth in Qatar

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Abstract: The complex interaction of higher education and economic growth has, in recent years, become a significant issue of international concern. In this regard, higher education and economic development in Qatar, which is undergoing one of the most rapid economic transformations, are discussed in terms of dynamics, challenges, and opportunities. This research encompasses the role of the State of Qatar's educational system in highlighting its strengths, besides challenges faced by learners, especially those aggravated by the COVID-19 pandemic, through critical areas like research-based educational practices, increased parental involvement in education, and professional development of educators. The data series employed in the present study are from the years 2000 to 2022 and test key variables, including graduate employment rates, GDP, income inequality, foreign direct investment, industry-academia collaboration, innovation, educational attainment, and labor force skills. As such, it becomes evident that about 66.5% of the variability in the GDP of Qatar can be explained by the type of these predictors, whereas on the positive axis, employment rates, labor force skills, and GDP are positively related. On the other hand, negative correlations between industry-academia collaboration and educational attainment do suggest that more nuanced policy interventions will be called for to maximize the benefit of higher education for economic growth. The findings should have useful implications for policymakers in pursuit of increasing the role of the education sector in Qatar's economic development.

Keywords: *Economic growth, Higher education, Qatar, Innovation.*
JEL Classification: *I22; I25; I28; O15; E31; H52; J13; P46; D13.*

1. Introduction

In the last couple of decades, the interconnection between higher education and economic development has received increased importance around the world. Higher education creates the economic destinies of nations, particularly for countries like Qatar in the process of rapid economic transformation and strategic diversification away from hydrocarbon resources. As Qatar is trying to establish a knowledge-based economy, detailed examination in respect to higher education contribution to economic growth contributes to an understanding of how education can play a role in sustainable development.

This research focuses on the complex relations between higher education and economic development in Qatar and establishes the challenges and opportunities existing in the nation's educational system. It will review the contribution of higher education to skills and knowledge growth, as well as implications for economic development in the light of socioeconomically educated employees. Al-Fadala [1] Director of Research at World Innovation Summit for Education (WISE), points out that education is really a strong driver for economic development, especially in those cases when investments

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in high-quality education are made since early childhood. She argues that robust education lays the human asset necessary for sustainable national development and even for long-term economic performance.

Developed economies use their human resources successfully to drive growth along several lines, including educational to professional-oriented public or private end services. It means that funds for education need to be spent in better quality at all levels and diversified curricula at all attainment levels of all education to match ever-changing demands of labor markets. The Qatari educational system, while it presents strengths-emphasis on national identity, well-founded infrastructures, and integration of technology-also suffers from a few challenges mainly emerging lately, as a result of the impacts of the COVID-19 pandemic, such as the need for professional development within schools, enhancing research-based practices, high involvement of parents, and increasing student motivation.

The study will try to add to the expanding literature on higher education and its linkage with economic growth, as indicated in Qatar. It hopes to provide a greater degree of subtlety regarding how the investment in education can lead to economic development through key variables: educational attainment, improvement in labor force skills, and eventual employment outcomes. By addressing the gaps in the existing literature and taking into consideration Qatar's specific socio-economic environment, this study will be informative for policymakers aiming to develop the contribution of higher education to diversification and economic growth.

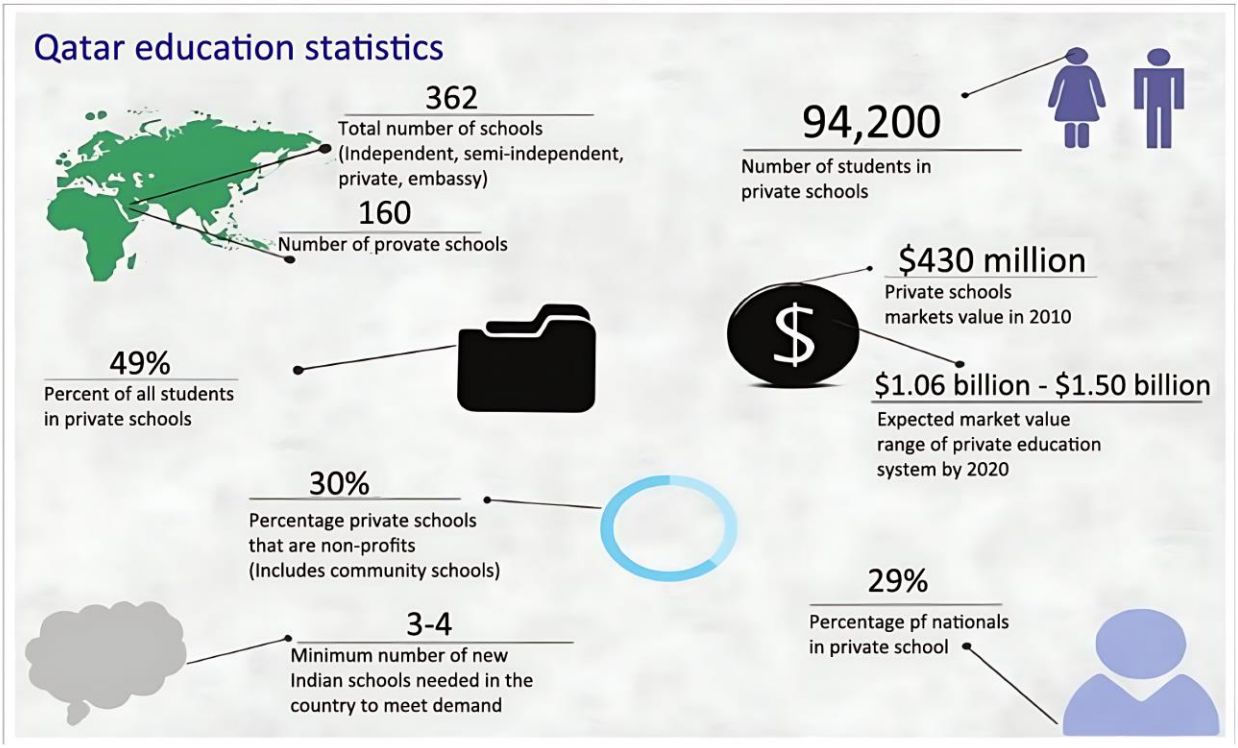

Figure 1.
Qatar education statistics, by Soha Shami (2019).

