Using Gapminder

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Abstract

As a teacher of geography, I am always aware of the dynamic nature of the subject where events can happen without warning, such as the earthquake in Haiti, or with pre warning of the event, such as the London Olympics in 2012 and the Brazil Football World Cup in 2014. I am always looking for resources I can use personally or with my students to enhance their learning experience. In this context, Gapminder World is a valuable tool to get some order into the vast amount of data available. Gapminder World can best be described as a modern "museum on the Internet – unveiling the beauty of statistics for a fact based world view". This contribution first gives an introduction to the history and rationale of Gapminder World and then introduces two examples from secondary education with an explicitly economic background.

1   History and background of Gapminder World

The Gapminder Foundation is a non-profit venture which promotes sustainable global development and achievement of the United Nations Millennium Development Goals. It was founded in Stockholm by Ola Rosling, Anna Rosling Rönnlund and Hans Rosling in 2005. The foundation provides services as collaborative projects with universities, UN organisations, public agencies and non-governmental organisations (Gapminder 2011b).

Their initial activity was to pursue the development of the Trendalyzer software. Trendalyzer sought to unveil statistical time series by converting boring numbers into enjoyable, animated and interactive graphics. The current version of Trendalyzer has been available since March 2006 as Gapminder World (Gapminder 2011a), a free web-service displaying time series of development statistics for all countries. In March 2007, Google acquired Trendalyzer from the Gapminder Foundation. The Google Public data explorer is a visualisation tool similar in layout to Gapminder's World. It is based upon the Gapminder foundation's trendanalysing technology (Google 2011). The difference between the two is that there is a wider range of data in Gapminder's version, and Gapminder has a range of variations such as the agriculture version (Gapminder 2011e).

Gapminder World is an easy to use piece of software that uses a graph with which bubbles are used to show countries. Here is a short excerpt from an article by Heers et al. (2010) that expands on the discussion:

> "Creating a visualization requires a number of nuanced judgements. One must determine which
> questions to ask, identify the appropriate data, and select effective *visual encodings* to map data

values to graphical features such as position, size, shape, and color. The challenge is that for any given data set the number of visual encodings – and thus the space of possible visualization designs – is extremely large. To guide this process, computer scientists, psychologists, and statisticians have studied how well different encodings facilitate the comprehension of data types such as numbers, categories, and networks. For example, *graphical perception* experiments find that spatial position (as in a scatter plot or bar chart) leads to the most accurate decoding of numerical data and is generally preferable to visual variables such as angle, one-dimensional length, two-dimensional area, three-dimensional volume, and color saturation. Thus, it should be no surprise that the most common data graphics, including bar charts, line charts, and scatter plots, use position encodings. Our understanding of graphical perception remains incomplete, however, and must appropriately be balanced with interaction design and aesthetics."

After experimenting with various shapes, Gapminder chose bubbles as "they show a good combination of aesthetics and comprehensibility, and although comparing bubble areas is a bit difficult for our brain, we can at least roughly tell the proportions" (Hans Rosling, personal communication). Besides the bubbles, it was also important to "liberate the x-axis" from time and instead place the time so that one unconsciously connects the animation to the year – i. e. in the background in grey. Gapminder World bridges the divide between school and university geography and other subjects and importantly to real life uses, as Gapminder World has been used across a range of organisations and institutions including Organisation for Economic Co-operation and Development (OECD 2011), United Nations Development Programme (UNDP 2011) and the Global Footprint Network (Global Footprint Network 2011) as well as in academia, and now schools.

Gapminder is currently working on:
*   Keeping the tools' statistical content up-to-date and making time series freely available in Gapminder World and Gapminder Countries.
*   Producing videos, teaching resources, Flash presentations and PDF charts showing major global development trends with animated statistics in colourful graphics.

Gapminder's work serves a purpose of filling a gap. Gapminder believes there has been a market failure in distributing global data. A lot of people are interested in the data, but don't get access to it (and if they manage to access the data, they need to be advanced skilled statisticians to analyze it). Gapminder wants to make the data more accessible and easier to use allowing instant visual analysis rather than needing an extended amount of time to work through the data. Gapminder believes decision makers, politicians as well as education at almost all levels lack adequate tools. Their idea is that all people, independently of their political agenda, should get free access to already existing statistics about global development to improve their understanding of a complex society.

2 How to use Gapminder in schools?

The Gapminder Foundation aims to develop use in school education. Their focus is to use the tool in education across the board – not just at university level but also in secondary school. This is part of a recent trend of university research increasingly engaging with school education. Although the Gapminder Foundation has a development edge to its activities and is located in the Karolinska Institutet, a medical university in Stockholm, it has actively developed a focus to make its work available to the public, to schools and to many governmental and non-governmental organizations. They have the ethos in making its work accessible across the world and within a range of sectors.

