The Role of Education in the Future AGI. A Study on the Balance of Education, Finance, and Social Welfare

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Abstract

According to the provisions set out in Objective 4 of the Agenda for Sustainable Development set up by the United Nations in September 2015 for the implementation of a fair and quality education, boundless by borders as a result of the adhesion of the states fully assumed for these objectives, the action plans must be vitalized and contextualized by the information crisis created by the pandemic, war, and artificial intelligence. These circumstances have instituted a global tension in education. While some companies are cushioning this tension through their investments in the specialization of employees, the solution to neutralize the global educational risk is the development of the public educational process per the worldwide objective. For future generations of professionals, educational practices must establish and develop contextualization and practice to meet the competence requirements required by AGI (artificial general intelligence) within enterprises. In AGI companies people use LLM (large language model) for evaluation and analysis and specialization involves competence for the profession's

deontology and appropriate technical professional training. Thus, there is an established need for an educational program that develops upskilling, a program with a double significance: the establishment of professional skills and the foundation of personality attributes for safe, ethical, and responsible professional practice.

The UN together with the OIM calls for a unitary educational system in principles and the implementation of an educational process based on scientific thinking and developed socio-emotional skills.

The general subject of this article examines to what extent education impacts social well-being and financial performance. The research aims to study the circumstantial conditional association between education, well-being, and economics and to highlight the impact of education on social welfare and the economy. The research is based on information capitalized in Eurostat, IMF, and OECD databases and starts from the status quo of the last 20 years, the analysis of this period notes an increasing rate of completion of the higher education cycle, but UNESCO statistics on skills acquired in reading and calculation affirms a decreasing rate of these. Going forward with the research, we observe the consequence in the employment rate for people who have graduated from an institution of higher education, much higher than the employment rate of primary or secondary education graduates, the Nordic countries being at the top of this ranking. This situation, however, generated an increasing unemployment rate in the analyzed period. This study researches how extent programs combat unemployment among young people aim to increase practical and social-emotional skills, analyzes the impact of investments in education and their effect on the economy, and the incidence of integrity and quality control of the educational process. Graphical representations and data analysis are performed in Microsoft Office.

Keywords: education, sustainability, artificial general intelligence, higher education, workforce, well-being.

JEL Classification: I20, I23, I24, I25, J01, J21, J24.

1. Introduction

"Education is the most powerful weapon you can use to change the world" (Nelson Mandela). The school in its early form, i.e. from the 9th to the 13th centuries, developed along two main lines: religion and philosophy. In the organization of the terrestrial world, philosophers such as Xenophon of Elea affirmed that God is the absolute principle of all things. Anaxagoras, on the other hand, portrays God as the Universal Nous - the active and organizing thought that created minerals, plants, animals, and man. The rationalism of scholasticism is advanced by Plato's Dialectic as the basis for the innovative research of the new order that has God at its center (Ion Buga, 2021). Thus, education has meant since ancient times more than the accumulation of knowledge, but the shaping of a character, imprinting moral quality, harmonious development, elegance in behavior, and diplomacy in speech, all of which summed up a robust but skillful model of education (Iancu, 2019).

The chances of a world are determined by education, its territoriality, and the level of quality and equality of these services towards the learning of students. The gloomy scenarios project in the not-too-distant future a chasm regarding education and schooling opening for future generations. Therefore, education may become a privilege for the elite while for the poor, education will become completely inaccessible. Indeed, there is a huge potential for growth and development in education and training thanks to technology and artificial intelligence. The educational environment can benefit from structural transformations thanks to artificial intelligence that can solve inequality of learning, lack of resources, pollution, lack of educational programs, and shortage of teachers (UNESCO, 2021). The calls for investment, technology, and innovation are useful for the establishment and improvement of education plans and budgets for regions and countries that do not have the resources for such allocations.

The share of total public expenditure on education is made up of education expenditure per pupil, depending on the level of education and the source of funding. Africa, despite having one of the highest education expenditure ratios in GDP, has the highest number of out-of-school children in the Southern Hemisphere, and Africa also has the highest number of countries that do not have allocated sources of funding for science, technology, and innovation (Unesco

Institute for Statistics, 2024). The high cost of education in the absence of investment and innovation jeopardizes evolution and development which is more important than income.

