

# Word Education Visualized

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## 1 Introduction

This project is used to visually explore the education domain and in part answer the following question. **How has the level of education changed in different countries?**

Several detests are combined to visually explore this domain. We focus on 4 main indicators. The **Learning Outcome** is a harmonized value over several student achievement tests pooled across subjects. The **Completion Rate** shows the rate of pupils completing their education by different education levels. The **Literacy Rate** is the rate of people above 14 literate in a specific country. And the **Pupil-Teacher Ratio** which is the number of pupils or students by one teacher.

We not only explore these indicators by showing their relation to some explanatory features but also visualize the differences in education between different countries and the change over several years. A further focus is to show the differences between genders in the education domain.

## 2 Data

The following four data sources are used for this project. How these datasets are combined was already discussed in the Wrangling part of the project.

### 2.1 World Bank Education Database

This dataset <sup>1</sup> is a collection of 162 education related indicators for 266 countries over the years 1960 to 2020. Most of the indicators are provided separately for female and male which allows a distinction by gender. Further, the metadata includes an income group and region for each country. This is the main source of data used.

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<sup>1</sup><https://data.worldbank.org/topic/education>

## 2.2 World Bank Harmonized Learning Outcomes (HLO) Database

This dataset <sup>2</sup> includes an average score across standardized, psychometrically-robust international and regional student achievement tests. To maximize coverage by country, tests have been harmonized and pooled across subjects (math, reading, science)

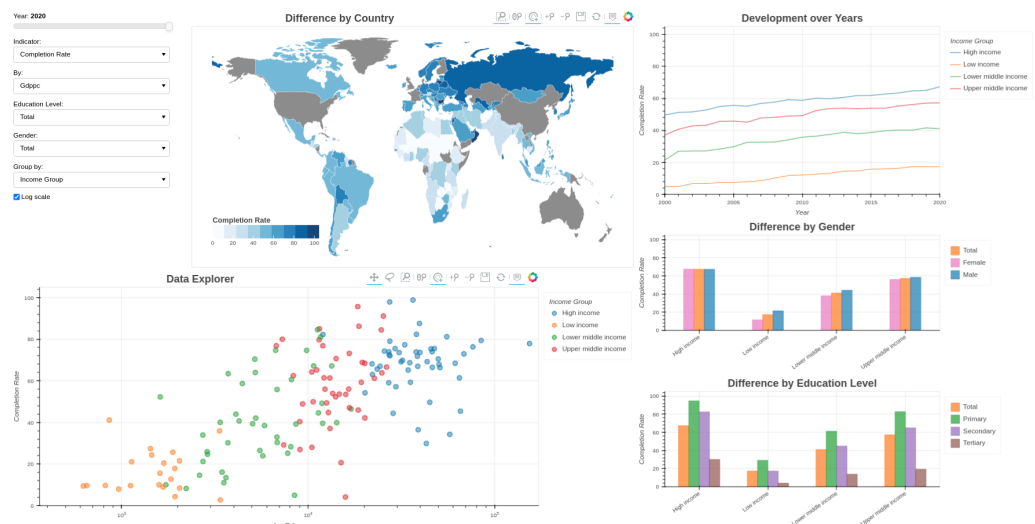
## 2.3 Maddison Project Database 2020

This dataset <sup>3</sup> is used to add a GDP per capita to our dataset. Several indicators are a rate of GDP.

## 2.4 Natural Earth

This data source <sup>4</sup> provides shape-files for our choropleth visualizations.

# 3 Dashboard



Figur 1: World Education Dashboard

The dashboard created can be seen in Figure 1. It was created with the python charting library Bokeh <sup>5</sup>. The library is rather powerful allowing to create various charts from a high number of Glyphs. Further, callbacks in python or JavaScript can be implemented to enable numerous interactions.

The World Education dashboard is divided into 4 sections and a section for tools which we describe briefly in the next sections.

