Role of Education, E-learning and Financial Development towards Environmental Sustainability

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Abstract

Due to globalization, the role of financial development, education and E-learning is increasing in the daily life of people, which significantly influences the environmental outcomes. But this association has attained little attention in Chinese context from scholars and environmental economists. This study tries to fulfil this vacuum by exploring the impact of financial development education and E-learning on Chinese environmental performance through the ARDL approach. The findings disclose that education and E-learning improve environmental performance in China. Based on these findings, it proposed that the Chinese government should promote E-learning and education in remote areas of China to improve environmental performance and the overall well-being of society.

Keywords: *Education, E-learning, CO2 emissions, ARDL, China.*

Introduction

Three of the world's most important socio-economic development components include health, education, and poverty (Hannum & Buchmann, 2005). The Millennium Development Goals (MDGs) of the United Nations (UN) in 2000 emphasized importance of health, education, and poverty as the main indicator of human development (Diaz-Sarachaga et al., 2018). This declaration demands the world community to take the initiative in the field of health, education, and poverty reduction so that the situation on these indicators improves over the next 15 years (Jones & Chant, 2009). In 2015, the UN general assembly issued an extension of these goals with the name Sustainable Development Goals (SDGs), which are 17 in number and must be implemented by the end of 2030. Like MDGs, the SDGs also focus on developing healthy lifestyles, reducing all types of poverty, and providing quality education for all (Liu et al., 2015).

Despite these directions by the UN, about 2.6 million children could not live only for a month after birth. According to (Afzal et al., 2021; Azam et al., 2021; Organization, 2016), out of these 2.6 million Children, about one million children die just after one day of birth. The UNICEF also sheds light on the reasons behind stillbirths, which represent the complications in the pregnancy and delivery procedures alongside infections in the children at the time of birth (X. Li et al., 2022). However, the difference in mortality rate in the countries depends on the different factors in the countries. For instance, these factors are much more favourable in a country like Japan, where just one out of 1000 children die within the first 28 days of birth; however, the scenario is worst in the context of Pakistan, where 46 out of 1000 children die at the time of birth. The socio-economic condition of a country is mainly responsible for the chances of an infant's existence (Yang et al., 2022; Ye et al., 2022). With every passing day, the gap between developing and developed economies is increasing in the context of attaining SDGs. If immediate actions are not taken, the situation will be out of control in the developing economies in the coming years, and they will slip further away from the targets of SDGs. The simple and widely accepted definition of the term' health outcome' represents the factors that can affect the lifestyle of resident of an economy (Nutbeam, 2008).

Health outcome refers to health-related issues; chronic ailment and illness, psychosocial working, care expenses, longevity, life quality and mortality satisfaction with care (Dutta et al., 2020; Kasparian & Kovacs, 2022). The study of (Wen et al., 2006) provided the proper definition of health outcome by saying that health variation of an individual, group or the whole population is due to an interference. It considers all the aspects of services provided by the health sector, ranging from the cost of services, time involved incomplete recovery, hospital services, management of services, and the social recognition of the patient (Jiang et al., 2020). Many empirics in the field of health economics have used the abovementioned factors as crucial indicators of quality of life. Many researchers argue that the health outcome of the people is directly affected by environmental performance.

Information and communication technologies have completely transformed society by providing a facility to exchange and convey inexpensive and highly efficient information (Kouton et al., 2021). ICT has made e-learning possible, revolutionizing the environmental and education sectors. The role of e-learning is rising in the environmental sector, and the literature is growing. The literature argues that ICT can significantly solve various environmental issues (Usman, Ozturk, Hassan, et al., 2021). ICT provides guidelines that help reduce human activities' influence the environment. For instance, E-commerce helps reduce petroleum consumption by reducing transportation activities (Nogueira et al., 2022). In the case of ASEAN economies, (Lee & Brahmasrene, 2014) reported a significant favourable relationship among ICT and CO2 emissions. Thus, it is imperative to understand the transmission channels through which ICT influences environmental sustainability. The transmission mechanism between ICT and environmental sustainability can be categorized in three manners (Asongu et al., 2017; Higón et al., 2017). Firstly, ICT positively enhances environmental sustainability through the channel of technological advancement. ICT promotes E-learning that can significantly reduce transportation activities that lead to a substantial CO2 emissions cutback. Lastly, ICT development improves social and economic performance, promotes environmental behaviour among people, and significantly improves environmental sustainability. ICT not improves environmental sustainability but can also be used to bring awareness among the people regarding the preventive measures to curb the spread of several diseases (Gao et al., 2022).

