

- **GitHub:** <https://github.com/berdikhanova/DS4SG-Global-Inequality> (complete code for this project is in the [Assignment](#) branch)
- **Link to the live version of your website:** <https://quizality.herokuapp.com/>
- **Link to the published version of your story on the web:** [Medium](#) (to be submitted to TDS)
- **A clear title for our project:** An interactive quiz game to illustrate the extent and depth of global inequality on a relative basis
- **Members' Contribution:**

Name	Contribution
Marina	General research, 2 questions, answers and data visualizations on <i>Education</i> deployed in the app, Education section write-up, final edit, Medium article + setting up weekly meetings
Felipe	General research, 2 questions, answers and data visualizations on <i>Income</i> deployed in the app, Income section write-up, developing the structure of the app using PyWebIO, Heroku development support.
Norika	General research, 2 questions, answers and data visualizations on <i>Health</i> deployed in the app, Health section write-up, Heroku deployment support
Naveen	General research, 2 questions, answers for <i>Environment</i> topic, Environment section write up, medium article write up (introduction, challenge, step 1, step 2), adding visualizations

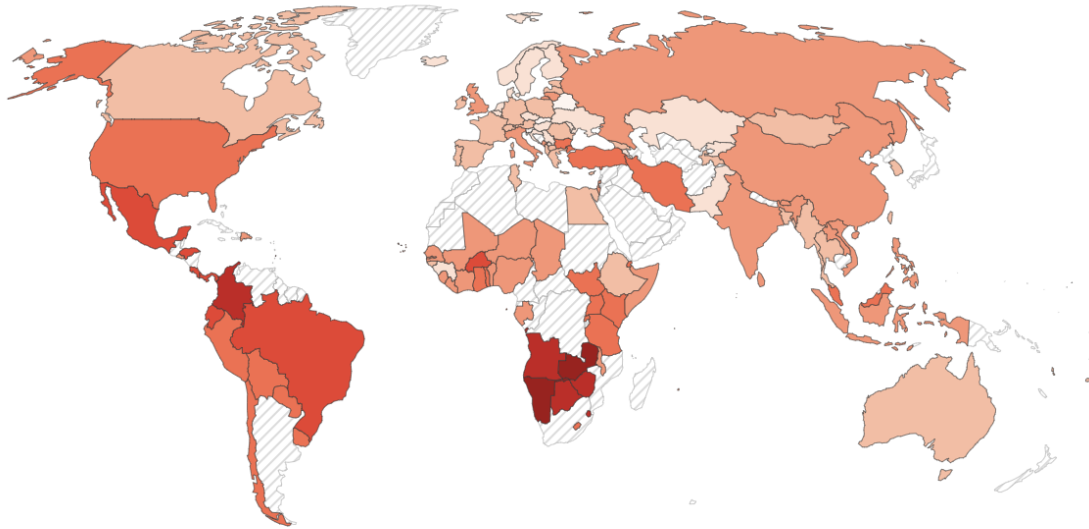
Data Storytelling for Global Inequality: The need to depict global inequality through an interactive web app for non-technical audiences

Income inequality: Gini coefficient, 2020

The Gini coefficient is a measure of the inequality of the income distribution in a population. Higher values indicate a higher level of inequality.

Our World
in Data

World



Source: World Bank Poverty and Inequality Platform

OurWorldInData.org/income-inequality/ • CC BY

Note: This data relates to either disposable income or expenditure per capita (exact definitions vary).



(fig 1. source: OurWorldInData.org, 2022)

Why do we care about global inequality?

‘Inequality’ in itself is a term that can trigger a number of different ideas in the mind of the reader or listener based on their knowledge and prejudice. The meaning attached to ‘Economic Inequality’ is not self-explanatory. Individuals from developed countries often cannot envision the extent of deepening economic crises in the Global South. As students at an international university, we have had the unique opportunity to travel around the world and have witnessed

firsthand the disparities in income, education, healthcare and other socio-economic issues. Therefore, my peers and I signed up for a project for our tutorial class, ‘Data Science for Social Good’, for our Fall semester of 2022. Since we all are from different countries (Kazakhstan, Brazil, Japan and Pakistan) and we have traveled together over the past three years, our discussions have centered around economic disparities in our home countries compared to our rotation cities, including San Francisco, Seoul, Berlin, London and Buenos Aires. The global experience allowed us to build a unique perspective on issues of global inequality with respect to the local contexts and the complexity of global inequality. Hence, our project’s final product aims to shed light on inequality on a comparative basis.

