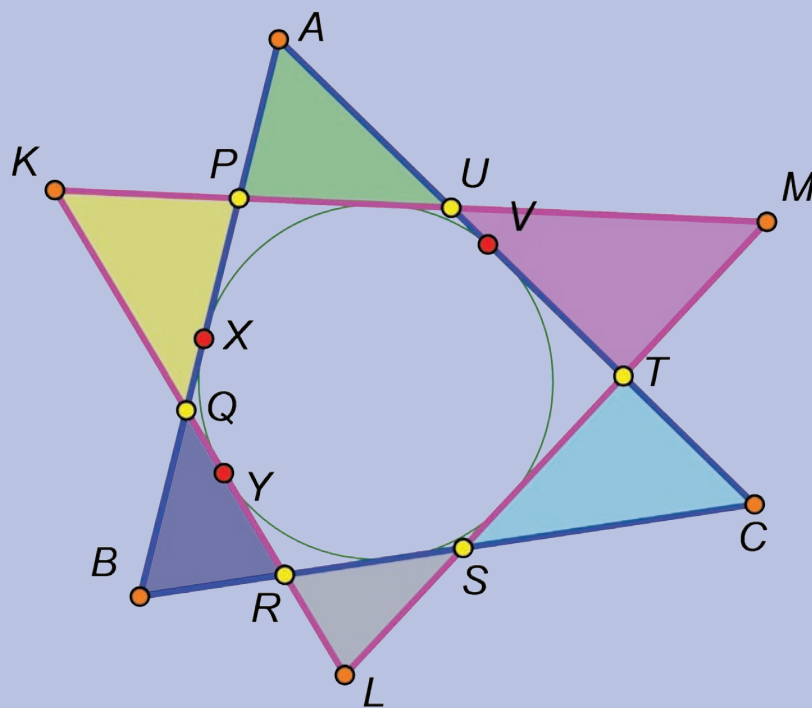


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Number Line Image Generator – A Website Review

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http://www.oliverboorman.biz/projects/tools/number_lines.php

INTRODUCTION

Last year, as part of the South African Numeracy Chair, I was involved in creating a supplement for the local Grahamstown newspaper (Grocott's Mail) called *Fun with Maths*. The aim of the supplement was to encourage parents and teachers to engage learners with various numeracy concepts in a fun way that differed from traditional teaching approaches. Supplements 4 and 5 of the series presented number line activities⁸. Sizeable evidence shows that the number line is a powerful learning tool for children in primary school (see for example Beishuizen, 1997; Bobis & Bobis, 2005; Clarke, Downton & Roche, 2011). Researchers believe that regular use of number lines can develop learners' ability to form a *mental* number line, which in turn may assist learners in carrying out mental computation tasks. However, research has found that many learners are unsuccessful in using number lines effectively, a fact which may well be attributed to their lack of experience engaging with number lines. This review provides a brief background of various types of number lines, particularly structured number lines, and describes and reviews a web-based resource that could be used to produce a variety of closed number lines for classroom situations. The number lines incorporated in the *Fun with Maths* supplements were all created using this web-based tool.

TYPES OF NUMBER LINES

'Traditional' or more familiar number lines with marked line segments (tick marks) are referred to as *structured number lines* where the numbers are representations of lengths or proportion, the lengths between the numbers and marks providing a model for learners to work from. Examples of structured number lines are given below.

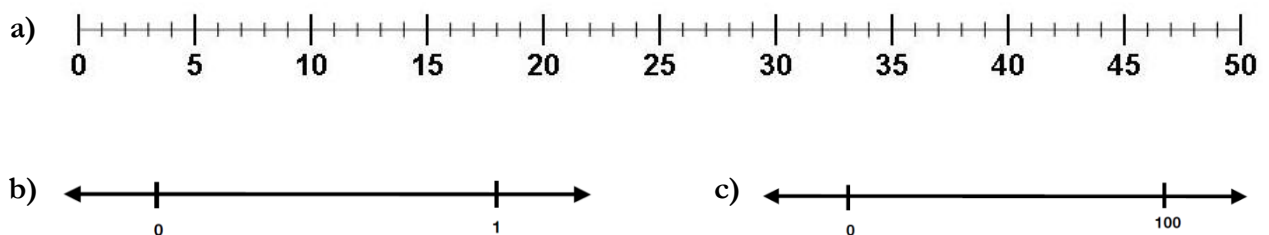


FIGURE 1: Examples of structured number lines.