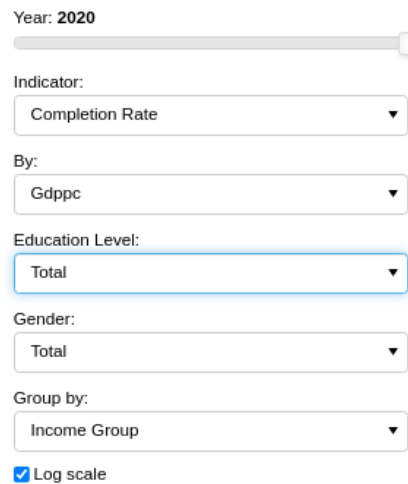
<sup>2</sup><https://datacatalog.worldbank.org/search/dataset/0038001/Harmonized-Learning-Outcomes-HLO-Database>

<sup>3</sup><https://www.rug.nl/ggdc/historicaldevelopment/maddison/releases/maddison-project-database-2020>

<sup>4</sup><https://www.naturalearthdata.com/downloads/>

<sup>5</sup><https://docs.bokeh.org/en/latest/index.html>

### 3.1 Tools



Year: 2020

Indicator:  
Completion Rate

By:  
Gdppc

Education Level:  
Total

Gender:  
Total

Group by:  
Income Group

☒ Log scale

Figur 2: Dashboard Tools

The tools as shown in Figure 2 allow various global interactions which affect all plots. First, a year slider allows visualizing information from 2000 to 2020. Next, the indicators Learning Outcome, Completion Rate, Literacy Rate and Pupil-Teacher Ratio can be selected. We can compare these indicators by some explainable indicator like Gdppc, Amount spent on Education, Population and Expenditure Per Student Rate. Further, we can not only have a look at the total values but differ by Education Level and Gender. Last, we can group either by Income Group or Region. Also a Checkbox for using a log scale or not is provided which changes the scale of the Data Explorer X axis if desired. Because not all combinations of Education Level and Gender exist for all indicators the tools themselves react to changes of the Indicator and By selectors.

### 3.2 Data Explorer

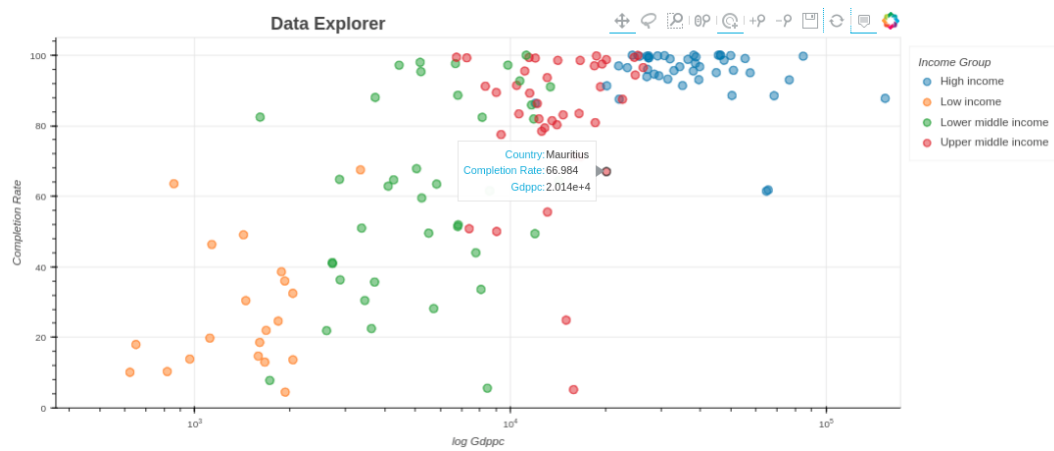


Figure 3: Data Explorer

The Data Explorer chart as shown in Figure 3 is positioned on the bottom left on the dashboard and allows the user to explore the data by using the tools and allows various interactions. The user is able to get detailed information by circle by hovering over the circle of interest. Further, if the user is interested in some specific countries he can click them using the Tap tool. This selects the country in all other views. Several zooming tools are also implemented for this chart.