Nowadays education research is supported by more than 6 mil. papers on education realized in the last 50 years and among them more than 700.000 research on the quality of education. More nearly 100,000 papers research the impact of artificial intelligence in education. Therefore, we can say that research on artificial intelligence is at its beginning, however, it is important to note the impact of research and innovation in increasing educational performance, it has given in a short period impressive skills and tools for efficiency and accuracy, for example ChatGPT.

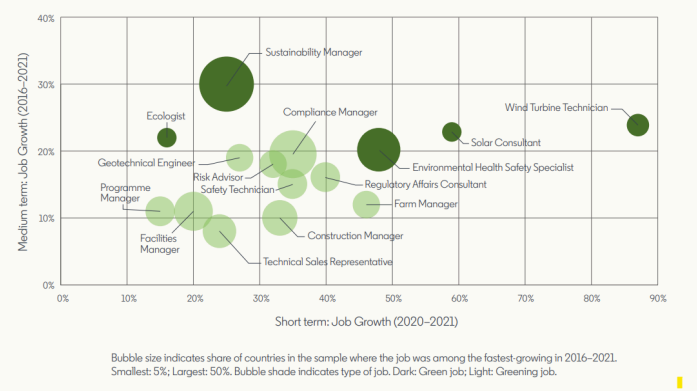
A generally accepted view is emerging that innovation in education reflects the ability to experiment, share, and extend more so it reflects the ability to get fair value in an equitable and unbiased way. Innovation in research needs to happen at any scale, according to the UNESCO study of 2021 - Reimagining our Futures Together - more at the UN Summit in September 2024 the duty to support developing countries in their approach to investing in education is reiterated. The actions set, in the meetings held during the summit, emphasize ensuring measures for the implementation of early education and increasing skills while harnessing digital technologies (UN, 2024). Concerning the emerging centers of artificial intelligence, it reaffirms SDGs 4 and 5 set by the UN, according to which a strategy for maximum coverage of basic digital competencies among both teachers and students, while promoting intermediate and advanced digital competencies, should be implemented expeditiously (UN, 2024).

This study aims to contribute to the scientific field with research realized on the context influencing the qualitative factors of education. Respectively to perform an analysis of the causal link between the performance of research and innovation in the field of technology and the performance of the educational act present in the value chain. We also intend to analyze whether the consistency in investments and updating of teaching methodology has a positive effect on the educational level, manifested by the level of promotion, and the continuation of the learning process over a long period.

2. Literature Review

Whether because of the demands of the transition to a sustainable economy or the gargantuan challenges of artificial intelligence - the field of jobs is experiencing both opportunities and challenges. According to a study by LinkedIn, the demand for new skills outstrips the supply. But in this global context, new jobs are emerging, for example, sustainable development manager or energy auditor. More experience and green skills differentiate the labor market. According to LinkedIn the US labor market ranks first in renewable energy, surpassing the Middle East. Moreover, as part of the transformation of the economy towards a sustainable economy, green financial products are being implemented, the management of which must be green and for which sustainable finance skills are required (LinkedIn Economic Graph, 2023).

Concerning green skills, dig into the status quo of competencies and attribute talent. In demand in all fields of activity, especially in emerging markets, talent is manifested through innovation in sustainable and environmentally sustainable actions. Another study conducted by LinkedIn Economic Graph exposes the situation that globally the share of green talent among workers with at least a bachelor's degree increased at an average annual rate of 11% between 2015 and 2021, compared to 9% among workers without a bachelor's degree for the same period (LinkedIn Economic Graph, 2022).



Source: Green Jobs, LinkedIn Economic Graph. Global Green Skills Report (2023).