Gapminder World has the ability to bring to life data, especially using the tracking tool and time series nature. Another advantage is that Gapminder World's data is updated relatively frequently, however, it must be noted that there are limited data sets available for certain indicators and time periods. Gapminder World allows changes over time to be seen, for example the onset of the HIV / AIDS epidemic in Sub Saharan Africa, but also to see the associated changes in Standard of Life/ Quality of Life such as life expectancy. As a tool to show change, Gapminder World is a powerful, but easy to use tool, especially for a wide range of users from 11 year old pupils to government advisors. One key point is that Gapminder World is free to access and to use in education: Gapminder World uses the Creative commons licence to allow it to be used, although Google did acquire the Gapminder World trendalyser software. Further, all data sets used in the Gapminder World allow you to see where the data is from, how it has been collected and allows further analysis of the data. Examining the source of the data can assist pupils in developing a critical awareness of the processes behind these visualizations, and can encourage questions about how the data is collected and presented. This deconstruction of visualizations can focus on issues of how the numbers were counted, who counted them, who paid, why these indicators were chosen, what was done when data were missing, and why gapminder chose to present certain numbers and not others.

As Roberts (2010) states in her lead article in Teaching Geography "Enquiry is a key component of geography", Gapminder World allows pupils to investigate, use data and importantly make sense of some difficult concepts, such as uneven development and inequalities. Gapminder World can be used by pupils to explore and encourages curiosity. Unlike textbooks, Gapminder World allows pupils to categorize data themselves. It allows the student to analyze, interpret and challenge the data. The size and colour of the bubble can be changed to show a number of variables. The position of the bubble on the graph depends upon the variables plotted on the x and y axis, and on the time of the information. In all five variables can be plotted. Gapminder World can show up to 200 countries at once (see figure 1). The software allows you to highlight specific countries using a selection tool and to even see these selected changes over time, using the trail tool along. All the tools in the viewer are located around the central graph, making it very easy to use. The speed of the animation over time can also be changed. Gapminder has included a video guide and pdf guide to aid the use of the software by users. This video can be found at the top of the Gapminder graph as a light bulb icon. The pdf guide (Gapminder 2011c, see figure 1) can be found on the left hand side of the Gapminder World start page in the area titled "explore Gapminder for yourself".

Gapminder World Guide
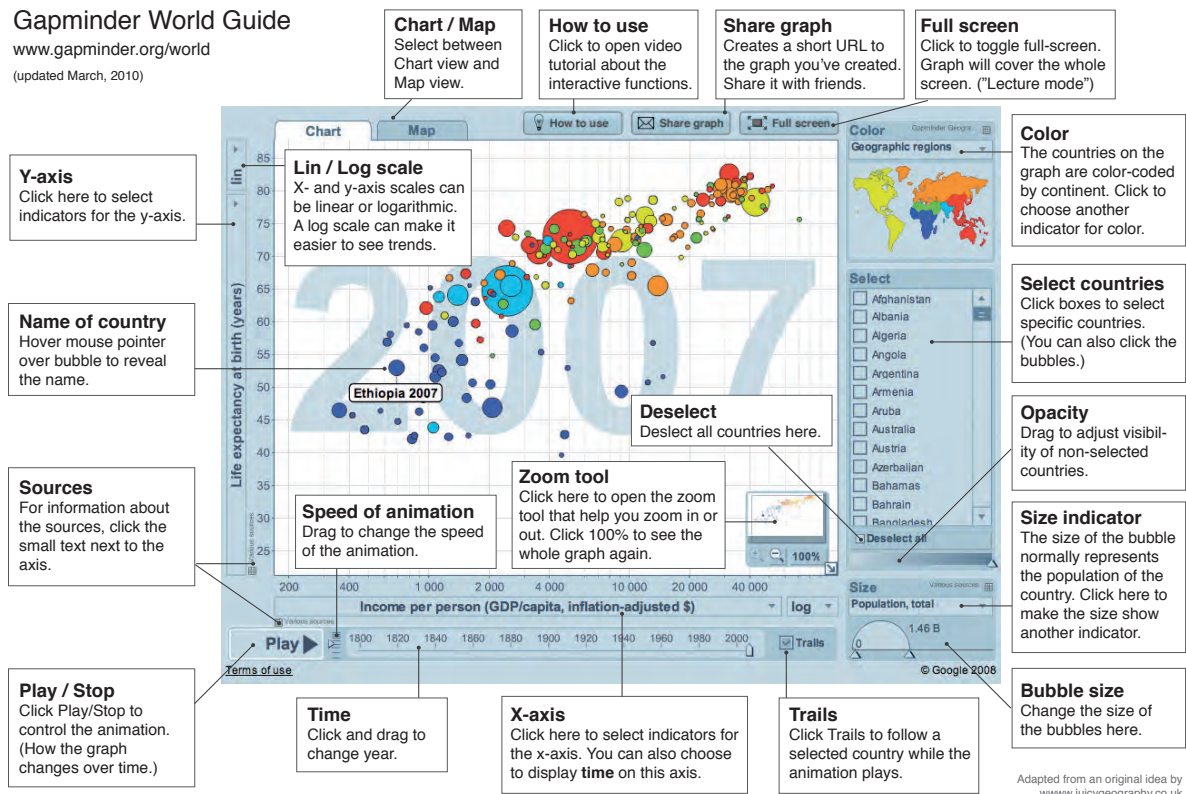www.gapminder.org/world
(updated March, 2010)

Chart / Map
Select between Chart view and Map view.