### 3.3 Difference by Country

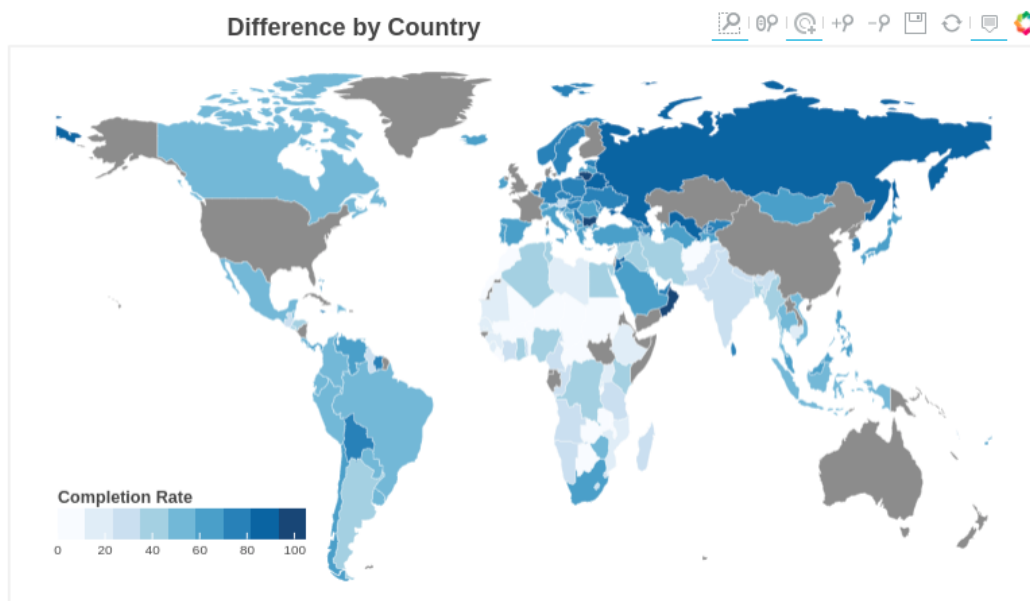
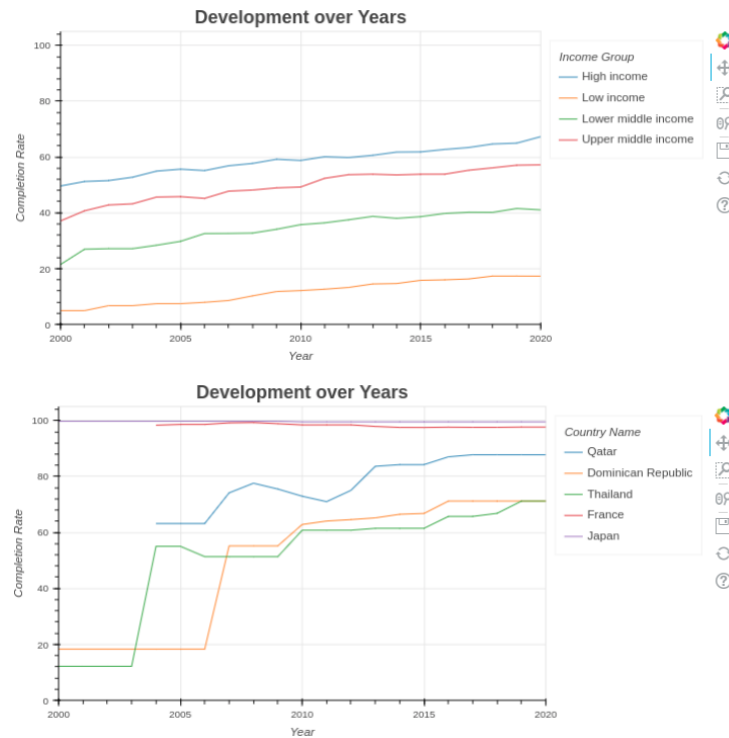