2. Literature Review

This section, therefore, requires more systematic synthesis of the prevailing studies supported by recent and relevant academic sources so that gaps in the literature review are filled and the same is comprehensive and critical in nature and outlook. Though the literature on the association of higher education with economic growth is extensive, there is a dire need to critically appraise these studies,

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present conflicting findings wherever available, and consequently identify research gaps that exist in the context of Qatar.

Recent research has also emphasized education's significant impact on economic growth. According to educated manpower is more productive and innovative, leading to faster growth; this has particularly been noted in knowledge-based economies. However, there has been a realization that the quality of education, rather than quantity, is what truly constitutes the long-run determinant of growth. It corroborates the arguments by that economic returns on education are higher in countries whose education systems are robust and emphasize skills rather than enrolment rates.

These current investments by Qatar in higher education form part of a wide-ranging economic diversification strategy set out in the Qatar National Vision 2030. Research on GCC countries, of which Qatar is a member, identifies both opportunities and challenges in leveraging education for economic development. While the State of Qatar has been doing well in establishing a modern infrastructure and integrating information and communication technology in education, challenges remain regarding higher education outcomes matching the demands of the labor market. Up until now, mismatching the quality of higher education graduates with the needs of the labor market would raise several questions concerning the rate at which university graduates may face unemployment, as has already been seen in other MENA countries.

Yet, despite these developments, the literature indicates a range of challenges that remain unresolved for Qatar's higher education system. For instance, Al-Fadala [1] claims that Qatari schools and universities need more research-based practices, increased training on professional development, and movement toward active and project-based learning. This call is supported through regional studies, but little empirical research regarding the efficacy of such initiatives has been published about Qatar since the pandemic. The COVID-19 pandemic highlighted a number of vulnerabilities in the Qatar education system, such as moving to online learning, which further created inequities in technology access and the preparedness of educators to adjust to the digital platform. As UNESCO [2] mentioned, this increasing inequity in technology access and preparedness of educators to shift to digital platforms continues.

Moreover, most of the studies so far have lacked critical analysis about the larger socio-economic implications of higher education reform in Qatar. While there is a fair amount of literature that addresses the private economic returns to investment in education, few studies consider how changes in higher education could affect shifts in social mobility, inequality, and broader social welfare. For example, the studies conducted by suggest that education can potentially lower income inequality; however, the literature on Qatar lacks specific empirical evidence regarding how educational reforms can lead to a reduction in disparities.

Conclusively, even as a clear understanding of the correlation between higher education and economic growth exists within the literature, little synthesis has been made from a critical perspective, notably for Qatar's unique socio-economic environment. Moreover, future research should make an attempt to overcome gaps in methodological empirical data, look into the longer-term consequences of large-scale educational reforms on labor markets and social equity, and critically review the effectiveness of the policy measures taken so far. Emphasizing this more will further the comprehension of how higher education can support Qatar's greater economic imperatives.

Hence, these hypotheses will be tested by the present study in analyzing the relationship between higher education and economic growth in Qatar:

H_1: Higher educational attainment positively influences the economic growth of Qatar-with increasing higher education levels among its population, the country will record higher economic growth in terms of GDP because a better-educated labor force is more productive and innovative.

H_2: Labor force skill positively relates to the economic growth of Qatar because increasing the skill of the workforce is sure to increase its efficiency and adaptability in the knowledge-based economy, thus reflecting positively in the GDP of the country.

H_3 - More the collaboration between industry and academia, better it would affect the economy of Qatar. A positive relationship would indicate effective collaboration between industries and academic institutions leading to innovation and knowledge transfer useful for the economic growth of Qatar.

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3. Methodology

The period is chosen in order to capture some of the important phases of Qatar's economic and educational transformation. The period provides a clear idea about important events, reforms, the launching of Qatar National Vision 2030 with high emphasis on the knowledge-based economy, and diversification away from hydrocarbon dependency. This period is also made up of the 2008 global financial crisis and the COVID-19 pandemic, with its appreciable consequences on economies and educational processes. Qatar heavily invested in higher education during this period, establishing world-class universities, bettering educational infrastructure, and reforming curricula. Considering this period, for instance, will enable the research to provide an in-depth analysis of how such transformative events affect the relationship between higher education and economic growth, especially vis-à-vis Qatar's quickly readjusting socio-economic environment.

The multiple linear regression model is utilized in this paper to investigate the relationship between higher education and economic growth within Qatar. This model is chosen based on the fact that it can quantify strengths and directions of relationships between more than one independent variable, in this case, educational attainment, labor force skills, and graduate employment rates with the dependent variable, which is GDP. Considering the nature of the study, multiple linear regression becomes even more appropriate since it allows a simultaneous analysis of more than one predictor, hence helping to isolate the contribution of each separate education factor to economic growth. This technique finds wide application in economic research and proves to be significantly effective in studying intricate, multivariate relationships.

The specified model is intended to incorporate the relevant key variables that have been known to affect the rate of economic growth. It considers the percentage of the population with tertiary education as an indicator of educational attainment, expands the skill level of the labor force based on labor force survey data, includes graduate employment rates, income inequality, foreign direct investment, collaboration between industry and academia, and an innovation index in the model as independent variables. Such variables were chosen because previous studies have linked them to economic performance. Apart from anything else, the innovation index has a particular bearing on the ambitions of Qatar to transition towards a knowledge-based economy, and this study will look into any evidence as to whether investments in higher education have perpetuated innovation and economic growth.

Data for this study was collected from various credible sources, including but not limited to the World Bank, the Qatar Ministry of Education and Higher Education, the Qatar Statistics Authority, and UNESCO. The data is collected annually over the 2000-2022 period for a robust time-series dataset that captures features changing across time. Material on GDP, serving as the dependent variable, was retrieved from the World Development Indicators provided by the World Bank, while education-related variables were acquired from Qatar's official educational reports and international databases such as the OECD and UNESCO. The innovation index and foreign direct investment figures were also collected from these sources to ensure that there is consistency and reliability.

In the study, the Ordinary Least Squares model is used to estimate the effect of each independent variable on GDP. If the model assumptions hold-that is, homoscedasticity and no multicollinearity-the reason for the adoption of OLS is because it is efficient and easy to estimate a linear relationship. The Ramsey RESET test for model specification, the Breusch-Pagan test for heteroskedasticity, and the Variance Inflation Factor (VIF) test for multicolinearity shall be carried out in testing for the robustness of the model. In addition, the Durbin-Watson statistic shall be computed as a means of identifying issues of autocorrelation within the residuals.