The challenge:

Although we acknowledge that reducing global inequality requires high-level transformative changes with appropriate political and economic policies, there are several things we can do at the individual level. Thus, we aim to explore the effects of global inequality across different levels of analysis (international, regional and national) globally for four topics: health, income, environment, and education. Although it is by no means a complete list of topics where global inequality is present, we believe it is a solid start to start educating the general audience.

Designing an interactive web app with Data Storytelling

Step 1 (game design):

We focused on game design. Firstly, we researched game interactivity to identify which design features would help users immerse themselves in the game. We realized that using choice architecture is crucial for establishing the basis of interactive games. We came across

factfulnessquiz.com, which uses a quiz design to test audiences on facts about global trends in various topics. This inspired us to design our web app in a quiz form with a random question generator to keep the audience engaged and provide more explanation for each indicator and its subcategories. We also chose a multimodal approach, delivering information through an interactive aspect, visualizations and text, as it is a more effective learning method for educational material, according to Carnegie Mellon University (2021).

Step 2 (Content creation & Data):

We set ourselves the challenge of identifying and analyzing the most comprehensive database available for measuring global inequality and development. The World Development Indicators database compiled by the World Bank has 1453 featured indicators for all member countries (based on data availability). We focused on eight indicators across four topics: health, environment, income and environment. As data scientists, we aim to make such high-quality statistical data easily comprehensible for general audiences and demonstrate the potential of data storytelling.

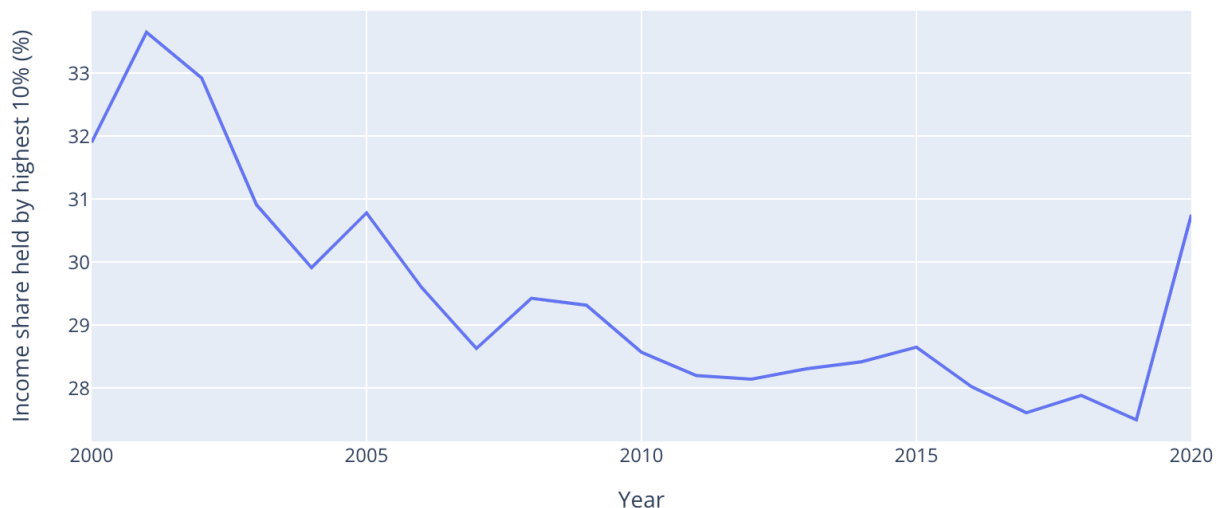
Four topics:

Income:

The most common measure of inequality is income. It is easy to measure and is highly correlated with several variables associated with quality of life. The differential of our game is to have a broad vision of income, to look at it not only from inside each country, as is usually done, but to compare rich and poor people worldwide. That is a more accurate measure of true inequality.

For example, we ask, “If all you cared about was income, would you rather be in the bottom 10% of a rich country or the top 10% of a poor country?” This has an unintuitive answer: if we care solely about having the highest income, then being a poor person in a rich country is much better than being a rich person in a poor country. That is because the disparity between countries is usually much more extensive than within countries. Take the UK, which is in the 90th percentile of the wealthiest countries. The bottom 10% earners of their population would receive \$12.306 if we divided their GDP proportionally to their earnings. On the other end, Uganda is in the 10th percentile of GDP per capita, and the wealthiest 10% population would get only \$2.960. That is four times less!