On the implications of artificial intelligence for the expansion of the workforce and on the ecological transition of labor markets, the study conducted by Alexander et al for the IMF in July 2024 classifies sustainable and unsustainable jobs according to the nature of the tasks. Moreover, sustainable jobs are exposed to the demands of artificial intelligence and the

advances it is making. Conversely, unsustainable jobs show minimal exposure to artificial intelligence, with manual labor predominating among them (Alexander et al., 2024). They study the future of the labor market with Pizzinelli's predecessor study investigating the uniformity of education, training, and work experience across jobs. According to him, occupations that require longer periods of professional development are better suited to incorporate AI knowledge, thus bringing complementary skills to job tasks (Pizzinelli, 2023) but are also more resilient to these changes (TimeCO2, 2024). In response to the up-green skills requirements for the transition to a sustainable economy, MFI is a contributor to capacity building. In education, it continues to increase the number of its free online courses with more than 160,000 active learners participating, and to build sustainable financial solutions to support education (IMF, 2023).

In the transition towards a sustainable economy, the emerging character and characteristics of the activity are supported by scientific studies, research, and academic papers (Regulation (EU) 2023/2772 regarding sustainable reporting). In these circumstances, accurate forecasts of academic performance provide benefits and predictability for students, teachers, policymakers, institutions, and businesses (Asselmanetal et al, 2023). These predictions can improve both academic performance and the objective performance of value chain stakeholders (Hakkal, Lahcen, 2024). However, once artificial intelligence has been formalized (including through the European Commission's AI Act establishing harmonized rules on artificial intelligence in Regulation (EU) 2024/1689, the question of the ethics and integrity of its use arises. According to the study by Lee et. al., there is an acceptance among universities to use it to explain concepts and to provide some ideas before the design of the work (Lee et.al., 2024). Moreover, learning in virtual reality is considered an efficient technique mainly in gaining experience and less in acquiring pedagogical information - for example, in training courses conducted for pilots to conduct training classes (Jongbloed et. al., 2024), however complementary studies reveal that to accomplish a high level of knowledge and contextualization requires personal study (Squires, Rigby, 2024). Even better, another study reveals that contextual knowledge analysis is a growing requirement among employers, academia, and research (Brianza et. al, 2024). But to evaluate contextualized information as an applicable science in research and practice, Brianza

reveals that factors such as social, epistemic, and technological resources influence the outcomes of contextualized expertise (Brianza et. al., 2022). Moreover, science-gained expertise (Berliner, 2001) capitalizes on contextual information (Hatano, 1986) and although this is a desired and pursued strategy in both academia and business, information exchange still reflects a major gap between theory and practice and the contextual approach is insufficiently addressed for practitioners to establish meaningful connections between theory and practice (Ripple et. al., 2018). The efficiency of contextualization that validates informational conductivity is realized through self-regulated metacognitive learning (Dahri, 2024) respectively through the mobilization and updating of techniques (Jianget et. al. 2016) that converge to increased efficiency of contextualization processes (Flavell, 1976). This is because awareness involves one's thinking and understanding (Lai, 2011). Also, in self-regulation (Dent, 2016) practitioners evaluate their knowledge and gaps and take actions to improve them (Boekaerts, 1999). The emergence of large language models (LLMs) is encouraging to improve self-regulation (Joublin, 2023) and develop critical thinking (Khan, 2023). Thus, LLM provides possible response options (Khan, 2023) that develop the informational event horizon (Winter, 2023). Other studies reveal the importance of LLM in SRL (self-regulated learning) (Wang, 2023). Also from the AI side, tools are being developed that improve self-learning. The Technology Acceptance Model (TAM) (Bagozzi, 1989) assesses and improves individual education (Li, 2023) and professional competencies (Al-Rahmi, 2019). Moreover, as we also showed from the studies conducted for the IMF, the disparity must always be assessed when analyzing the success of implementing an LLM tool (Herrmann, Weigert, 2024) and more so in the self-learning process (SRL) a human-computer disparity must always be assessed (Wang, Liu, 2023).

3. Methodology

The literature review to examine the scientific literature corresponding to the research topic was carried out by querying a sample of papers covering the literature published between 2023-2024, considering the emerging topic of the paper, we considered relevant the studies conducted in the last 2 years. To conduct the search and screening procedure we queried the *Web of Science* (WOS) database. The database was queried according to the keywords

"Education", "High education", and "Artificial Intelligence". After extracting the papers, we formatted two databases and bibliometric analyzed them in the *Vos Viewer* program. The bibliometric analysis terms were extracted from the fields "Title" and "Abstract". A total of 1,452 papers were analyzed.