How to use
Click to open video tutorial about the interactive functions.

Share graph
Creates a short URL to the graph you've created. Share it with friends.

Full screen
Click to toggle full-screen. Graph will cover the whole screen. ("Lecture mode")

Color
The countries on the graph are color-coded by continent. Click to choose another indicator for color.

Y-axis
Click here to select indicators for the y-axis.

Lin / Log scale
X- and y-axis scales can be linear or logarithmic. A log scale can make it easier to see trends.

Name of country
Hover mouse pointer over bubble to reveal the name.

Select countries
Click boxes to select specific countries. (You can also click the bubbles.)

Deselect
Deselect all countries here.

Opacity
Drag to adjust visibility of non-selected countries.

Sources
For information about the sources, click the small text next to the axis.

Speed of animation
Drag to change the speed of the animation.

Zoom tool
Click here to open the zoom tool that help you zoom in or out. Click 100% to see the whole graph again.

Size indicator
The size of the bubble normally represents the population of the country. Click here to make the size show another indicator.

Play / Stop
Click Play/Stop to control the animation. (How the graph changes over time.)

Time
Click and drag to change year.

X-axis
Click here to select indicators for the x-axis. You can also choose to display **time** on this axis.

Trails
Click Trails to follow a selected country while the animation plays.

Bubble size
Change the size of the bubbles here.

Adapted from an original idea by wwww.juicygeography.co.uk

Fig. 1: Gapminder World Guide (Gapminder 2011c)

Dorling & Barford (2006, 91) make the statement that the collection of mass data on a large scale and relating to a wide range of variables is essential to our understanding of the world – an understanding that is particularly enhanced when the data are used to create maps which enable us to see a range of variables relatively and simultaneously. Gapminder World has the ease for the user to investigate these with the flexibility of user choice, combinations as well as over time for any number of selected countries.

Gapminder has actively made the data used in its software via a tab on its website as well as actively seeking data sets from bodies such as the World Bank. Not many organizations have been able to upload their own data into bubble-graphs (yet) – for technical and legal reasons. Instead, there has been a long struggle to get institutions to change their data policies and open up for 3rd party use and analysis. There are some examples of organizations using bubble-graphs on their websites as above, but Gapminder is still waiting for the "big revolution". Since Google started its Public Data project (Google 2011), the adaption rate will probably increase.

Although the Gapminder World can be viewed as a geographical information system (GIS), these data sets can be used in excel. Gapminder does not need a GIS package, which many schools do not use, cannot afford or are not confident to use.

3   Economic examples I: Aspects of India's growth

Gapminder can be used to show many economic examples, such as the development of the BRIC countries (Brasil, Russia, India and China), and how these countries have developed economically and in other ways, such as health, and in whether it was health or wealth (fig. 2) development that triggered the other and vice versa.

Gapminder can be used to show concepts such as emerging economies by assessing degrees of development by using several indicators such as GDP, adult literacy rates, infant mortality. Using Gapminder makes it happen, visualizing large amounts of data that otherwise would be in a table and more difficult to comprehend. The software and range of data makes this sort of task especially accessible. The software is good to assess HDI, fiscal debt and deficits at a national and international scale. It can be used to produce development profiles exploring how economies take off enabling the user to investigate which conditions combine to enable growth. For example you can see take off, growth and how a country may begin to plateau and decline in the current global situation. It can show the trajectory from a controlled, closed to an open economy in India, but can also be used to draw attention to less visible aspects of this growth process.

In figure 3 you can see the change in Indian politics over the last 60 years. In the 1960s to late 70s there was stagnation. In the 1980s India opened up, and since 1991 there was economic reform, and from 2002 growth accelerated to rates reaching 8% annual growth. Now, how does this compare with China? As you can see, China over the last 50 years has much greater rates of annual growth over most of the same time period, reaching over 10% in the same period of growth as India's 8% in the last decade. However, the recent global economic recession has impacted the growth with a slight fall, but not negative growth. In fact both these countries still show significant growth compared to the rest of the world's major countries, like USA, Japan and Germany.