Average income share held by the richest 10% in the world over time since the 2000s



(fig 2. source: <https://quizality.herokuapp.com/>)

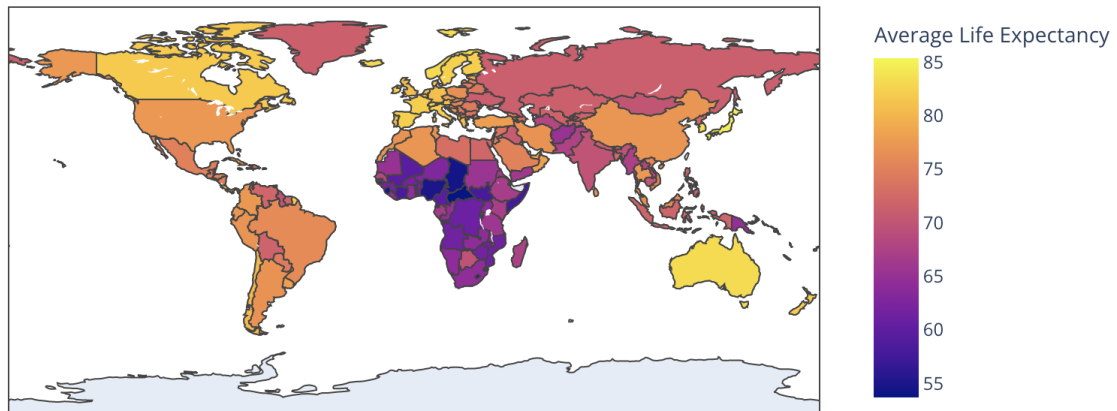
Studies show that income inequality negatively affects health, social cohesion, crime, happiness, and life expectancy. Inequality, both within and among countries, has been decreasing over the last 30 years. Still, the COVID-19 pandemic hit the poorest people the hardest, which drove inequality back up. We believe that informing people about the extent of global inequality is the first step to generating a collective effort against it. Also, the data on inequality that we see in

the world today shows that something we cannot control, when and where we are born, is a critical determinant of health disparities.

Health:

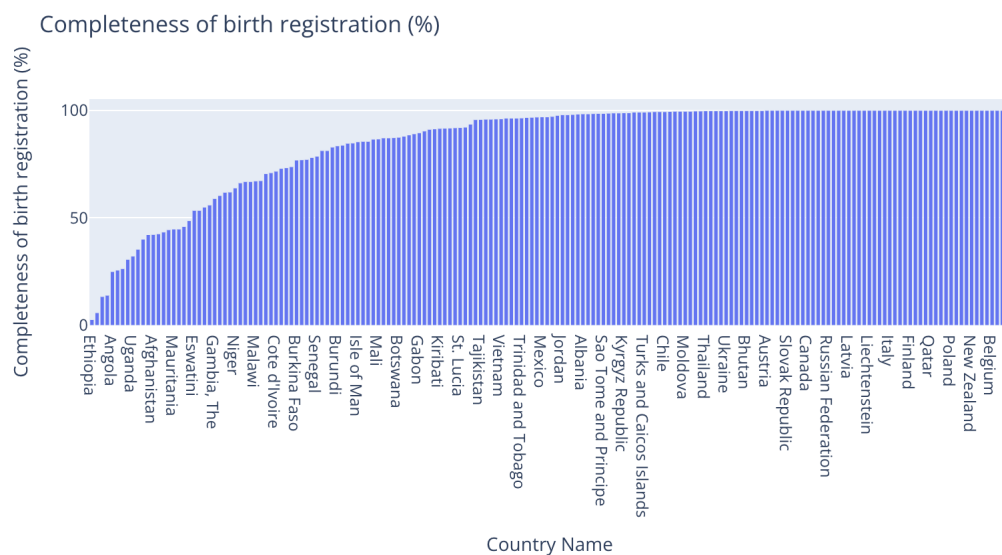
Living conditions have significantly improved in recent centuries in terms of health. Yet, the rate of progress varies dramatically across our planet. Consider the variation in life expectancy by nation. By definition, life expectancy indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life. Thus, it is an essential metric for assessing population health. In 2019, life expectancy ranged from 54.26 years in the Central African Republic to 85.29 years in Hong Kong – a staggering gap of over 30 years in average expected survival. These extreme health inequities partly reflect wealth inequalities between countries. Theoretically, richer nations have longer average lifespans than poorer nations because they have more efficient healthcare systems and resources allocated to health determinants (Guo, 2016). In our game, we ask users to input the difference between countries with the longest and shortest life expectancy, and the output is how far the answer is from the actual value. An interactive choropleth map is then displayed, giving the user an intuitive view of the bias in life expectancy by region (data.worldbank.org, 2022).