To capitalize on the informational focus of the analyzed studies, we performed examinations on the following queries:

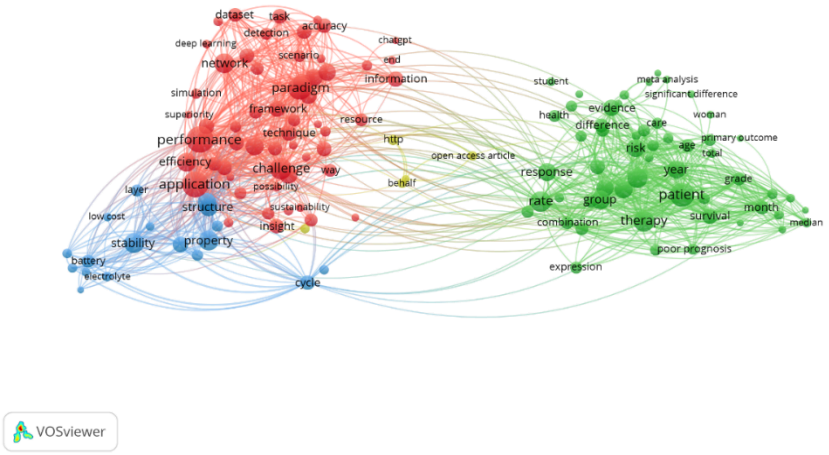
3.1 Area of events of artificial intelligence in education.

3.2 Differential impact between accuracy and performance on education using artificial intelligence.

For items 3.1 and 3.2 the representations obtained in *Vos Viewer* are investigated with statistical data represented in a tabular construct analyzed correlatively with the representations from the bibliometric analysis.

4. Results and Discussions

In this section, we present the results of the systematic review in the same order as in the previous methods section. We start with a brief overview of the sample resulting from the search and screening. We then present the results obtained for each of the points established in the previous section. The bibliographic coupling group in Panel A (Lim et. al., 2024) reveals immersive information that radiates to peripheral centers signaling either independent centers or specialized domains. However, the 3 cluster centers (red, blue, and green) show homogeneous formations characterized by interdependence. The obtained bibliometric result reveals the economic environment actions involving similar characteristics concerning artificial intelligence-augmented education.



Panel A. The artificial intelligence trend in education

3.1 Artificial intelligence events in education - investments in technology and higher education

The consolidation of the specialized literature with statistical data is realized according to the data reported by the UNESCO - Institute for Statistics in the period 2016-2022, so before the interval 2023-2024 (the period for the research carried out on the specialized literature) so we can say that the results of bibliometric research are the consequence of the research actions carried out with innovation and technology developed in the period 2016-2022. Therefore, the investments in innovation, science, and technology representing the number of professionals involved in the conception or creation of new information are presented in **Table 1** - Researchers per million inhabitants (FTE). The study reveals the top 5 places: Australia, New Zealand, North America, Europe, and Oceania.

	Sustainable Development Goal Regions	Researchers per million inhabitants (FTE)
1	Australia and New Zealand	28,810
2	North America and Western Europe	26,736
3	Northern America	25,601
4	Europe and Northern America	22,914
5	Europe	21,582

Table 1. Researchers per million inhabitants (FTE)
Source: Authors' research from the UNESCO - Institute for Statistics database

On the other hand, even if the bibliometric analysis reveals an increased density between education and technology, the statistical data differentially expose the expenditure in education from the expenditure in technology, respectively investments, from the data analysis the top 5 countries that rank in the top of public expenditure on tertiary education, from the data reported by UNESCO - Institute for Statistics for the period 2017 - 2023, are Sierra Leone, Denmark, Bolivia, Norway and Barbados according to **Table 2** - Government expenditure on tertiary education as a percentage of GDP (%).