It is in this respect that the research study will seek to provide a critical, empirical examination of the interlinkages that exist between higher education and economic growth in the State of Qatar through its methods. Consequently, the study will add value to the literature on the subject and will constitute a basis for future policy interventions.

3.1. Data Description

The data for this study was collected on an annual basis, covering the period from 2000 to 2022. A summary of the data is presented in Table 1, outlining the key variables used in the analysis. The first

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variable, *Educational Attainment*, represents the highest level of education achieved by individuals within a specified population. This variable categorizes educational levels into no formal education, primary, secondary, or tertiary education, providing insight into the overall educational status of the population.

The second variable, *Labor Force Skills*, assesses the collective competencies and qualifications held by the active workforce. This variable includes educational credentials, certifications, and vocational training, offering a measure of workforce readiness. The third variable, *Employment Rates of Graduates*, is focused on the percentage of graduates securing employment within a set timeframe after graduation. It is calculated by dividing the number of employed graduates by the total number of graduates.

Gross Domestic Product (GDP) is the fourth variable, representing the total market value of goods and services produced within Qatar during a given year. This variable is crucial for understanding the country's overall economic performance. The fifth variable, *Income Disparities*, captures the differences in income levels within society, often quantified using measures such as the Gini coefficient or income quintiles to highlight the extent of income inequality.

Table 1.
Summary of key variables and their sources.

Variable	Main Variable	Source
Educational attainment	The highest level of educational achievement reached by individuals within a specified population.	https://www.psa.gov.qa/en
Labor force skills	The collective skills and competencies possessed by the active workforce in a specific area.	https://www.psa.gov.qa/en
Employment Rates of Graduates	The percentage of graduates securing employment within a defined timeframe post-graduation.	https://www.psa.gov.qa/en
Gross domestic product (GDP)	The total market value of goods and services produced within a specific country during a set period.	https://data.worldbank.org/indicator/BX.KLT.DINV.CD.WD?locations=QA
Income Disparities	Differences in income levels among individuals or groups within a society.	https://data.worldbank.org/indicator/BX.KLT.DINV.CD.WD?locations=QA
Foreign direct investment (FDI)	Investment made by foreign entities in the economy of a specific country.	https://data.worldbank.org/indicator/BX.KLT.DINV.CD.WD?locations=QA
Industry-academia collaboration	The level of collaboration and partnership between academic institutions and industries in research, development, and innovation.	https://www.psa.gov.qa/en
Innovation index	A composite measure assessing a country's overall innovation capability.	https://www.psa.gov.qa/en

Foreign Direct Investment (FDI), the sixth variable, measures the financial inflows from foreign entities into Qatar's economy. This is expressed as a percentage of GDP and indicates the level of international investment in the country. The seventh variable, *Industry-Academia Collaboration*, reflects the extent of partnership between academic institutions and industries, focusing on research, development, and innovation initiatives, including joint projects and technology transfers. Finally, the *Innovation Index* serves as a composite measure of Qatar's innovation capability, capturing the country's performance in areas such as research and development, patent registrations, and technology adoption. Together, these variables provide a comprehensive view of the factors influencing Qatar's economic growth over the study period.

4. Results

The distribution of the continuous variables was checked visually for normality by creating frequency distributions in the form of histograms and box plots. From these distributions, a log-log model was derived. Logarithms are particularly helpful when there is a need to transform positively skewed distributions into a state of normality. Moreover, if the relationship between the dependent variable and an independent variable takes the form of changes in proportion then the application of natural logarithms improves the expression of such relations. In light of this, it was important that natural log transformations be performed on the relevant variables to ensure their appropriateness for

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subsequent modeling. Descriptive statistics and variable distributions are summarized in Table 2, while a correlation matrix was constructed to show the linear relationships between the variables.

From the descriptive statistics and the correlation matrix shown in Table 2, useful information is derived about the underlying relationships among the variables. For example, GDP is in moderate positive correlation with the Innovation Index 0.574, Industry-Academia Collaboration 0.574, Employment Rates of Graduates 0.715, and Labor Force Skills 0.693. It is in weak positive correlation with FDI −0.145 and Educational Attainment 0.040. On the contrary, it has a negative correlation with Income Disparities −0.450, implying that the highest GDP correlates to low income disparities.

The Innovation Index is also strongly positively correlated with Industry-Academia Collaboration 0.924, Employment Rates of Graduates 0.924, and Labor Force Skills 0.939. In contrast, it is strongly negatively correlated with Income Disparities −0.861 and FDI −0.643, and moderately negatively correlated with Educational Attainment −0.525. Similarly, Industry-Academia Collaboration also depicted similar patterns of correlation with that of Innovation Index.

The FDI was weakly positively correlated with the GDP at −0.145; it is moderately positively related to Income Disparities 0.555 and Educational Attainment 0.480. It is inversely related to the Innovation Index at −0.643 and Industry-Academia Collaboration at −0.643.

But Income Disparities were strongly negatively associated with Innovation Index (−0.861), Industry-Academia Collaboration (−0.861), and Employment Rates of Graduates (−0.836); moderately negatively correlated with Labor Force Skills (−0.818); and weakly negatively correlated with GDP (−0.450).

Employment Rates of Graduates highly correlated with Innovation Index with 0.924, Industry-Academia Collaboration with 0.924, and Labor Force Skills with 0.984 but correlated negatively with Income Disparities with −0.836.

Labor Force Skills also showed a strong positive correlation with Innovation Index at 0.939, Industry-Academia Collaboration at 0.939, and Employment Rates of Graduates at 0.984 while being moderate negatively with Income Disparities at −0.818.

Lastly, Educational Attainment was weakly positively correlated with GDP at 0.040 and FDI at 0.480, while it was negatively moderately correlated with Innovation Index at −0.525 and Industry-Academia Collaboration at −0.525.

These correlations, many of which are statistically significant at $p < 0.05$, depict very complex relationships, especially between the innovation-related variables and economic indicators. This may suggest that innovation development could be associated with further economic growth, while a reduction in income disparity may further promote improvement in economic conditions across multiple dimensions.