Average Life Expectancy across the Globe in 2020



(fig 3. source: <https://quizality.herokuapp.com/>)

Another example from health is the completeness of the birth registration. The World Bank reports the percentage of children under age five whose births were registered at the time of the survey. This official identification document can aid in safeguarding kids from abuse, exploitation, and violence. Children who lack a birth certificate cannot demonstrate their age, which increases the likelihood of being coerced into an early marriage, the workforce, or the armed forces. The United Nations General Assembly placed birth registration firmly on the international development agenda, Goal 16: provide legal identity for all, including birth registration, by 2030 (UNICEF, 2019a). Although the proportion of children under five registered globally is up around 20 percent from 10 years ago – increasing from 63 per cent to 75 percent as a globe, the majority of countries in sub-Saharan Africa lag behind the rest of the world, with Ethiopia (3 percent), Zambia (11 per cent*) and Chad (12 per cent) (UNICEF, 2019b). As the gap in the speed of improvement is being highlighted, the barriers related to lack of knowledge on how to register births, unaffordable fees for registering births and obtaining birth certificates, etc., need to be addressed.



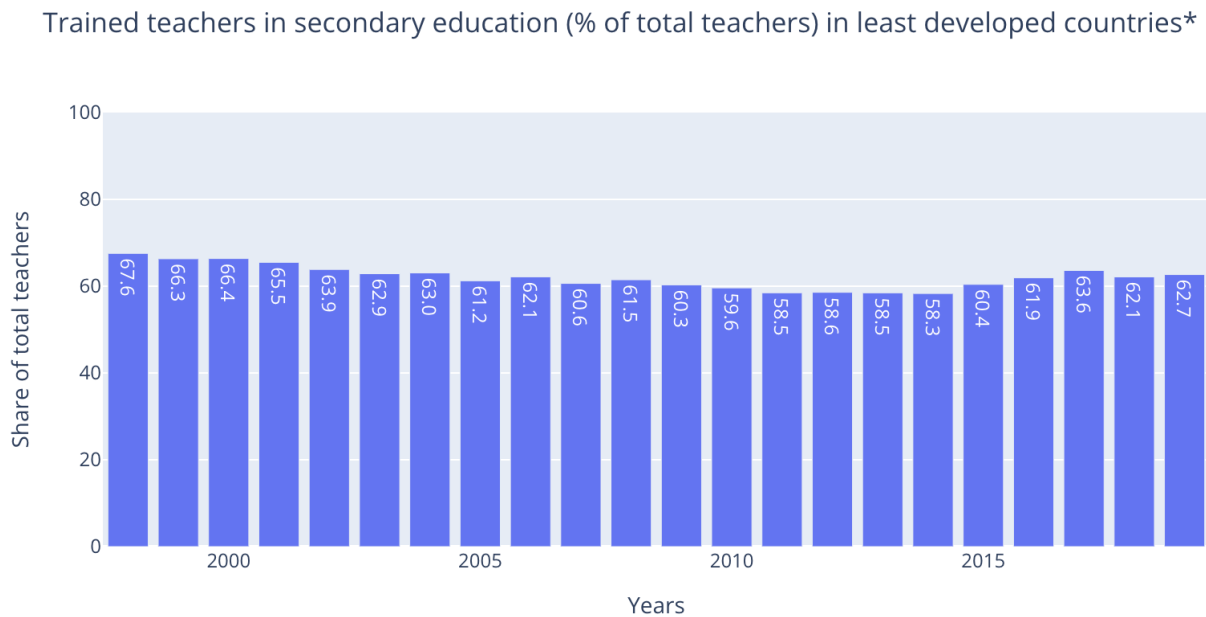
(fig 4. source: <https://quizality.herokuapp.com/>)

Education:

There is no doubt about the importance of education as it leads to many benefits such as higher income, better health outcomes, escaping poverty traps, and many others. Many organizations, including the United Nations Development Programme, have focused on improving the quality of education, and use metrics like literacy rates and student outcomes as the measures of the quality of education. We have decided to look at a more granular level and explored two other indicators: 1) Share of trained teachers in secondary education (% of total teachers), and 2) Share of youth not involved in education, employment or training (% of total youth population).