Many empirics study the link between education and environmental sustainability (Butt, Sajjad, & Awais, 2023), but whether the link is causal or not is debatable. We aim to update this area of research with the inclusion of e-learning alongside the traditional methods of education. Studies such as (Li & Ullah, 2022; Zafar et al., 2020) have analysed the theoretical and empirical relation concerning education and the environment in detail. Past literature has provided three explanations for the association between education and the environment. First, a higher level of schooling may lead to better environmental performance; secondly, higher environmental sustainability may improve the education standards; thirdly, time preference or any other omitted factor may impact both education and the environment. Consistent with these views, this study is an effort further to analyse the nexus between education, e-learning, and environmental sustainability. This study makes an empirical contribution to the literature by offering short and long-run results.

Model and Methods

We aim to examine the effects of education and e-learning on environmental sustainability. It is widely recognized that all factors are important in improving environmental quality measures. By taking help from past studies such as (Higón et al., 2017; Usman, Ozturk, Hassan, et al., 2021), Eq. 1 indicates the constructed model:

$$CO_{2,t} = \delta_0 + \delta_1 \text{Education}_t + \delta_2 EL_t + \delta_3 GDP_t + \delta_4 FD_t + \delta_5 GE_t + \varepsilon_t \qquad (1)$$

Where $CO_{2,t}$ is carbon emissions that depend on educational attainment (Education), e-learning (EL), government expenditure (HE), financial development (FD), and GDP per capita (GDP). This research work simultaneously computes the short and long-run estimates by utilizing error correction transformed modelling i.e. Eq.2.

$$\Delta CO_{2,t} = \delta_0 + \sum_{k=1}^{n} \beta_{1k} \Delta CO_{2,t-k} + \sum_{k=0}^{n} \beta_{2k} \Delta \text{Education}_{t-k} + \sum_{k=1}^{n} \beta_{3k} \Delta EL_{t-k} + \sum_{k=0}^{n} \beta_{4k} \Delta GDP_{t-k} + \sum_{k=1}^{n} \beta_{5k} \Delta FD_{t-k} + \sum_{k=0}^{n} \beta_{6k} \Delta GE_{t-k} + \delta_1 CO_{2,t-1} + \delta_2 \text{Education}_{t-1} + \delta_3 EL_{t-1} + \delta_4 GDP_{t-1} + \delta_5 FD_{t-1} + \delta_6 GE_{t-1} + \lambda . ECM_{t-1} + \varepsilon_t \qquad (2)$$

The ECM measures the adjustment speed (for instance, λ) from short-run to long-run dynamics of bounds testing method, renowned as the ARDL model (Pesaran et al., 2001). The conventional cointegration methods are available, but they have a few limitations. For instance, previous popular cointegration methods necessitate that variables must be integrated at I(1). Though the ARDL approach is free from integration limitations, the model deals with mixed orders of integration. This method provides simultaneously short and long-run results, while other cointegration methods can convey the long-term results. The "Δ" variables measures the short-run dynamics, while the long-run effects are measured through $\delta_2 - \delta_6$ normalized on δ_1. The F-test and ECM-test affirmed the long-run estimates. The conventional time series methods are inefficient in the case of the small number of observations except the ARDL which provides efficient results (Lei et al., 2021). Endogeneity and serial correlation issues can easily resolve in the ARDL method by incorporating short-run dynamics. The study

examines the nexus between education; PEdu (Primary Education), SEdu (secondary Education); TEdu (tertiary Education), E-learning, and environmental sustainability for Chinese economy spaning the 1995 to 2020 and collected World Bank databases and depicted in Table 1.