This particular issue of how India's and China's growth has changed over time is developed in a TED podcast called "Asia's rise, how and when" (Rosling 2011). In this video, Rosling talks about how India has developed economically over the last 150 years, and predicts future growth over the next 40 years. However, what it cannot show based on national data is that the economic growth has not related to growth for all in the country. In India the proportion / amount of people classed as in poverty (fig. 4) has actually grown. The growth of the worlds' poorest has not been found in the poorest countries but in developing countries such as India as they develop (Williams 2011).

Further questions that could be investigated using Gapminder include: Can the shift in the burgeoning middle class be seen? However, data at a national scale doesn't show the full picture. Here, figure 5 shows examples of regional data from India. India on the whole has its income increasing, but interestingly the infant mortality (as one indicator), although it drops significantly in some states, recently increased in some other states again!
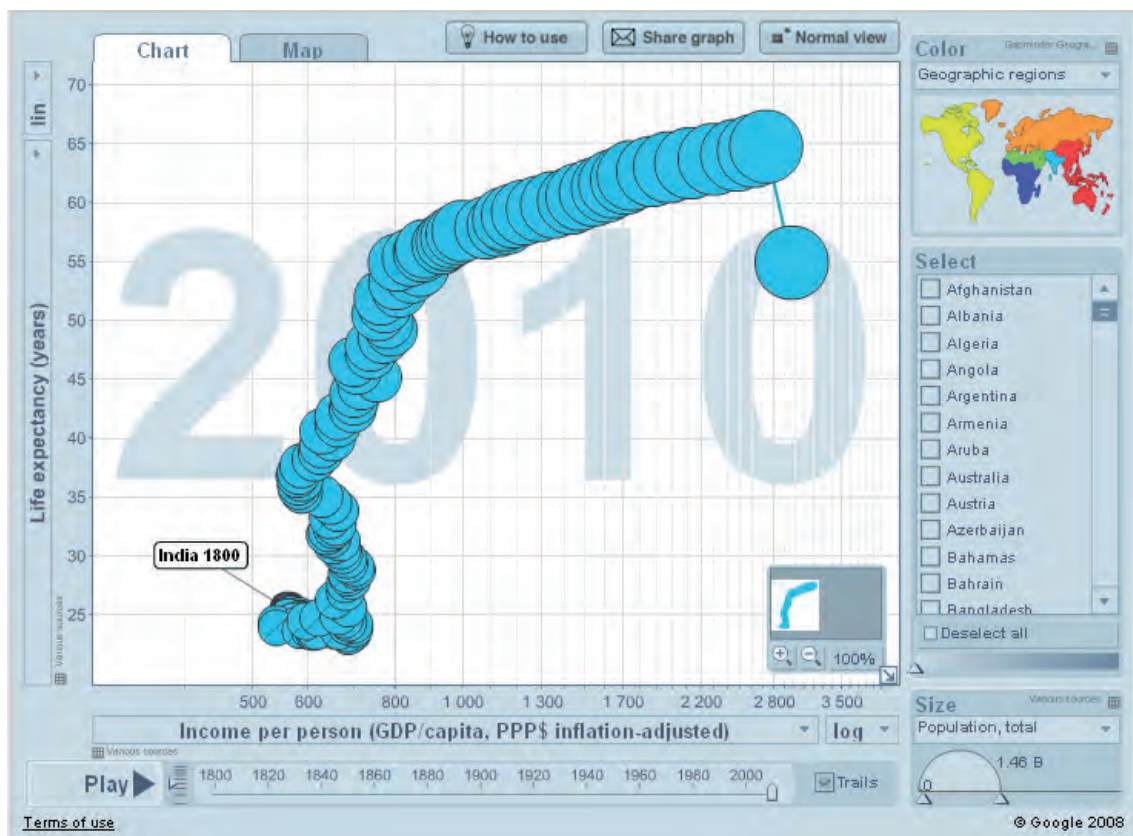
Fig.2: India's health and wealth