According to the UNESCO Institute for Statistics, there are only 62% of trained teachers in secondary education in 2019 in the Least Developed Countries (as per the UN's classification), compared to the global 83% average. Trained teachers refer to the teaching force with the necessary pedagogical skills to effectively teach and use teaching materials. The share of trained teachers reveals a country's commitment to investing in the development of its human capital engaged in teaching, says the World Bank. Teachers' incompetence and absenteeism remain one

of the biggest challenges in developing countries as teachers who lack the competence necessary to educate the students present many problems for the government as well as the schools, such as producing poor student achievement results, distracting other faculty members, and consuming large amounts of administrative time (Painter, 2000; Yariv, 2004).



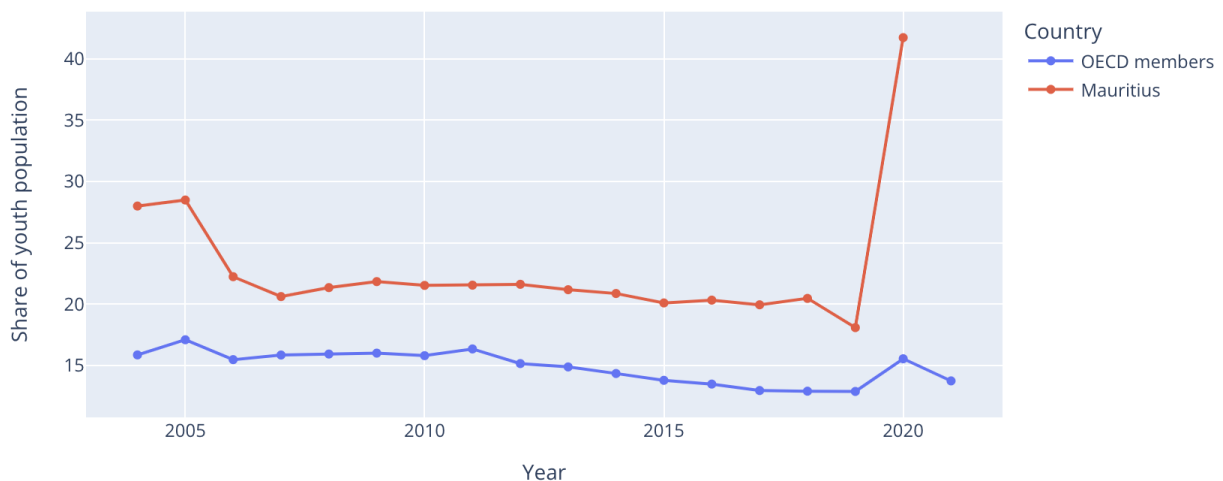
(fig 5. source: <https://quizality.herokuapp.com/>)

While the problem is absent in developed countries, with 100% of teachers having the necessary pedagogical skills at all levels of education, countries like Niger and Madagascar have 17% and 20% of trained teachers, respectively, making it almost impossible for students to escape a poverty trap.

According to the International Labour Organization and the World Bank, youth unemployment is an important policy issue for many economies. Now more than ever, young men and women face increasing uncertainty in their hopes of undergoing a satisfactory transition in the labor market, and that effect is enhanced in developing markets. While underemployment and unemployment

in the 20s were proven to increase depression and suicide rates, the effect of generational unemployment is yet to be studied. According to the economist at the World Bank, unemployed or underemployed youth are less able to contribute effectively to national development and have fewer opportunities to exercise their rights as citizens. They have less to spend as consumers, less to invest as savers, and often have no “voice” to bring about change in their lives and communities. As seen on the graph, almost 42% of the youth in Mauritius are not participating in education or labor as of 2020, compared to the OECD’s average of 15%. We can also see a rapid increase in this indicator in 2020 - the same trend can be observed in other developing countries, like the Dominican Republic, where the number jumped from roughly 25% to 38% in the same period. While we see a slight increase in OECD’s average, the rapid jumps in this indicator in developing countries again illustrate the pandemic’s striking effect on the developing world.