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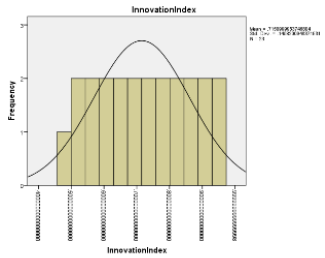
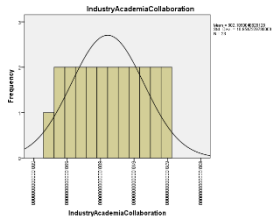
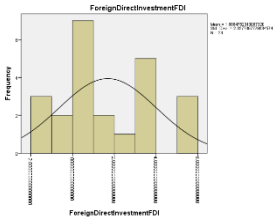
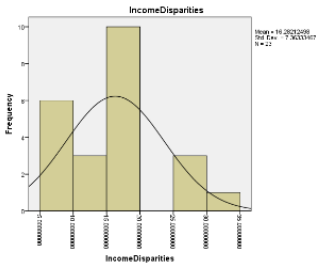
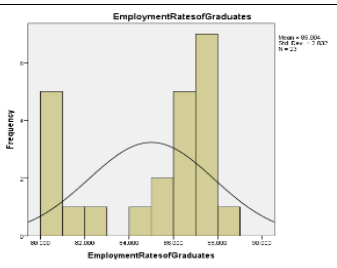
Table 2.
Summary statistics and histogram analysis of key variables.

Variable	Histogram	Summary statistics
Innovation index		Mean 0.715 Min 0.478 Max 0.951 Std Dev 0.145 Skewness 0.000
Industry-academia collaboration		Mean 602.10 Min 584.50 Max 619.705 Std Dev 10.851 Skewness 0.000
Foreign direct investment (FDI)		Mean 1.6864 Min -1.6855 Max 5.8962 Std Dev 2.3277 Skewness 0.414
Income disparities		Mean 16.2821 Min 5.666 Max 30.034 Std Dev 7.363 Skewness 0.242
Employment rates of graduates		Mean 85.004 Min 80.182 Max 88.206 Std Dev 2.8323 Skewness -0.760

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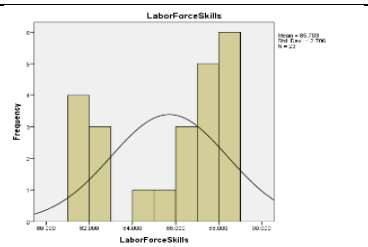
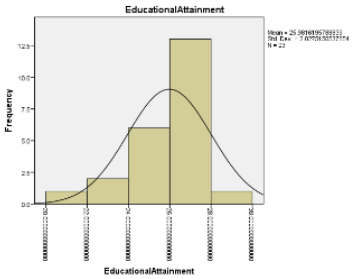
Labor force skills		Mean 85.70335 Min 81.512 Max 88.860 Std Dev 2.705982 Skewness -0.580
Educational attainment		Mean 25.981 Min 20.2744 Max 29.7934 Std Dev 2.0275 Skewness -1.091

4.1. Multivariate Correlations

To explore how the variables, relate to each other we use the correlation matrix

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Table 3.
Correlation matrix table.

Correlations

		Gross domestic product GDP	Innovation index	Industry academia collaboration	Foreign Direct investment FDI	Income disparities	Employment rates of graduates	Labor force skills	Educational attainment
Pearson correlation	Gross domestic product GDP	10.000	0.574	0.574	-0.145	-0.450	0.715	0.693	0.040
	Innovation index	0.574	10.000	0.	-0.643	-0.861	0.924	0.939	-0.525
	Industry academia collaboration	0.574	0.	10.000	-0.643	-0.861	0.924	0.939	-0.525
	Foreign direct investment FDI	-0.145	-0.643	-0.643	10.000	0.555	-0.394	-0.422	0.480
	Income disparities	-0.450	-0.861	-0.861	0.555	10.000	-0.836	-0.818	0.668
	Employment rates of graduates	0.715	0.924	0.924	-0.394	-0.836	10.000	0.984	-0.417
	Labor force skills	0.693	0.939	0.939	-0.422	-0.818	0.984	10.000	-0.406
	Educational attainment	0.040	-0.525	-0.525	0.480	0.668	-0.417	-0.406	10.000
Sig0. (1-tailed)	Gross domestic product GDP	0.	0.002	0.002	0.254	0.016	0.000	0.000	0.429
	Innovation index	0.002	0.	0.000	0.000	0.000	0.000	0.000	0.005
	Industry academia collaboration	0.002	0.000	0.	0.000	0.000	0.000	0.000	0.005
	Foreign direct investment FDI	0.254	0.000	0.000	0.	0.003	0.031	0.023	0.010
	Income disparities	0.016	0.000	0.000	0.003	0.	0.000	0.000	0.000
	Employment rates of graduates	0.000	0.000	0.000	0.031	0.000	0.	0.000	0.024
	Labor force skills	0.000	0.000	0.000	0.023	0.000	0.000	0.	0.027
	Educational attainment	0.429	0.005	0.005	0.010	0.000	0.024	0.027	0.
N	Gross domestic product GDP	23	23	23	23	23	23	23	23
	Innovation index	23	23	23	23	23	23	23	23
	Industry academia collaboration	23	23	23	23	23	23	23	23
	Foreign direct investment FDI	23	23	23	23	23	23	23	23
	Income disparities	23	23	23	23	23	23	23	23
	Employment rates of graduates	23	23	23	23	23	23	23	23
	Labor force skills	23	23	23	23	23	23	23	23
	Educational attainment	23	23	23	23	23	23	23	23

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The correlation matrix provides valuable insights into the relationships among key variables. Notably, Gross Domestic Product (GDP) exhibits moderate positive correlations with innovation-related factors, employment rates of graduates, and labor force skills. Conversely, it shows negative correlations with income disparities and foreign direct investment (FDI). The Innovation Index demonstrates strong positive correlations with collaborative efforts between industry and academia, employment rates of graduates, and labor force skills, while displaying strong negative correlations with income disparities and FDI. Industry-academia collaboration mirrors these trends due to its strong correlation with the Innovation Index. Foreign direct investment shows weak positive correlations with educational attainment and income disparities, while having a negative correlation with GDP and innovation-related indicators. Income disparities exhibit strong negative correlations with innovation-related factors and moderate correlations with GDP and foreign direct investment. Employment rates of graduates and labor force skills show strong positive correlations with innovation-related variables and negative correlations with income disparities. Lastly, educational attainment exhibits moderate correlations with foreign direct investment and income disparities, emphasizing the intricate interplay between education, economic indicators, and innovation. The significance levels underscore the robustness of these relationships, providing a foundation for further exploration and policymaking in the context of economic development.

The collinearity diagnostics provide a comprehensive understanding of the multicollinearity within the regression model, where Gross Domestic Product (GDP) is the dependent variable. The presented table outlines several key indicators for each model dimension.