Table 1: Data nature and description

Variables	Mean	Median	Maximum	Minimum	Std. Dev.	Definitions
CO2	6.794	6.851	7.071	6.487	0.214	CO2 emissions (kt)
SEdu	4.356	4.372	4.748	3.919	0.262	School enrollment, secondary (% gross)
TEdu	2.944	3.025	4.068	1.479	0.819	School enrollment, tertiary (% gross)
PEdu	4.985	5.015	9.290	4.550	0.212	Average years of primary schooling, age 15+, total
EL	1.863	2.945	4.254	-5.307	2.758	Individuals using the Internet (% of the population)
GDP	8.352	8.414	9.247	7.326	0.632	GDP per capita (constant 2015 US$)
FD	4.808	4.795	5.206	4.433	0.194	Domestic credit to private sector (% of GDP)
GE	15.42	15.53	17.13	13.19	1.088	Government final consumption expenditure (% of GDP)

Results and discussion

By following econometric roadmap, it is compulsory to access the variables' stationarity before choosing the ARDL approach for empirical tasks. The prerequisite for the ARDL model is that none of the series should be second difference stationary and the PP and GF-GLS tests applied to check the unit root analysis and reported in Table 2; infer a set of a mixture order of integration. Hence, the ARDL approach explores the long-run and short-run impact of education and E-learning on environmental sustainability in China and reported in Table 3. As we are using three proxies for education variables, thus we have estimated three separate models in this study.

Table 2: Unit root test

	PP		DF-GLS			
Variables	I(0)	I(1)	I(0)	I(1)	Decision	
CO2	-0.624	-2.754*	-0.452	-2.061**	I(1)	I(1)
SEdu	-0.821	-3.012**	0.841	-1.987**	I(1)	I(1)
TEdu	-1.512	-2.688*	-0.345	-2.578***	I(1)	I(1)
PEdu	-5.564***		1.023	-1.644*	I(0)	I(1)
EL	-5.664***		-0.987	-1.687*	I(0)	I(1)
GDP	-1.458	-2.875*	-1.742*		I(1)	I(0)
FD	-0.632	-2.821*	0.175	-3.875***	I(1)	I(1)
GE	-1.021	-4.321***	-0.721	-4.921***	I(1)	I(1)

Note: *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

Table 3: Carbon emissions outcomes from ARDL

	Model (1)		Model (2)		Model (3)	
Variable	**Coef.**	**t-Stat**	**Coef.**	**t-Stat**	**Coef.**	**t-Stat**
Short-run						
SEdu	-0.050	-0.879				
SEdu(-1)	-0.011	-0.924				
SEdu(-2)	-0.002**	-1.989				
TEdu			-0.023***	-4.114		
PEdu					-0.007	-0.473
PEdu (-1)					-0.016	-1.174
EL	-0.007	-0.727	-0.004***	-2.856	-0.005***	-3.150
EL(-1)	-0.005***	-4.820	-0.002***	-6.436		
GDP	0.002***	2.764	0.003***	3.254	-0.004*	-1.729
GDP(-1)	0.003**	2.179	0.002*	1.930		
GDP(-2)	0.004	1.492	0.003***	3.705		
GE	-0.006*	-1.693	-0.008	-1.346	-0.006	-1.255
GE(-1)	-0.002*	-1.765	-0.003*	-1.664	-0.003**	-2.369
FD	0.004	1.101	0.005	0.795	0.006	0.998
Long-run						
SEdu	-0.017*	-1.670				
TEdu			-0.013***	-5.029		
PEdu					-0.184***	-13.16
EL	-0.014	-0.878	-0.012*	-1.686	-0.015***	-11.26
GDP	0.051***	9.896	0.041***	6.989	0.017***	2.635
GE	-0.003*	-1.912	-0.006***	-3.337	-0.005**	-2.436
FD	0.021	0.243	0.012	0.808	0.014***	3.788
C	3.935***	4.794	3.950***	5.454	3.285***	8.655
Diagnostics						
F-test	20.32***		8.320***		5.698***	
ECM(-1)*	-0.208***	-5.400	-0.209***	-6.514	-0.402***	-6.297
LM	0.320		0.785		0.901	
RESET	0.891		0.157		0.452	
CUSUM	S		S		S	
CUSUM-sq	S		S		S	

Note: *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

The education, secondary education, and tertiary education have an adverse statistically significant link with CO2, revealing that all three proxy education measures bring significant improvement in environmental sustainability in China; 1 percent escalation in secondary education, tertiary education, and education reduces CO2 by 0.017 percent, 0.013 percent, and 0.184 percent, correspondingly, hence, a positive association between education and environmental sustainability (Nathaniel et al., 2021). These studies argue that education stimulates innovation that triggers improvements in productivity and ensures environmental quality. Education indirectly influences the environment through social, financial, and occupational channels (Yin et al., 2021).