The empty number line (ENL) on the other hand is presented with no numbers or markers and is a "visual representation for recording and sharing students' thinking strategies during mental computation" (Bobis, 2007, p. 410). The ENL, in which learners only mark those numbers they need for their calculation, allows learners to model their own thinking and to develop flexible mental strategies for solving problems (Bobis & Bobis, 2005).

⁸ These are available from Grocott's series 1–10 at <http://www.ru.ac.za/sanc/numeracyresources/grocottssupplement/#d.en.71044>

Because they are used for different purposes, structured number lines and empty number lines are profoundly different. In order to use them effectively, learners will need to have different skills and knowledge (Bobis, 2007). Although some foundational skills and knowledge can be derived from working with the structured number line that can assist learners in understanding and using the empty number line, we cannot assume that learners who understand how to use one type of number line will automatically transfer that knowledge to working with the other (Bobis, 2007).

BENEFITS

Researchers believe that learners can benefit from working with number lines, not only using them to locate numbers, but using empty number lines to solve addition, subtraction and multiplication computations, as well as using number lines in problem-solving activities. The number line has the advantage of showing how numbers continue in both directions as far as you like, as well as providing a way to connect whole numbers, fractions and decimals (Gravemeijer, 1994). Additionally, Dehaene (2011) argues that our mental models of number seem to be linked to the ordinal aspects of number, where numbers are placed in order with respect to each other as represented on a linear scale or number line.

While structured number lines may not be useful for the flexible modelling of one's own thinking, they do require that learners think in different mathematical ways about the example they are working with. For example, in Figure 1b) learners may start thinking in fractional distances between 0 and 1, while in Figure 1c) mathematical thinking (proportional reasoning) may be in terms of 10s, 20s, halving strategies to find the mid-point, and so on.

NUMBER LINE IMAGE GENERATOR: http://www.oliverboorman.biz/projects/tools/number_lines.php

There are a variety of websites that generate number line worksheets for particular purposes - addition, subtraction, multiplication, or number representation (fractions, decimals, time and so on). Here I would like to explore and review one particular website that allows you to create your own fully customised number lines. Once created, you can download an image of the number line and insert it into documents to present as worksheets or activities for your learners. To give you an idea of the types of number lines you could produce using this website, I have included some examples below.