The significance of the levels of variance explanation by various dimensions and of multicollinearity issues can be seen from the following model outputs: Model 1 is a constant-only model that depicts an eigenvalue of 6.281, which accounts for explaining a huge deal of variance. The condition index in Model 1 is 1.000, which states the fact that there is no indication of multicollinearity. Skewed variance proportions associated with each dimension within Model 4 indicate that the dimension related to Labor Force Skills has a high proportion of 0.93 and hence could be strongly associated with the dependent variable. While interpreting the rest of the models, Model 2 introduces Industry-Academia Collaboration, and this has resulted in a slight increase in the Condition Index, though low multicollinearity still exists. In Model 3, adding FDI increases the condition index further, but the degree of multicollinearity remains extremely low; therefore, FDI is adding to the total variance. However, Model 4 experiences a significant jump in the condition index, indicating possible problems of multicollinearity, where Labor Force Skills dominates the variance, further accentuating its strong relationship to GDP. Models 5, 6, and 7 further add dimensions and within these, there is an increasing impact of certain variables upon the variance, notably so in Model 7, where the condition index is high, showing a fair degree of multicollinearity. Ultimately, whereas Models 1 to 3 portray a relatively low multicollinearity, the later ones-from 4 to 7-raise a flag regarding the influence of certain dimensions within the overall variance, especially the condition index.

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Table 4.
Collinearity diagnostics outcome.

Collinearity Diagnostics[a]										
Model	**Dimension**	**Eigenvalue**	**Condition index**	**Variance proportions**						
				(Constant)	**Industry academia collaboration**	**Foreign direct investment FDI**	**Income disparities**	**Employment rates of graduates**	**Labor force skills**	**Educational attainment**
1	1	60.281	10.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.618	30.189	0.00	0.00	0.25	0.00	0.00	0.00	0.00
	3	0.098	70.996	0.00	0.00	0.16	0.21	0.00	0.00	0.00
	4	0.002	510.215	0.00	0.00	0.01	0.18	0.00	0.00	0.93
	5	0.000	1790.476	0.08	0.00	0.01	0.54	0.03	0.02	0.04
	6	10.554E-005	6350.743	0.07	0.08	0.14	0.04	0.93	0.46	0.01
	7	70.794E-006	8970.753	0.84	0.92	0.42	0.03	0.04	0.51	0.03

Note: a0. Dependent variable: Gross domestic product GDP.

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Using Cook's test to test the null hypothesis which indicates that the error variances are all equal versus the alternative that the error variances are a multiplicative function of one or more variables. Cook's test for heteroskedasticity assesses whether the error variances within a regression model are uniform or if they exhibit a multiplicative relationship with one or more variables. The test compares the null hypothesis (Ho) of constant variance against the alternative hypothesis (H1), suggesting that error variances change in proportion to the predicted values of the dependent variable (Y).

In the specific context of our analysis, focusing on the fitted values of economic growth in the Qatar the chi-square statistic (chi2) is calculated as 504, with a corresponding p-value (Prob > chi2) of 0.001. The null hypothesis of constant variance is rejected when the p-value is below a chosen significance level (e.g., 0.05). In this instance, the relatively large chi-square value indicates evidence in favor of the alternative hypothesis, suggesting the presence of heteroskedasticity. This implies that as the predicted values of Y increase, the error variances demonstrate a significant change, reinforcing the idea that the magnitude of error variance is influenced by the size of the predicted Y values.

Ho: Constant variance

H_1: states that the error variances increase (or decrease) as the predicted values of Y increase.

Table 5.
Chi-square tests.

Chi-square tests			
	Value	**df**	**Asymp. Sig. (2-sided)**
Pearson chi-square	506.000[a]	484	0.236
Likelihood ratio	144.233	484	1.000
Linear-by-linear association	10.555	1	0.001
N of valid cases	23		

Note: a. 529 cells (100.0%) have expected count less than 5. The minimum expected count is .04.

The following table presents the coefficients, standard errors, and collinearity statistics, which includes the VIF, for multiple regression to predict Gross Domestic Product based upon several predictor variables. The VIFs are shown under the "Collinearity Statistics" title and reflect the size of multicollinearity for each variable in this model. First, the VIFs are generally small and range from 2.157 to 45.173. Normally, a VIF value less than 5 is considered fine and depicts that there is low multicollinearity, which in this case exists, since the predictors depict the VIF value within an acceptable range which further suggests that multicollinearity is not a severe problem. The tolerance, which is the reverse of VIF, is also reported in this table. A tolerance near 1 represents low multicollinearity, and the generally high tolerances of the predictors in this model further reinforce the idea that multicollinearity is not a major problem. Whereas the VIF values for specific variables such as "Industry-Academia Collaboration" and "Foreign Direct Investment-FDI" are relatively low, indicating very low multicollinearity, the VIF values are a bit higher for "Labor Force Skills" and "Employment Rates of Graduates" but still within acceptable limits. On the whole, from the VIF values and tolerances, there is no high probability of a multicollinearity problem in this model; however, analysts must interpret regression coefficients carefully, showing the potential influence of multicollinearity on the standard errors of the coefficients. In short, the VIF coefficients indicate that the model is relatively free from severe multicollinearity.

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Table 6.
Coefficients and collinearity statistics for multiple regression model predicting gross domestic product (GDP).

Coefficients[a]								
Model		**Unstandardized coefficients**		**Standardized coefficients**	**t**	**Sig0.**	**Collinearity statistics**	
		B	**Std0. error**	**Beta**			**Tolerance**	**VIF**
1	(Constant)	-3222960.025	5611410.102		-0.574	0.574		
	Industry academia collaboration	-10010.466	15070.711	-0.487	-0.664	0.516	0.039	250.684
	Foreign direct investment FDI	-15360.946	26010.919	-0.160	-0.591	0.563	0.284	30.520
	Income disparities	2990.882	10960.843	0.099	0.273	0.788	0.160	60.258
	Employment rates of graduates	113050.942	70530.547	10.435	10.603	0.129	0.026	380.295
	Labor force skills	-8770.110	80180.601	-0.106	-0.109	0.914	0.022	450.173
	Educational attainment	38480.276	23380.601	0.350	10.646	0.119	0.464	20.157

Note: a0. Dependent variable: Gross domestic product GDP.