	Country	2017	2018	2019	2020	2021	2022	2023	Total
1	Sierra Leone	2.75	3.24	2.99	3.58	3.35	2.70	2.10	20.71
2	Denmark	2.39	2.38	2.41	2.41	2.37			11.96
3	Bolivia	1.88	1.81	1.86	1.95	1.78	1.66		10.94
4	Norway	2.09	2.06	2.13	2.31	1.91			10.52
5	Barbados	1.24	1.39	1.18	1.42	1.72	1.47	1.27	9.70

Table 2. Government expenditure on tertiary education as a percentage of GDP (%)
Source: Authors' research from the UNESCO - Institute for Statistics database

The analysis shows that even though Africa ranks 19th out of the 29 regions reported by the UNESCO - Institute for Statistics, according to **Figure 1** - SDGs by region, it ranks first in the country rankings for tertiary education.

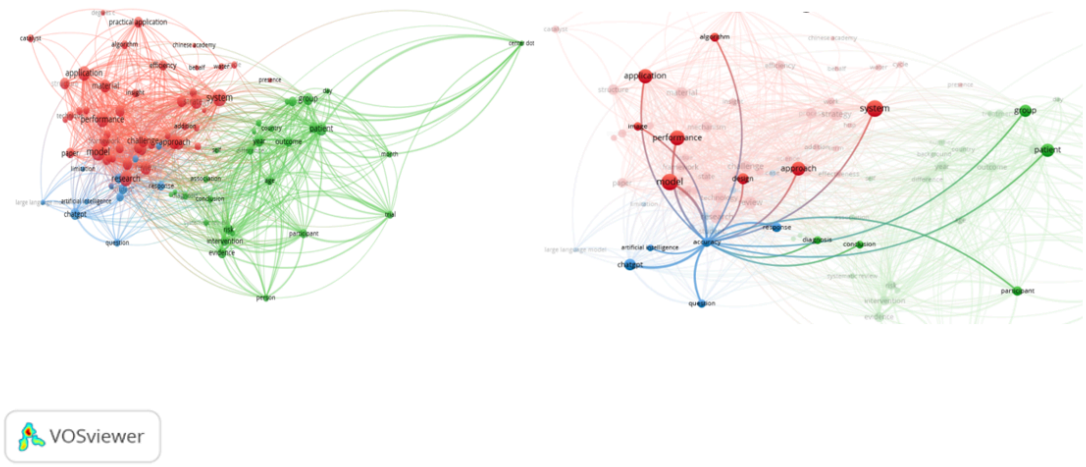
Tabel 1 - Researchers per million inhabitants (FTE)

	Sustainable Development Goal Regions	Researchers per million inhabitants (FTE)
1	Australia and New Zealand	28,810
2	North America and Western Europe	26,736
3	Northern America	25,601
4	Europe and Northern America	22,914
5	Europe	21,582
6	Oceania	20,457
7	World	15,157
8	Central and Eastern Europe	13,236
9	Eastern Asia	11,834
10	Small Island Developing States	10,519
11	East Asia and the Pacific	9,946
12	Eastern and South-Eastern Asia	9,742
13	Latin America and the Caribbean	7,244
14	Upper middle income countries	7,108
15	Central Asia	6,449
16	Western Asia	6,296
17	Northern Africa and Western Asia	5,427
18	South-Eastern Asia	4,744
19	Northern Africa	4,431
20	Middle income countries	4,365
21	Arab States	3,533
22	Lower middle income countries	1,853
23	Central and Southern Asia	1,781
24	South and West Asia	1,745
25	Southern Asia	1,745
26	Sub-Saharan Africa	1,160
27	Low income countries	1,039
28	Landlocked Developing Countries	974
29	Least Developed Countries	428

Figure 1. SDGs by regions

Source: Authors' research from the UNESCO - Institute for Statistics database

3.2 The differential impact between accuracy and performance on education using artificial intelligence



Panel B. Resources and expected outcomes on school life expectancy

The determined factors analyzed in this cluster are the duration of the teaching process and we also considered relevant to analyze the number of teachers in higher education schools. The bibliographic coupling group in **Panel B** determines current as well as future trends. The bibliometric survey reveals current characteristics converging to the event horizon line. This may signify its potential in the future (Damar, 2021) constituted by a natural diversification or from the interaction with specific emerging factors that will drive future research toward new investigative environments.