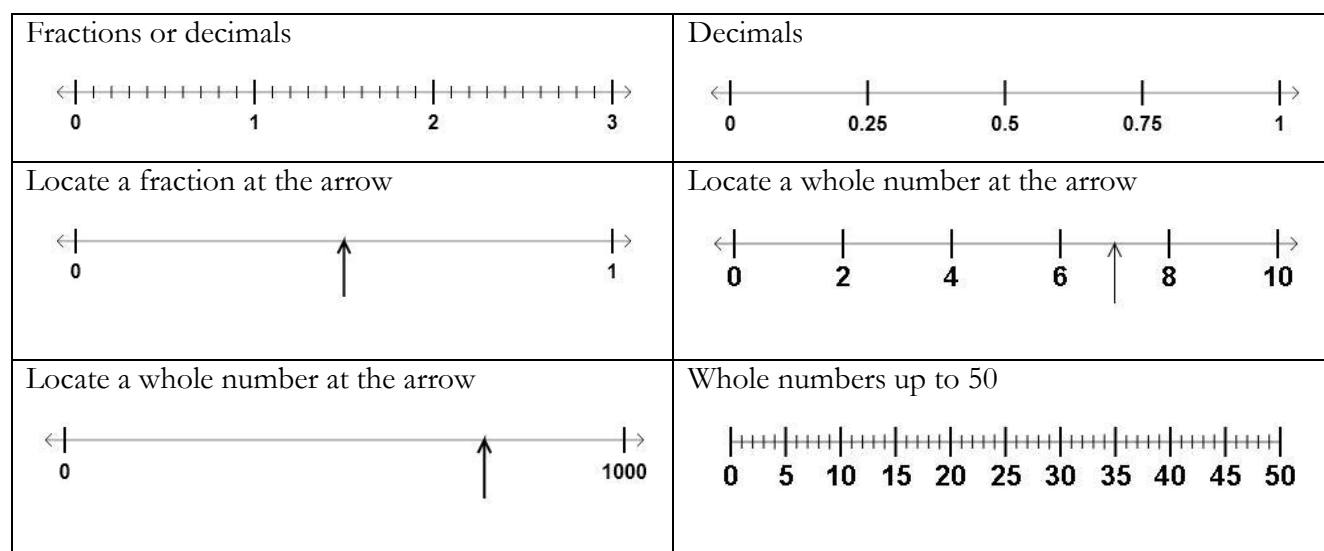


FIGURE 2: Number lines generated on Number Line Image Generator.

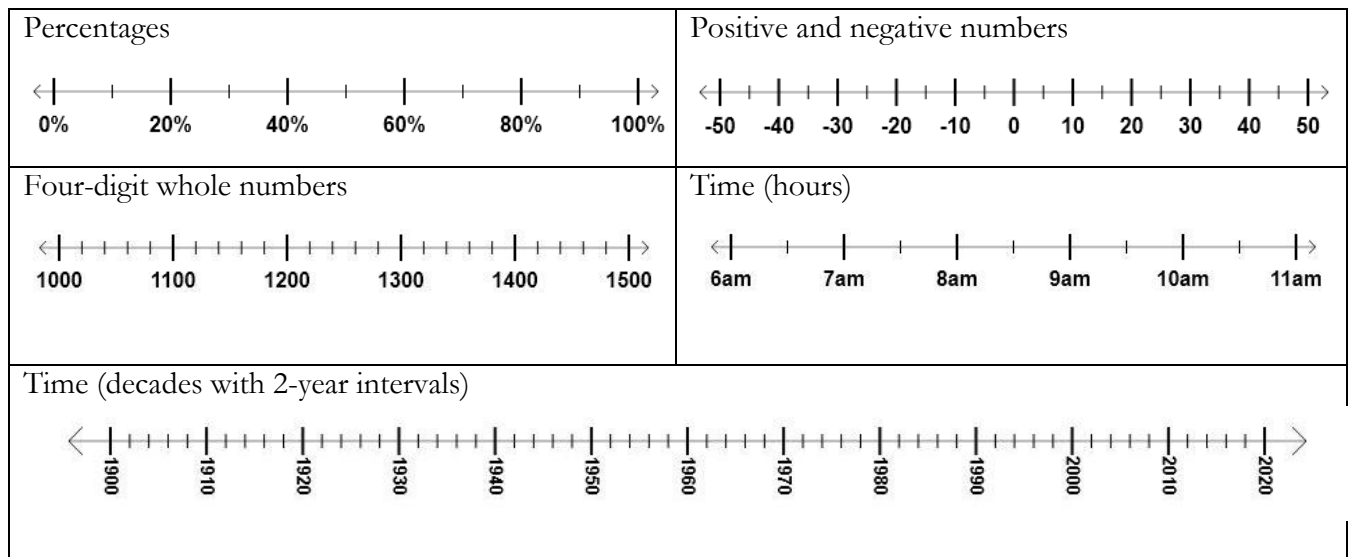


FIGURE 3: More number lines generated on Number Line Image Generator.

USING THE GENERATOR

First navigate to the website address (http://www.oliverboorman.biz/projects/tools/number_lines.php). The main part of the default landing page is shown in Figure 4.