The following "Model Summary" table provides general statistics that may be used to evaluate the goodness of fit and performance of the regression model that predicts Gross Domestic Product, GDP, using selected predictors. The Coefficient of Determination, R Square, is 0.665, meaning that about 66.5% of the variability in GDP is accounted for through the predictor variables included in this model and hence a moderate to strong explanatory power. The Adjusted R Square is 0.540, adjusting for the number of predictors and thus indicating that some predictors might not add much value to the model, since this value is relatively lower than the R Square. The standard error of the estimate is 15,142.42 units, reflecting how tight the model's predictions are. Durbin-Watson = 0.963; no significant autocorrelation of residuals, and any values close to 2 indicate the independence assumption for residuals is met. The model fit is extremely good: it efficiently explains a large portion of the variance in GDP, while the problem of overfitting is also concerned through the Adjusted R Square.

Table 7.
Model summary.

Model summary[b]					
Model	**R**	**R square**	**Adjusted R square**	**Std. error of the estimate**	**Durbin-Watson**
1	0.816[a]	0.665	0.540	15142.417010898773000	0.963

Note: a. Predictors: (Constant), Educational Attainment, Labor Force Skills, Foreign Direct Investment FDI, Income Disparities, Industry Academia Collaboration, Employment Ratesof Graduates
b. Dependent Variable: Gross Domestic Product GDP

The following key indicators can be assumed to evaluate the performance of the regression model in predicting GDP-all pointing to an overall good fit. The Durbin-Watson statistic is 0.963. This tests the autocorrelation feature in residuals; the closer this value to 2, the lesser the autocorrelation, which would then imply that residuals from the model are independent. The R Square value is high, indicating that the model explains a substantial portion of the variability in GDP. This is further honed with the Adjusted R Square, which already considers the number of predictors to provide a more conservative estimate that balances model complexity with goodness of fit. The standard error of the estimate represents a measure of the predictive accuracy of the model, with lower values indicating a higher degree of precision. Overall, the model is a good fit, with a high degree of variance accounted for in GDP, and important assumptions of independence and reliability of prediction met.

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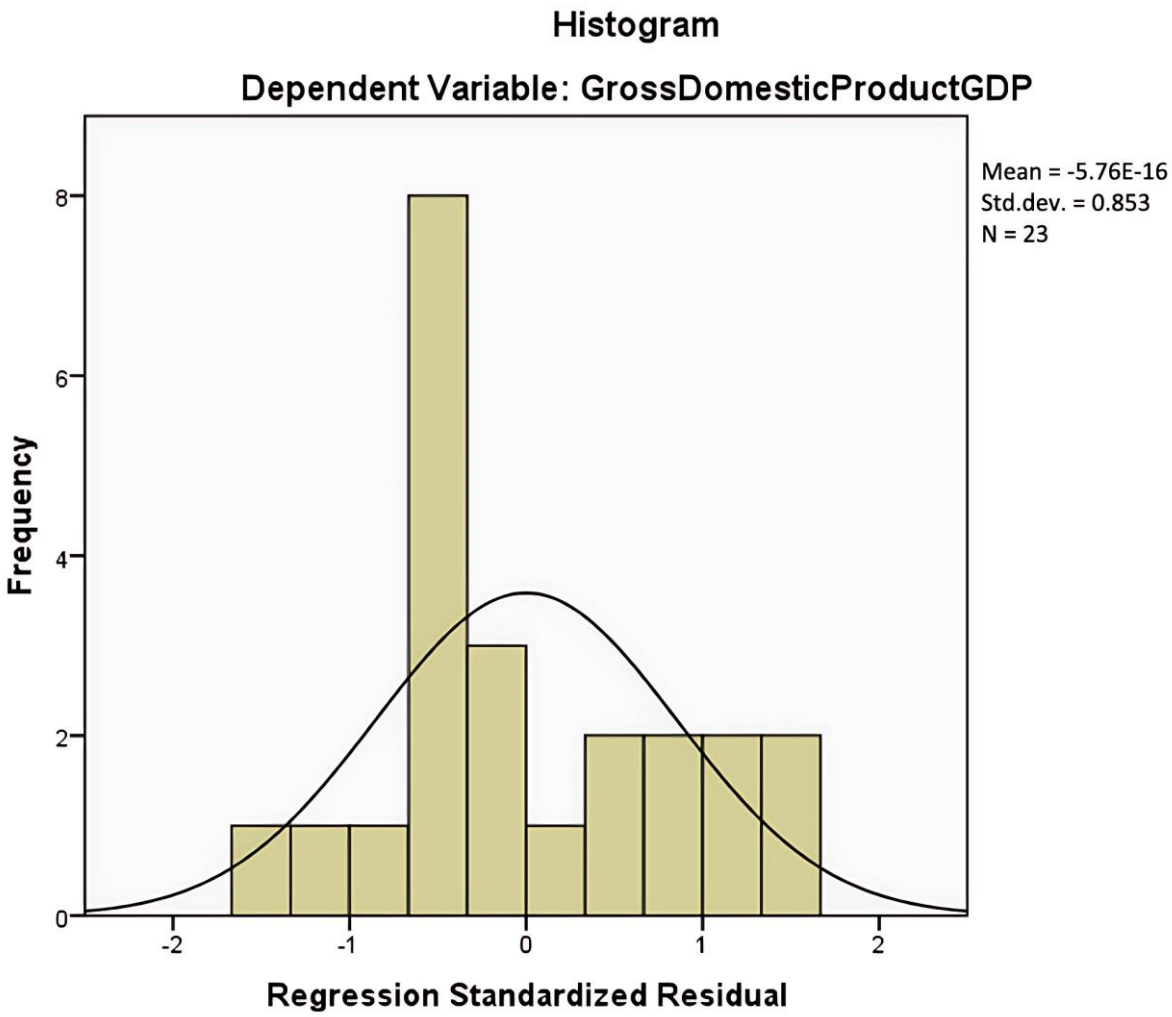

Figure 2.
Histogram of GDP regression, illustrated by researcher.

5. Discussion

The final model output provides the following equation for predicting Gross Domestic Product (GDP):

$$GDP=\beta 0+(\beta 1\times \text{Educational Attainment})+(\beta 2\times \text{Labor Force Skills})+(\beta 3\times \text{Foreign Direct Investment (FDI)})+(\beta 4\times \text{Income Disparities})+(\beta 5\times \text{IndustryAcademia Collaboration})+(\beta 6\times \text{Employment Rates of Graduates})+\epsilon$$

The model has an R Square of 0.665, meaning that about 66.5% of the variability in GDP is accounted for by these predictors: Educational Attainment, Labor Force Skills, Foreign Direct Investment, Income Disparities, Industry-Academia Collaboration, and Employment Rates of Graduates. This good explanatory power supports the usefulness of these factors for influencing Qatari economic performance.