Figure 4: Difference by Country

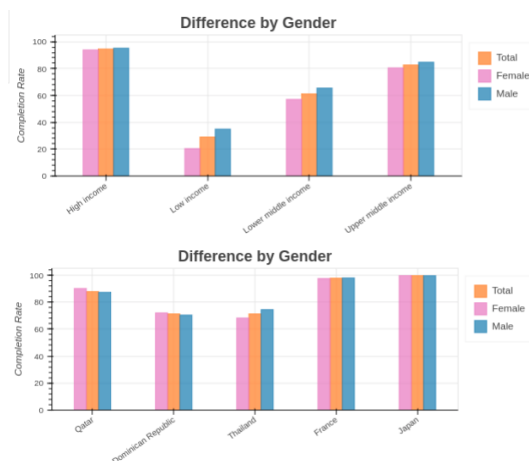
The Difference by Country choropleth as shown in Figure 4 shows the global difference by the selected indicator, education level and gender for a given year. On the bottom left of the chart we see the color scale by indicator. As for many countries there is no data present these countries are shown in gray.

### 3.4 Development over Years

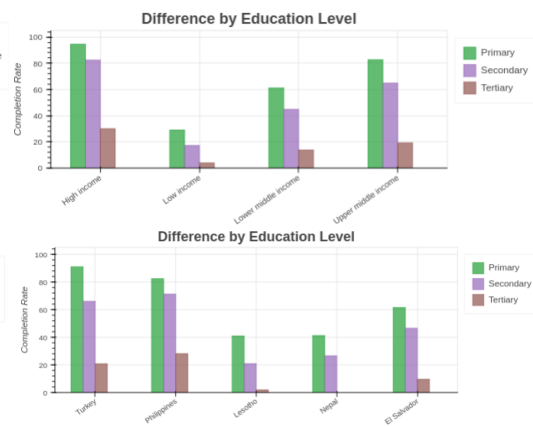


Figur 5: Difference by Year Selection

The line chart Development over Years shows by default the development of the indicator over the range of 2000 to 2020 grouped by either Region or Income Group. If specific countries are selected in the Data Explorer a detailed view for the selected countries is visualized.



Figur 6: Difference by Gender



Figur 7: Difference by Education Level

### 3.5 Difference by Gender and Education Level

The bar charts Difference by Gender and Education Level show by default the difference by gender and education level respective grouped by either Region or Income Group. If specific countries are selected in the Data Explorer a detailed view for the selected countries is visualized. The charts adapt also to the selection of Education Level and Gender.

## 4 Findings

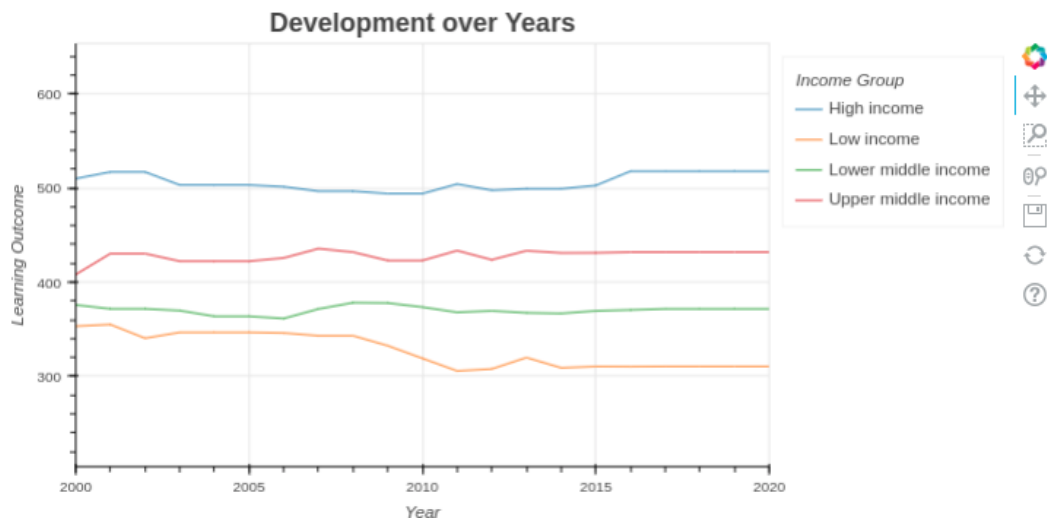
Last we point out some findings we made through visually exploring the education domain. For each main indicator we describe the most interesting observations made.