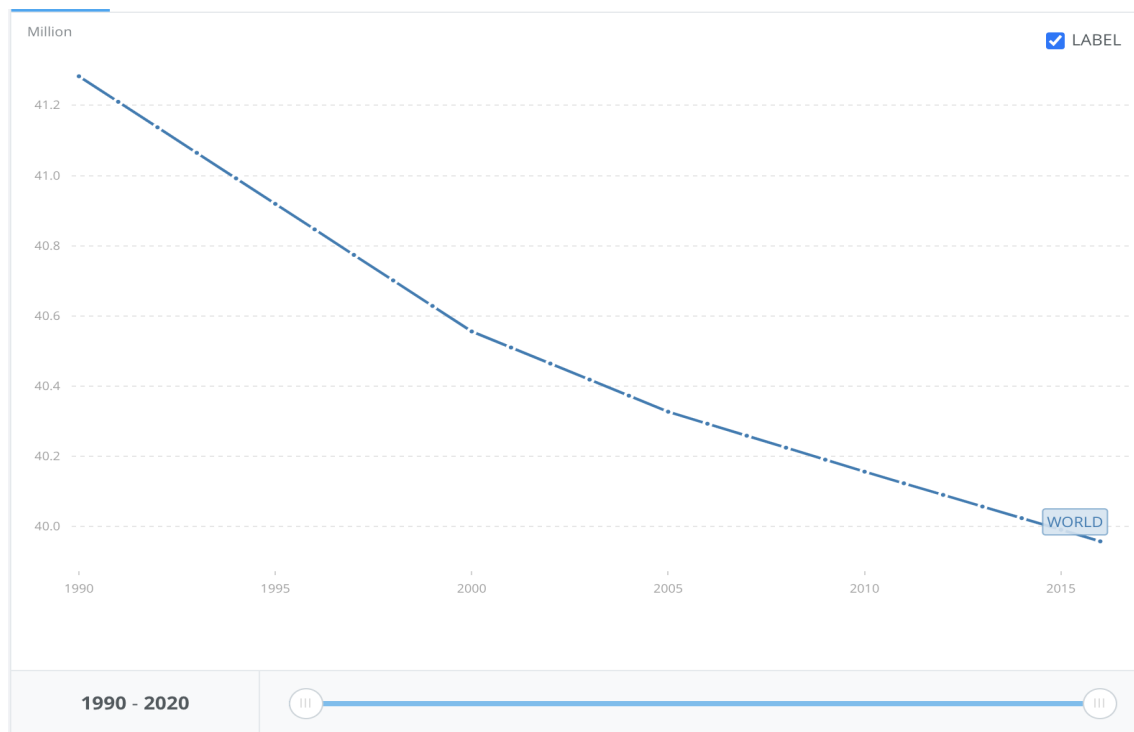
Share of youth not in education, employment or training, total (% of youth population)



(fig 6. source: <https://quizality.herokuapp.com/>)

Environment:

Human activities have significantly altered the natural environment over the past decades, leaving an environmental footprint that can be quantified through various indicators. These indicators help us identify the state of the planet, the use of natural resources and observed impacts in terms of identifying the most vulnerable populations to climate change. For example, measuring global forest cover annually has helped the international community to focus on biodiversity conservation as deforestation is one of the major threats to it. Over the past decade, global forest cover has decreased drastically with a sharp downward trend. Habitat loss due to human activities and production purposes is one of the biggest drivers of tropical deforestation. Beef production is the top driver of deforestation in global tropical forests. The forest conversion generates more than double that generated by the production of soy, palm oil, and wood products (the second, third, and fourth biggest drivers) combined (worldwildlife.org, 2018).



(fig 7. forest area (sq.km), source: (data.worldbank.org, 2022))

Moreover, electricity production has increased over the past decades and improved the quality of living. Yet, the use of non-renewable resources has remained significant. Since the beginning of the 21st century, coal has been the fastest-growing global energy source; it currently provides about 40 percent of the world's electricity needs. Irrespective of its economic benefits for the countries, the environmental impact of coal use, especially that coming from carbon dioxide emissions, is significant. OECD member states have a combined share of 29.4 percent of energy production from coal globally compared to least developed nations having a share of only 1.7 percent. However, the effects of climate change are spread disproportionately globally, with the Global South (least developed countries) being more vulnerable compared to the Global North (OECD members). (data.worldbank.org, 2022)

Step 3 (Web App Creation):

To make the Web App with the quiz game, we used the PyWebIO python library. The library allowed us to easily create the web components of our app using only Python, so that we could focus on the content.

With the library, we can create all sorts of content and display them on the web, including images, tables, text, and buttons. Notably, the library allows us to get user input and use it to make customized visualizations and give instant feedback on their responses.

We used pandas to work with the dataset and pyplot to make visualizations, which we displayed in our web app using an integration with pywebio. You can see our full code in the [GitHub repository](#) (for this assignment, we created and worked on the *Assignment* branch specifically).

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