From the bibliometric analysis, depicted in **Panel B**, the resolution applied on the first image reveals that one of the poles of education is the accuracy from which performance results, the image on the right side of **Panel B**.

For this reason, we decided to analyze the extent to which accuracy is supported in academia. **Table 3** shows the number of teachers involved in the higher education system. Thus, according to the data reported by the UNESCO - Institute for Statistics for the period 2017-2023, the top ten countries with the highest number of professors in the higher education system are shown in **Table 3**.

	Country	2017	2018	2019	2020	2021	2022	2023	Total
1	India	1,365,786	1,388,732	1,416,299	1,503,156	1,551,070	1,599,812	1,664,172	10,489,027
2	Japan	560,123	560,964	560,352	563,364	561,558	561,141		3,367,502
3	Germany	407,132	416,241	456,041	457,457	472,418	484,301		2,693,589
4	Brazil	445,514	448,533	472,012	439,269	438,364	442,095		2,685,787
5	Mexico	387,391	397,142		386,881	401,367	483,868		2,056,649
6	United States of America	1,581,424							1,581,424
7	Republic of Korea	219,598	220,797	211,090	216,295	222,134	226,248		1,316,162
8	Russian Federation	597,067	539,144						1,136,211
9	United Kingdom	156,295	161,145	217,004	192,027	193,011	200,310		1,119,792
10	Spain	167,063	171,869	175,759	175,019	179,661	186,592		1,055,963

Table 3. Teachers in tertiary education programs, both sexes (number)

Source: Authors' research from the UNESCO - Institute for Statistics database

Next, we found it necessary to analyze what is the school life expectancy related to the number of years of schooling that a person can receive during his/her lifetime. Given the importance of implementing a strategy that contains an early schooling program for the child, we consider that the expected lifetime schooling experience is closely related to accuracy and performance. **Table 4** shows the top 10 countries that are at the beginning of the analysis of the expected

number of years of schooling, based on data reported by UNESCO - Institute for Statistics for the period 2017-2023.

	Country	2017	2018	2019	2020	2021	2022	2023	Total
1	Greece	6.17	6.47	6.68	6.72	7.08	7.69		40.81
2	Türkiye	5.74	6.00	6.12	6.22	6.47	6.45		36.99
3	China, Macao	3.75	3.67	3.74	3.93	4.45	5.25	5.97	30.76
4	Australia	5.26	4.91	5.20	5.14	5.19	4.94		30.64
5	China, Hong Kong	3.58	3.82	4.06	4.31	4.59	4.62	4.76	29.74
6	Argentina	4.49	4.56	4.75	4.95	5.34	5.34		29.42
7	Republic of Korea	4.57	4.53	4.53	4.61	4.70	4.80		27.75
8	Finland	4.32	4.33	4.37	4.41	4.59	4.77		26.80
9	Chile	4.38	4.40	4.39	4.22	4.49	4.60		26.48
10	Belarus	4.19	3.94	3.74	3.66	3.58	3.42	3.24	25.77

Table 4. School life expectancy, tertiary, both sexes (years)

Source: Authors' research from the UNESCO - Institute for Statistics database

Although our study analyzes the accuracy and performance gained because of the use of artificial intelligence, we observe that although Africa invests in education, Sierra Leone is the country with the highest percentage of GDP allocated to tertiary education. It ranks lower in terms of innovation and the number of researchers, presented in **Figure 1** - SGD by region, but also in terms of the hard aspect of schooling being ranked 103 out of 158 reported by the Institute for Statistics - UNESCO, also from the same analysis performed results in many countries of the African continent with 0 aspects in terms of hard schooling. The analysis shows that the main objective of education in the educational strategy is the completion of schooling and employment.

About the school life expectancy indicator, for some of the countries with the highest number of years of schooling presented in **Table 4**, we identify traceability in the field of research, as they report a high number of researchers in innovation and technology. This correspondence is

presented in **Table 5** Researchers per million inhabitants for countries with the highest School Life Expectancy.