### 4.1 Learning Outcome

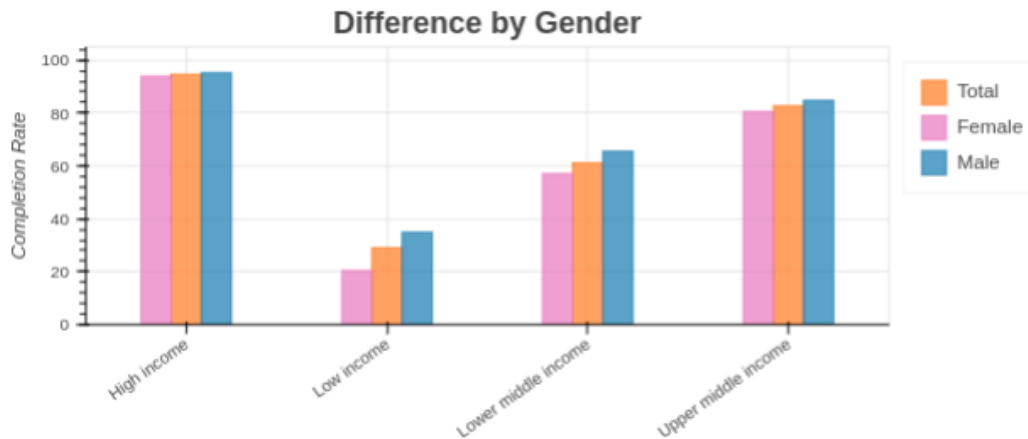
The Learning outcome in total is very stable over the last 20 years for all Income Groups but we see a clear difference between Income Groups. There is a clear relationship between the amount of money spent on education and the learning outcome. We see that the expenditure per student rate also has some impact on the learning outcome not only the total amount spent. It is clear that the High Income countries are able to spend more money on education than the lower income countries. As for difference by gender there does not seem to be a difference between the performance of male and female students. Usually the learning outcome is higher for the secondary education level.

### 4.2 Completion Rate

Over the span of 20 years the completion rate increased for all Income Groups, all education levels and both genders. But there is a clear difference between the Income Groups. While the High Income group has a primary school completion rate of almost 100% the Low Income