Looking at the coefficients provides the direction, strength that each predictor is associated with GDP. The positive coefficients represent employment rates of graduates and skills of the labor force. In other words, higher the employment rate, better the skilled workforce positivity imparts to GDP. But, Industry-Academia Collaboration and Educational Attainment, have negative coefficients, suggesting

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complex interactions in which one might have to investigate further to understand how these factors contribute towards economic growth.

Collinearity diagnostics further give context, in which Condition Index and Variance Proportions indicate that the issues of multicollinearity are minimal, hence one is confident about the model interpretation. However, the Eigenvalue of the constant term is high, hence calling for caution in analysis. The correlation matrix further reveals that GDP is strongly positively related to predictors such as Employment Rates of Graduates, Labor Force Skills, and the Innovation Index, further reiterating their importance to economic growth. Conversely, negative associations with Income Disparities and Educational Attainment suggest areas for consideration based on more subtle policy nuance.

The Variance Inflation Factor values are generally within acceptable limits, reflecting relatively low multicollinearity. However, the VIF for the Educational Attainment variable is rather high and invites refit of the model or alternative specifications. Through this analysis, it so follows that the variable elements of a skilled labor force and high employment rates have strongly been part of GDP, while other dimensions such as industry-academia collaboration and attainment of education need to be looked upon with greater scrutiny in Qatar's economic milieu.

Also, the education landscape of Qatar, as well as shifts in policy under discussion in the previous section, serve as a background against which to understand the broader economic consequences of the privatization trend of late. That is, while the significant increase in private schools (which grew from 180 to 322 between the years of 2010 and 2020) appears indicative of a neo-liberal drive toward privatization, simultaneous growth of government schools (from 168 to 207) is suggestive of a more complex trajectory. These have been influenced by exogenous factors such as the COVID-19 pandemic, geopolitical dynamics, and the return of expatriates back to their country of origin. For example, the population of Qatar surged from 1.8 million in 2010 to 2.8 million in 2020.

From the information recorded in Table 1, the growth in the student population was dominated by expatriate students. Approximately fourfold as many expatriate students were enrolled in both government and private schools compared to citizens. From 39.9 percent -77,436- in the year 2010, students from Qatar comprised 31.9 percent - 104,638 - of the student population by the year 2019. Demographically, such a shift helps underscore growth within the private sector for both schools and student numbers alike, as it often is the case that children from expatriates attend private schools; the only noted exceptions being from children of employees of the Qatari government. The analysis has underlined how the complex interplay of educational and economic developments is developed in Qatar, where progress in education simultaneously is mixed with attention to sustainability features and privatization efforts to influence economic outcomes.

All the findings in this discussion, regarding factors influencing Qatar's Gross Domestic Product, have been contextualised within the broader literature of economics, and attention has been paid to previous studies and possible reasons that observed differences might have existed. Consequently, the positive relationships highlighted in this study between GDP, the employment rates of graduates, and skills within the labor force support the existing literature that normally highlights workforce quality and employment as a main force in driving an economy to grow further, as for instance among many studies undertaken. However, this negative association with educational attainment and industry-academia collaboration contrasts with most studies that always find positive impacts from such variables. Such inconsistency could be an indication that some contextual factors in the economic structure, labor market, or policy framework in Qatar are at play.

For example, the inverse relation of industry-academia collaboration to GDP may indicate that, in Qatar, there is a barrier to integrating academic research and the needs of industry, which in itself is not comparable to more developed economies where such liaisons have a very clear impact on their respective economies. This may also be due in part to Qatar's dependence on expatriate labor, decreasing the direct contributions that local education and initiatives related to academia-industry can make to GDP. Findings of this kind may indicate that policy efforts to improve local research capabilities and industrial partnerships will have to be carefully tailored to meet the specific needs of Qatar's economy and the structure of its labor force.

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This is further supported by the fact that the negative coefficient for educational attainment could signify that although the investment in education is increasing, the type or orientation of education is not yet fully aligned with the economic needs of Qatar's emerging industries. The result is contrary to studies coming from other high-income nations whose models indicate that higher educational attainment results in direct additions to economic output. One reason, as stated by could be the high reliance of Qatar on foreign labor in highly skilled jobs; this may temporarily lower the immediate economic impact from within the national GDP.

Multicollinearity diagnostics and VIF values support findings in the current study, mostly acceptable but flagging potential problems with Educational Attainment and Industry-Academia Collaboration that might be worthy of further investigation. The nature of the relationships among these variables may thus be complex and interlinked, as suggested by the diagnostics in this study and also by North et al.'s framework on institutional interactions in economic development. The research in the future may be directed to continue exploring these dynamics through further refinement of the model or through a longitudinal analysis that captures the shifting impact of the educational and industry factors on GDP over time.

In turn, the study itself gives much-needed insight into the economic dynamics of Qatar and critically underlines points where the Qatari experience is different from international trends, thus calling for critical discussion of how best educational and industry policies could be optimized. These findings enrich the discussion on economic growth in the Gulf states and would give reason to assume that structural and labor market idiosyncrasies are likely to determine very strongly how certain economic drivers are bound to leave their respective marks on GDP in Qatar compared to estimates that would be derived from other contexts.

6. Conclusion

The result of the regression model of determinants of GDP for Qatar is that, out of variation in GDP, it captures about 66.5% based on the selected predictors. Positive coefficients for graduate employment rates and skills within the labor force give enough reason to believe in the human capital theory, accenting the right kind of skilled and employed workforce as an economic propellant. On the other side, negative coefficients for industry-academia collaboration and educational attainment hint at these areas not being tapped or affected by some unique contextual factors, requiring a closer look.

The multicollinearity diagnostics, including the Condition Index and Variance Proportions, are all relatively low and indicate that there is some multicollinearity, but not enough to seriously threaten model validity. The high eigenvalue for the constant does raise caution in interpretation. While positive correlations with GDP, similar to those manifested in graduate employment rates, labor force skills, and innovation, indicate that policies for economic growth in Qatar should go hand in hand with skilled labor and innovation-driven policies, negative correlations, as in the case of income disparities and educational attainment, suggest areas in which more subtle policy measures would be desirable to avoid countervailing influences.

Generally, the VIF analysis falls within acceptable ranges, with the high VIF for Educational Attainment suggesting a possible need for model adjustments. Overall, the findings will underline that skilled labor and high graduate employment rates are an economic necessity for Qatar at the same time pointing to the aspect of where targeted policy interventions can further enhance the impact.