The model 2 and model 3 are revealing that an increase in the internet usage contributes environmental performance improvements in the long run for Chinese economy. It indications that 1 percent intensification in E-learning reduces CO2 levels by 0.012 percent in model 2 and 0.015 percent in model 3 in the long run. Our findings report a positive impact of e-learning on environmental sustainability, as reinforced by the subsequent studies (Avom et al., 2020; Majeed, 2018). These studies claim that e-learning enhances knowledge about environmental issues and facilitates spreading information about clean energy use. With the e-learning facilities, people better interact with environmental care service providers to make decisions and advice about using energy products.

All three models are revealing that GDP per capita expansion inclines to boost significantly the long run Chinese CO2 level. In long run, 1 percent upsurge in GDP per capita enhances CO2 by 0.051 percent, 0.041 percent, and 0.017 percent in model 1 to 3, subsequently. The impact of government expenditures on environmental performance is significant and negative in all three models, revealing that increasing government expenditures improve environmental performance significantly in China. It displays that a rise in 1 percent government expenditures will dimish the long run CO2 by 0.003, 0.006 and 0.005 percent in model 1 to 3, respectively. It is also confirming that financial development tends to deteriorate the long run Chinese environmental performance. In the short-run, the impact of secondary education and education on environmental performance is found to be statistically insignificant, while the impact of tertiary education on CO2 is reported significant and negative in China. In model 2 and 3, the impact of E-learning on CO2 is reported to be significant and negative in the short run. Hence, our findings confirm that E-learning plays a dominant role in improving environmental performance compared with education in the short run. The results of diagnostic tests validate the findings of all three ARDL models; F-stat, ECM term; long-run cointegration, LM test for no serial correlation, Ramsey RESET test for correct functional form, and CUSUM and CUSUM-sq tests for stability condition.

Conclusion and Implications

There has been growing literature exploring environmental performance's social and economic determinants. Various researchers have investigated the linkages among the financial development, income, technological innovation and environmental sustainability. However, we failed to find any study examining the impact of education and E-learning on environmental performance. Thus, this study puts effort into filling this vacuum of literature by using the Chinese time-series data. The key concern of this research work is to explore the impact of education and E-learning on environmental performance. By employing the ARDL approach, it infers; all three proxies of education are revealing that education enhances environmental knowledge that ultimately improves the environmental performance both in the long and short-run. Secondly, E-learning is also displaying that internet use improves environmental outcomes in China in the long and short run. The impact of GDP per capita and financial development on CO2 is significantly positive in the long run, while the impact of government expenditure on CO2 is found to be significantly negative in the short-run and long run.

Based on these findings, our study put forward some important policy suggestions for education and the E-learning sector. This research highlights the significance of comprehensive measurements and conceptualization of the environment in Chinese public policy and educational research. It is suggested to improve the quality of education and ensure the level of equity that will help attain environmental knowledge that generates long-lasting environmental benefits. Embedding instructions related to environmental education into education curricula can generate benefits for the environmental sector. It is suggested to increase investment in E-learning, and the government should develop E-learning excellence centers in remote areas of China. This initiative will support collaboration, evaluation, implementation, development, and design of E-learning materials. The construction of E-learning centers will promote environmental performance in remote and less developed areas of China.

Despite these policy suggestions, our study contains several limitations. Our study captures the impact of education and E-learning on the aggregate economy of China. Due to data constraints, we couldn't explore this nexus for the disaggregated economy of China. Future studies should explore the same relationship for the provincial economies of China to provide more accurate policy suggestions for remote areas. The asymmetries among variables undermine the relationship. Thus, exploring the impact of positive and negative shocks among variables will be good. Future studies should explore the asymmetric impact of education and E-learning on environmental performance by using the NARDL approach.

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