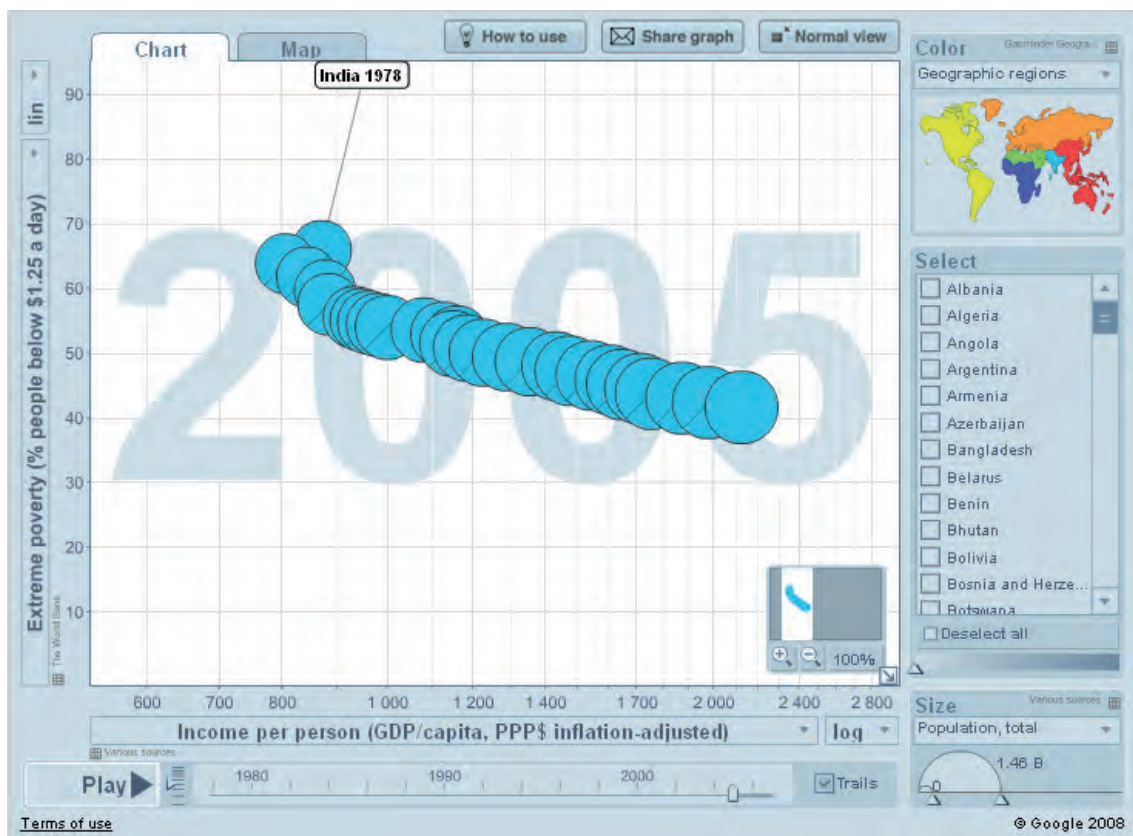
Fig. 3: India and China GDP / capita growth 1960–2008

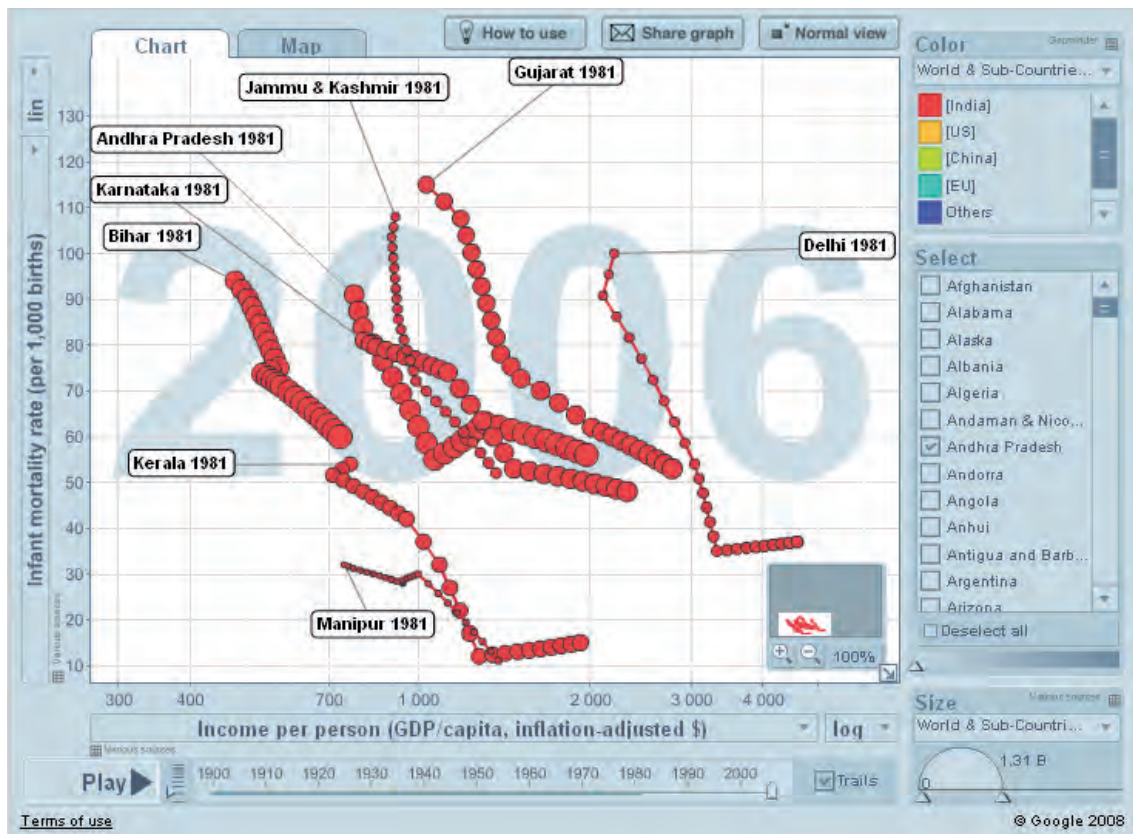*Fig. 4: India: extreme poverty vs income per person 1976–2005*

Fig. 5: Selected Indian state infant mortality vs income per person 1981–2006.