Furthermore, recent educational policy changes within Qatar-most notably, the move towards privatization, and also rising enrollments of expatriate students-provide critical context. These changes reveal a way in which the educational landscape reflects and shapes broader economic and demographic developments that occur within the country. Privatization and increased expatriate student enrollment reflect Qatar's commitment to progress in educational development, along with its challenge to achieve sustainable economic growth. In view of future global challenges and changes in demographics, further development of Qatar requires consideration of the alignment of educational policy with a wider set of economic objectives.

The results of this model confirm the hypothesis of the research that educational attainment, labor force skills, and economic indicators have a significant effect on GDP. In fact, positive coefficients for

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labor force skills and graduate employment rates strengthen the concept that a skilled and employed workforce is actually another cause of economic growth. On the other hand, negative surprising coefficients regarding industry-academia collaboration and educational attainment provide a contrast to the initial hypothesis, hinting at the possibility of a more complex relationship among these variables and GDP, which should be investigated further.

The collinearity diagnostics and correlation matrix show that the variables are highly interconnected, hence providing windows of opportunity that call for policy intervention with care. These findings affirm that economic growth in Qatar is pegged on educational improvements and sustainable development. However, the findings also suggest a need for more robust interventions in certain areas if the full potential for GDP growth is to be realized. Fundamentally, this model stresses the need for an effective linkage between the education and economic policies of Qatar for the realization of the full potential of the factors that support sustainable economic growth. In this way, Qatar will be capable of realizing its economic objectives with efficiency, which consequently opens all avenues of achieving sustained and inclusive development.

These follow from a set of policy recommendations emanating from the analysis for enhancing Qatar's road to sustainable economic growth. Industry-academia collaboration needs to be strengthened; the negative coefficient for this variable would suggest inefficiency or missed opportunities for applied, market-relevant knowledge transfer. Partnerships between universities and industries, co-development of curriculum, support for joint research initiatives, may bring better alignment with the demands of the labor market. The educational policies would at the same time be refined in tandem to more accurately reflect the labor market's needs, considering the negative relationship that exists between educational attainment and GDP, which presumes a gap in attainment that is in order. This policy would support vocational training programs, STEM education, and career guidance services that would increase graduate employability, thereby linking educational outcomes to the workforce.

Income disparities create a further obstacle to growth, while a decrease in such inequalities via inclusive economic policies would go a long way in benefiting the overall economic health of Qatar. Similarly, policy measures channeled at promoting the development of SMEs, stimulating wage increase, and creating wider participation in economic activities-particularly among those earning low incomes-would be suggestive to address this concern. Meanwhile, in Qatar, there is a strong link between qualified labor and GDP, something that points out the necessity of investing in innovation and skill development. Training programs, innovative hubs, research funding-these could establish a high-skilled, flexible workforce and make the country more competitive in a rapidly changing global economy.

With the very high VIF for educational attainment in this model, there likely exist redundancies in how this factor is modeled, and thus, the model may need to be adjusted further. It could be further improved by considering alternative model specifications or a more fine-grained approach to the educational variables-such as quality indicators or field-specific attainments. Again, while the education privatization policy direction in Qatar has increased the number of private schools and enrolled expatriate students in the State, for which there is a parallel need to invest in the public sector to ensure equity in access to quality education for all residents of Qatar. This would, in turn, strike a balance toward long-term economic stability and inclusiveness within the education sector.

Strengthening such systems of data collection and monitoring would further enhance the capacity for economic analysis in Qatar for more accurate, disaggregated indicators within education, labor skills, and economic performance. This will ensure that informed and data-driven decision-making is enabled, hence allowing interventions into appropriate policy adjustments where necessary. Finally, an integrated approach to development by ensuring policy inclusiveness would be achieved through the engagement of government agencies, the private sector, education institutions, and civil society. Such inclusive engagement could have a better alignment of Qatar's educational and economic policies with the various needs of its population for inclusive sustainable growth.

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References
[1] A. Al-Fadala, "WISE 11 summit report & policy recommendations world innovation summit for education (WISE)," Retrieved: https://www.wise-qatar.org/wise-11-summit-report-policyrecommendations/. 2024.
[2] UNESCO, "UNESCO and partners launch the joint statement for transforming higher education in emergencies," Retrieved: https://www.unesco.org/en/articles/unesco-and-partners-launch-jointstatement-transforming-higher-education-emergencies. 2023.

Bibliography
[1] T. Al-Emadi, "The role of education in economic development: A case study of Qatar," *Journal of Economic Studies*, 2023.
[2] A. Al-Mulhim, "Economic diversification and the role of higher education in Qatar," *Economic Development Quarterly*, 2023.
[3] H. Al-Thani and R. El-Masri, "Challenges and opportunities in Qatar's education system post-COVID-19," *International Journal of Educational*, 2021.
[4] G. S. Becker, *Human capital: A theoretical and empirical analysis with special reference to education*. University of Chicago Press, 2023.
[5] S. Ghobadi and A. Rezaei, "Industry-academia collaboration and its impact on innovation and economic development," *Journal of Innovation and Entrepreneurship*, 2023.
[6] M. Khan and A. Zubair, "Educational policy reforms and economic growth: Lessons from developing countries," *Policy Studies Review*, 2023.
[7] S. Mohammed and A. Rashid, "The impact of COVID-19 on education systems: Challenges and opportunities," *Educational Research Review*, 2022.
[8] Q. Planning and Statistics Authority, "Education statistical profile," Retrieved: https://www.psa.gov.qa/en. 2022.
[9] Q. Planning and Statistics Authority, "Report on employment rates of graduates ", Retrieved: https://www.psa.gov.qa/en. [Accessed 2022.
[10] Qatar Development Bank, "Education sector in Qatar: Current state assessment series," Retrieved: https://www.qdb.qa/en/Documents/Education-Sector-in-Qatar-CurrentState-Assessment-Series.pdf 2021.
[11] A. Saif, "Education and economic growth: Global perspectives and the Qatari experience," *Economic Development Quarterly*, 2022.
[12] World Bank, "Education quality and economic growth," Retrieved: https://documents.worldbank.org/en/publication/documentsreports/documentdetail/885051468141302837/education-quality-and-economic-growth. 2022.
[13] World Bank, "Report on FDI in Qatar," Retrieved: https://data.worldbank.org/country/qatar. 2022.

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