	Country	2016	2017	2018	2019	2020	2021	2022	Total
1	Republic of Korea	7,056	7,451	7,914	8,323	8,615	9,082		48,440
2	Finland	6,544	6,732	6,873	7,246	7,549	7,871		42,814
3	China, Hong Kong	3,652	3,709	3,972	4,235	4,349	4,585	4,809	29,312
4	China, Macao	2,614	3,177	3,471	3,629	3,866	4,132	3,545	24,434
5	Greece	2,728	3,264	3,441	3,685	4,074	4,326		21,518
6	China	1,211	1,238	1,319	1,486	1,602	1,687		8,543
7	Argentina	1,261	1,212	1,227	1,232	1,256	1,284		7,472
8	Belarus					1,434	1,394	1,382	4,209
9	Chile	500	500	529	512	519			2,560
10	Australia and New Zealand	4,856	4,812	4,850	4,849	4,747	4,696		24.114

Table 5. Researchers per million inhabitants for countries with the highest School Life Expectancy

Source: Authors' research from the UNESCO - Institute for Statistics database

Of course, even if some countries such as Belarus, Chile, and Turkey report a high school life expectancy, we can say that it represents the annual school enrollment rate for the reported age and number of years of schooling.

From our analysis, the countries of Northern Europe, North America, and Australia, countries that report significant resources in innovation and technology, in terms of the number of researchers, report a high duration of school life. This means that the usefulness of the duration of schooling is capitalized without reaching a marginal rate. Australia shows a balanced relationship between the number of years of schooling and important resources in innovation and technology, through the number of researchers, contributes relevant to our study so through the analysis we can say that investment in education is quantified in the number of researchers - innovation and technologization and capitalization of human performance contributes to all sectors GDP and even to exports.

Also, the distribution of spending on education matters, for example India which has the highest number of teachers (according to the data in **Table 3**) this statistic remains an expenditure that does not transform into investment. Analyzing this result correlated with the length of school life, India reports 10.68 years, which can mean both the age at which schooling starts and the length of schooling life, in both cases the result is a condition for GDP formation and not for

investment. Because both in India and Africa education, especially higher education, is accessible only to an elite, and this is the reality in many countries of the world.

On the other hand analyzing the anticipated optimal school life expectancy for investment and technology, regions such as China, Korea, Australia, and Finland (according to the data in **Table 4**) reveal an average school life expectancy of 26 years, analyzing this indicator in correlation with the number of researchers these regions lead their ranking, so we can say that for a country to achieve a solid commitment to investment and technology it is necessary to increase the active school life expectancy.

Another significant aspect is territoriality, because if in one region investments in innovation and technology are concentrated in one place (and from our analysis, we can expose the case of Egypt for Africa) this is not a sustainable strategy for the whole region, mainly. The region in question remains deprived of the benefits and advantages of scalable investment actions throughout its territory and the strategy is not a successful one in the relations with the other regions involved either. Often such places turn into export hubs that devalue the place of belonging.

5. Conclusions

Our study emphasizes both the importance of research and innovation in artificial intelligence in a corroboratory way with the educational environment. We conclude that this level of education is effective if affiliated with an educational standard.

We also mention the importance and impact of the social system that influences the implementation of innovation in technology (Khan, 2023). Hence, technology innovation can be perceived negatively or positively depending on the environment in which it is intended to be implemented this fact not only affects the efficiency of implementation but also affects the social environment in which it can create disturbances, and revolts. We also assert the importance of communication regarding self-education and its transdisciplinary support. Another important aspect in ensuring success between education and artificial intelligence is the homogeneity of environments and information. In such scenarios the performance gets to be maximized through low rates of returns obtained with the assumption of sufficient time

allocated to study and research, thus aiming at a macro and a micro level performance. We also assume the importance of sufficient human resources to ensure global interconnectivity at the industry level (science, innovation, and technology).

6. Future Research

Future research can be done in areas such as technological infrastructure in support of artificial intelligence or behavioral modeling of education using artificial intelligence. This paper represents a small analysis of the importance of education in the research and innovation process of artificial intelligence, the collaborative way in which these steps should be done, and how the studies can advance to other research contributing to this topic.

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