4   Economic examples II: Classification of countries

How to classify countries and whether it is right to label a country into, for example, more or less economically developed country is an ongoing debate in geographical education, especially in the UK. In my experience, the dynamic nature of economies over time makes classification particularly challenging.

There have been numerous articles and web discussions on the topic (e. g., Rosling 2006, Gapcast (Gapminder 2011d), and UN stats 2008), looking at what the main issues and contradictions are with the topic. There is discussion on how to classify countries, and what is the best and most up to date way to do so, often fuelled by teachers wanting to know how countries have changed and to use this information within examined classes following instruction from examination organizations.

The following examples (fig. 6 and 7) come from a class of 13 year olds who investigated how you might classify countries, and whether it was possible or not as part of a sequence of lessons on uneven development. In this work they were asked to use Gapminder world to investigate which combinations of indicators would show whether there were any patterns to be found and what type of data is actually useful and appropriate. The examples show interpretations of graphs by pupils. It becomes reasonably clear that pupils make up their own hypotheses from the data they visually structured, trying to link demographic data to development. Their hypotheses are neither right nor wrong. They include causal relations for their assumptions. However, it may be the teachers' effort to support pupils in finding out which assumptions do make sense, which variables do correlate and which just co-variate to make the use meaningful.

Gapminder World provides a means to challenge how people use these classifications and strengthens the fact that instead of there being a number of groups, in reality there is a continuum of countries that are constantly changing.

Another example can be viewed on the Gapminder teacher's section where a video clip shows students using the site to investigate how Haiti compared to its neighbouring countries in terms of development following the earthquake in 2010 (fig. 9).