Figur 8: Stable Learning Outcome over Years



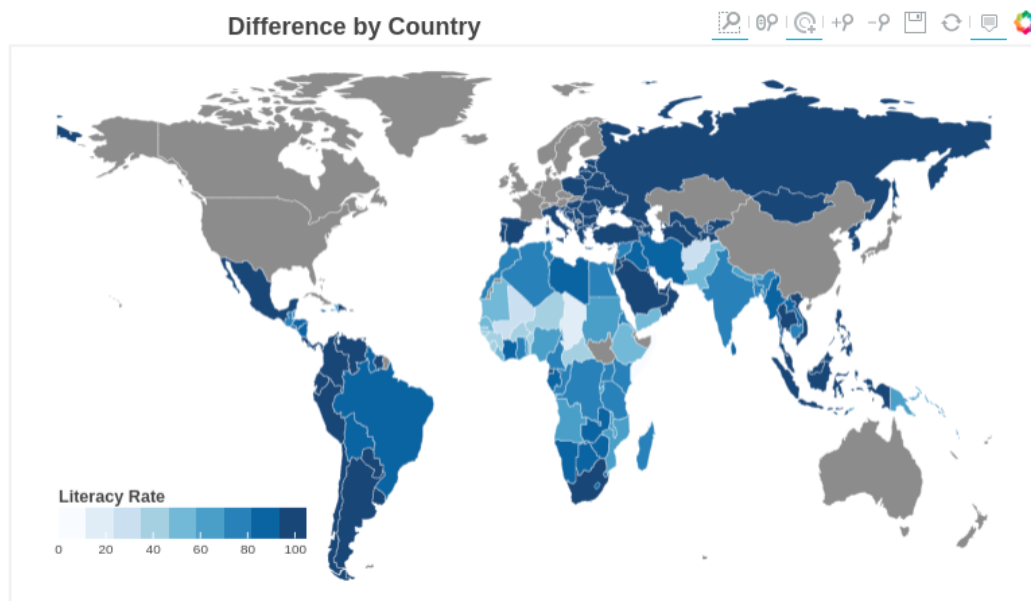
Figur 9: Completion Rate Difference by Gender

group does not even achieve 30%. Surely the completion rate shrinks with the education level.

When we have a look at the differences between male and female we notice that the completion rate for male is almost always higher. The higher income countries are more equal and equality shrinks the lower the income. In High Income countries the women exceed the man in the tertiary completion rate since 2006.

### 4.3 Literacy Rate

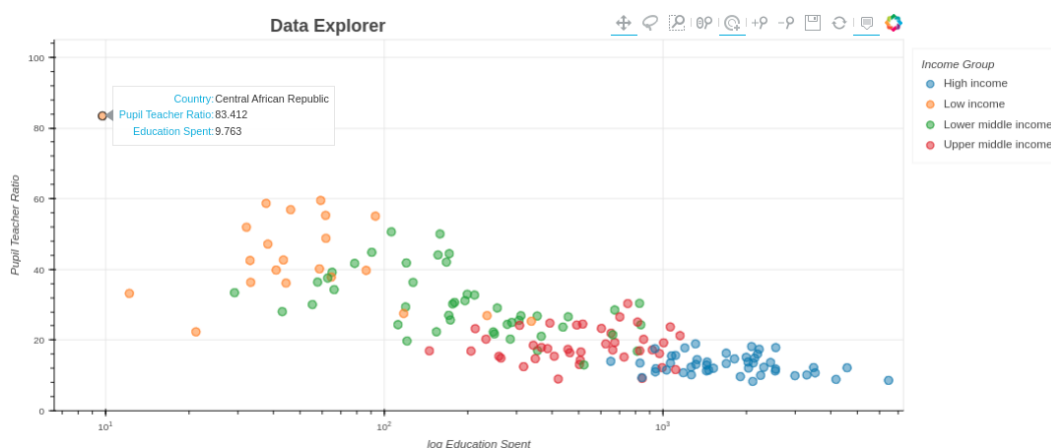
The Literacy rate rose over all Income Groups, Genders and Education levels over the last 20 years while the increase was higher for the lower income groups. The Literacy rate in High and Upper middle income groups is almost 100%. For Low income groups the 50% mark was only reached in the last 5 years.



Figur 10: Global Total Literacy Rate

For this indicator we also notice the highest difference between male and female for lower income groups. On average more than a 10% difference can be observed.

#### 4.4 Pupil Teacher Ratio



Figur 11: Pupil-Teacher Ratio in Primary Education Level

This indicator did only improve slightly for all income groups over the last 20 years. The pupil teacher ratio decreases with the amount spent on education which is understandable. On average low income countries have over 40 pupils by teacher while all high income countries have less than 20 pupils per teacher. In the Central African Republic there are even over 80 Pupils per teacher in 2020. Especially for the primary education level this ratio is high for lower income countries.