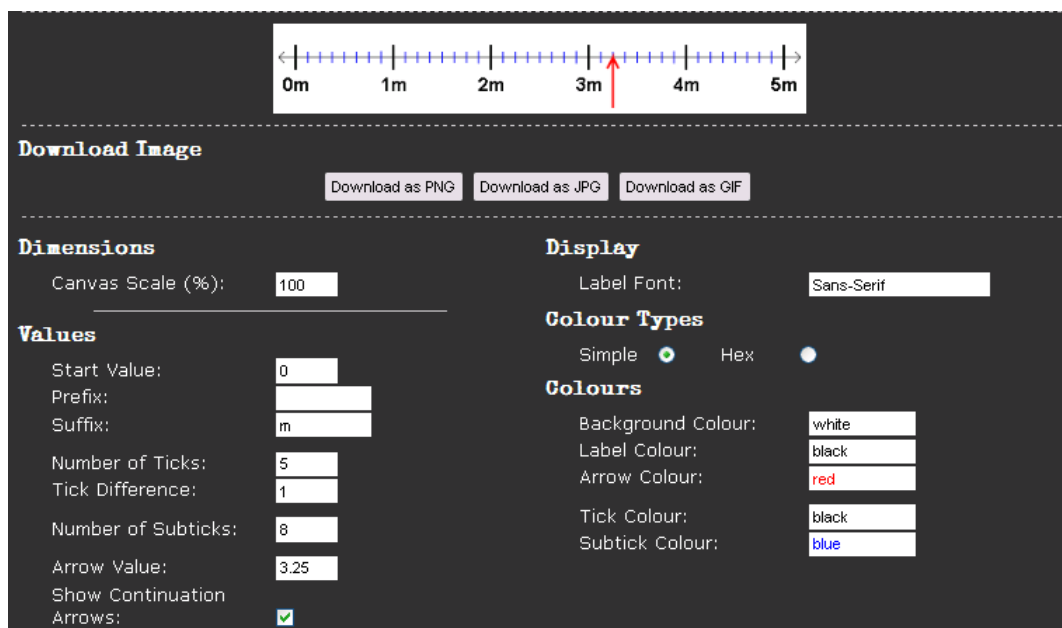


FIGURE 4: Number Line Image Generator default landing page.

The website page is very user-friendly, and a quick bit of playing around is probably all that’s required to get the hang of the various input options. The main input options are described below:

- **Start Value:** This setting determines where your number line will start. You can input both negative and positive values, including decimals.
- **Number of Ticks** and **Tick Difference:** Rather than entering an end value for your number line, the end point is automatically determined by your choice of “Number of Ticks” and “Tick Difference”. So, for example, choosing 5 ticks with a tick difference of 3 will result in an end value 15 units to the right of the start value. Only these tick values, along with the start and end values, will be labeled with numerical values.

- **Number of Subticks:** This setting determines the number of intervals into which the region between consecutive ticks will be divided.
- **Arrow Value:** This setting allows you to choose if you wish to have an arrow pointing to a specific point on the number line. To get rid of the arrow, either choose a value outside the range of your number line, or alternatively choose the “transparent” option from the “Arrow Colour” setting.
- **Prefix:** This setting allows you to customise the tick labels by specifying a prefix such as R or \$.
- **Suffix:** This setting allows you to customise the tick labels by specifying a suffix such as %.
- **Show Continuation Arrows:** This option switches on/off the display of continuation arrows at either end of the number line.

The default landing page for the Number Line Image Generator has some of these input options pre-populated, as shown in Figure 4. Simply change these values to create your own customised number line.

Once you have created your number line you can then download it as an image in PNG, JPG or GIF format. It doesn't really matter which you choose if you are working with print materials, so I normally choose JPG. Select the “Download as JPG” option just below the number line image and a dialogue box will open up giving you the option of either opening the image immediately or saving it to a folder. Once the image has been downloaded you are free to use it as you would any other image or picture.

CONCLUDING COMMENTS

The Number Line Image Generator website is relatively easy to use and allows for most types of number lines to be produced, although it unfortunately doesn't allow one to produce number lines with fraction symbols such as $\frac{1}{2}$ or $\frac{1}{4}$. However, I would recommend the image generator as a useful tool that could be used in Mathematics, Science and possibly other subjects as well.

ACKNOWLEDGEMENT

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