These are comments of pupils who was investigating how Haiti compared to the Dominican Republic using the life expectancy vs income per person (GDP/capita, inflation adjusted): "It's odd because although life expectancy has gone up significantly they've actually got poorer per person, which either means that they had a very odd lot of growth or a load of foreign aid, ... which has been giving them medicine, maybe some form of infrastructure sewerage but they haven't actually been gaining individual jobs so what we've got is a state entirely dependent on foreign aid." And "The Dominican Republic is the little one and Haiti is this back here and while actually they're not that far of in life expectancy the Dominican Republic per head is very well off, which is slightly disturbing because on a map they are well next door neighbours on the same island." The comments clearly show that support by teachers is necessary to construct and interpret these graphs. These qualifications should be emphasized in teacher training.
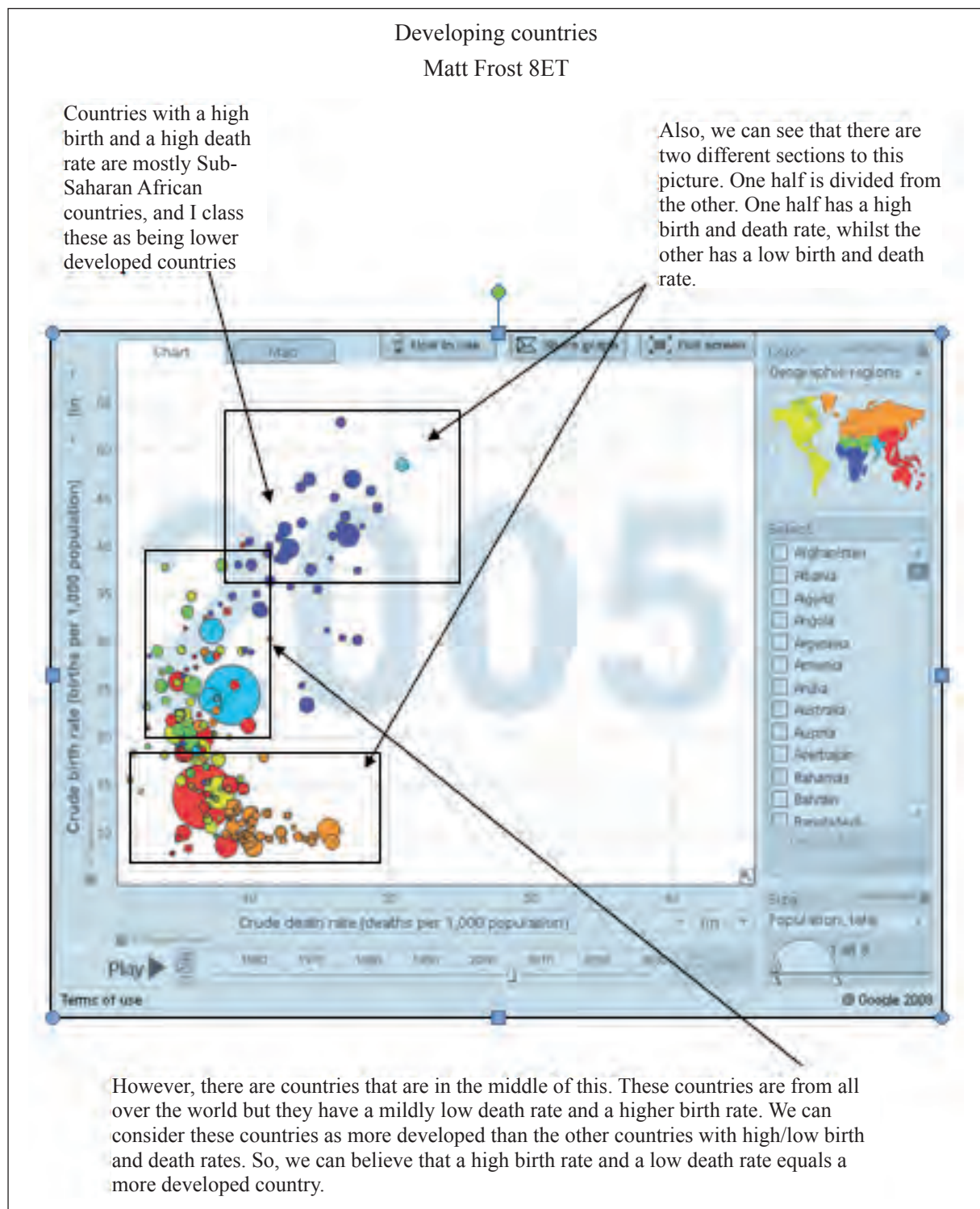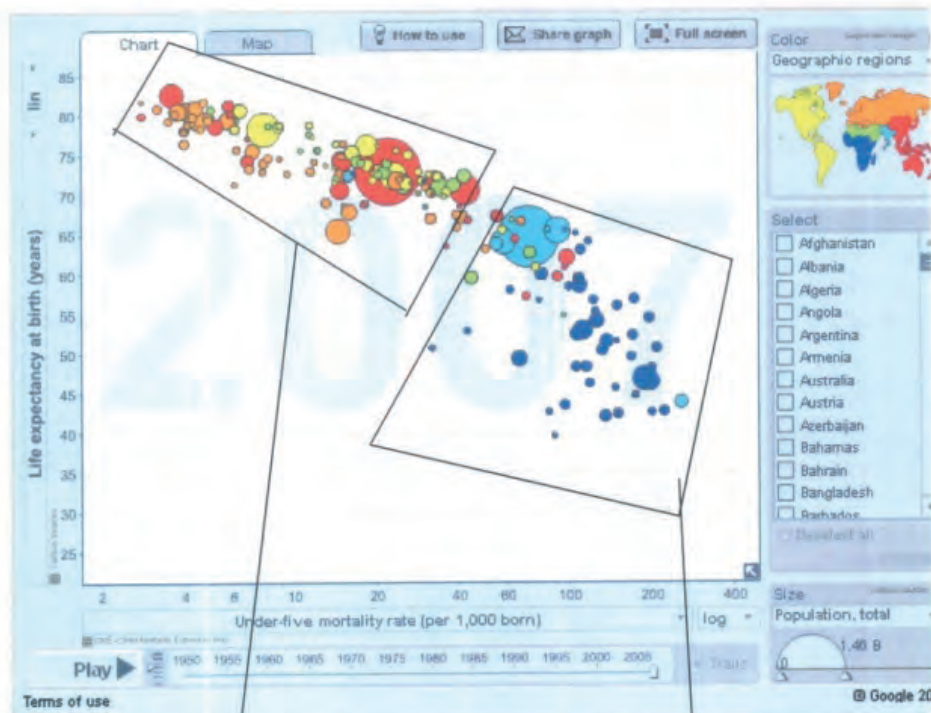
Developing countries
Matt Frost 8ET

Countries with a high birth and a high death rate are mostly Sub-Saharan African countries, and I class these as being lower developed countries

Also, we can see that there are two different sections to this picture. One half is divided from the other. One half has a high birth and death rate, whilst the other has a low birth and death rate.

However, there are countries that are in the middle of this. These countries are from all over the world but they have a mildly low death rate and a higher birth rate. We can consider these countries as more developed than the other countries with high/low birth and death rates. So, we can believe that a high birth rate and a low death rate equals a more developed country.

Fig. 6: Student example, classification of countries

Katy Hickman 8BH   Geography

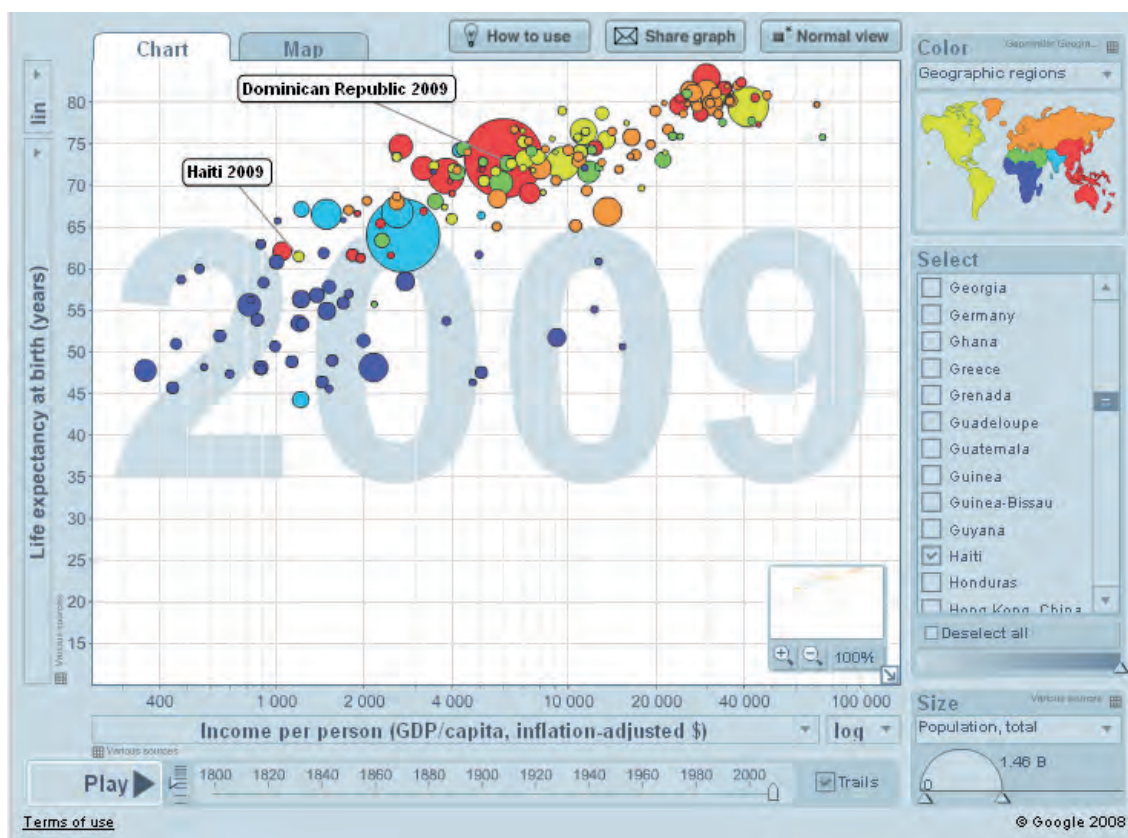*Fig. 7: Student example, classification of countries*

Fig. 8: Gapminder screenshot looking at Haiti vs Domican Republic considering life expectancy and income.

5   Conclusion

To conclude, Gapminder World is an exceptional tool to access and view a wide range of global and national data from a wide range of topics and sources. The adjoining web site provides a wide range of supporting material that teachers and educators will find useful. Gapminder clearly has improved the way students investigate and look at data especially looking at multiple data sets, allows them to interrogate the data and easily compare and contrast groups of countries, enabling them to spend a greater amount of time investigating the patterns and trends found. From my and a colleague's experiences, using Gapminder has made the learning more interactive allowing students to take ownership of the learning particularly how they view the data, and which data they view allowing a greater depth of learning to take place and a greater interest and engagement in the task set without students deviating from the task as can be found often when using computers or when plotting data in graphs using more traditional methods.

As a starting point, teachers should go to the Gapminder website www.gapminder.org and look at the resources available, and try the Gapminder World and view a couple of the example graphs as well as viewing some of the videos. Good ones to view are "debunking myths about the Third world" or "HIV: New facts and stunning data visuals". There is a downloadable desktop version of the Gapminder World that can be used offline. This can be accessed in the teacher's area and once downloaded can be used to create and bookmark graphs without the need of an internet connection, a valuable tool when using to explain and enrich the delivery of key principles across a range of topics.

Teachers planning to use Gapminder needs to build in time into their lessons to allow the students to delve into the data presented in Gapminder and not to be too worried if students are engrossed by the wealth of data provided or if the students investigate different combinations of countries and data as this in itself is a learning process. One cautionary note is to ensure the students are not putting combinations of indicators together that are not making sense in being related. Here strategies have to be developed that help teachers assessing students' hypotheses based on the data, while not hampering the hypotheses-generating process as such.

Acknowledgements

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