Introducing Robocompass

A nifty tool for Geometrical Construction

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How Geometrical Constructions are taught in Schools

Euclid's *Elements* – one of the most influential mathematical textbooks ever to have been written – is primarily a compendium of geometrical constructions created using straightedge and compass. But are we sure that these two geometrical tools which lie at the heart of such foundational ideas are being used effectively in the classrooms? The current practice is actually to use large wooden geometrical instruments in the classrooms, as the size of the real physical compass (in the 'geometry box') is not large enough to use conveniently as a demonstration tool.

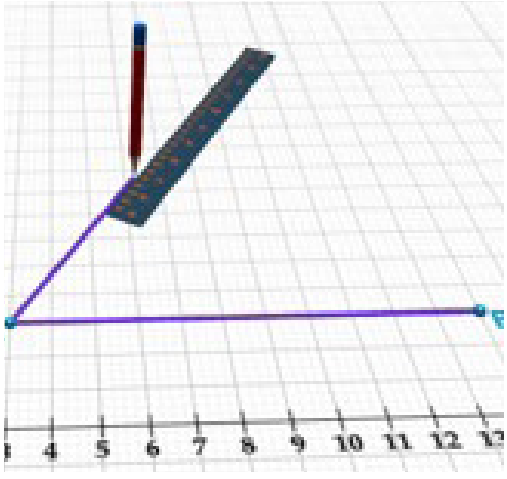
From a student's perspective, pencil smudges, torn papers, hurt fingers due to sharp edges, changing measurements as they move the instruments are some of the inconveniences they need to deal with when working with a physical geometry box. Spatial reasoning is one of the skills all students should inculcate, but are the challenges of using these physical instruments holding students back?

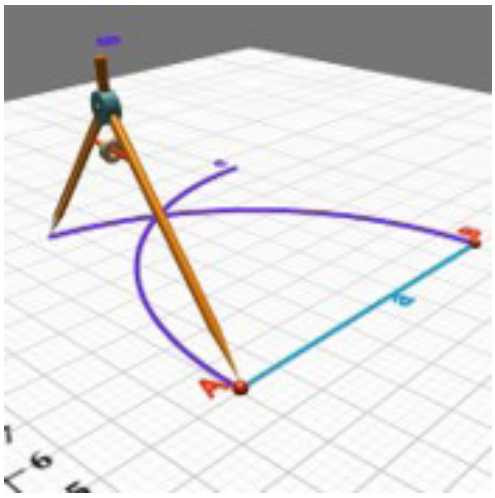
Keywords: geometry, construction, space, tools, software

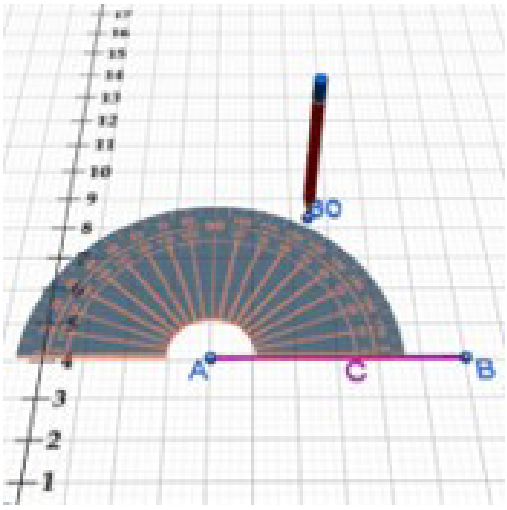
The question we are trying to address in this article is, with increasing computerisation of our classrooms, would a digital equivalent of a physical compass make it easier for teachers to demonstrate geometrical steps of a construction? Would it help students understand geometrical concepts better and appreciate the beauty behind geometrical constructions more fully? In this article, we explore these questions using a geometrical software called Robocompass, https://www.robocompass.com/. It is freely available on the web.

Technology based Approach

If not used appropriately, technology in the classroom can end up serving more to distract than to enable. This is because of two reasons: (i) technology introduces a radically new way of learning that students find difficult to adapt to; (ii) the technology comes up with a steep learning curve which teachers find difficult to cope with. Robocompass addresses these two primary concerns by simulating the behaviour and movements of geometrical instruments in 3D exactly as they would work in the real world. From a learning perspective, Robocompass uses 10 simple text-based commands which can be used to create the code for building constructions. The geometrical construction unfolds as the user types the commands one by one. The tool is very user friendly and correcting or modifying the commands can be done easily without having to remember too many menus/buttons or other distracting user interface operations.





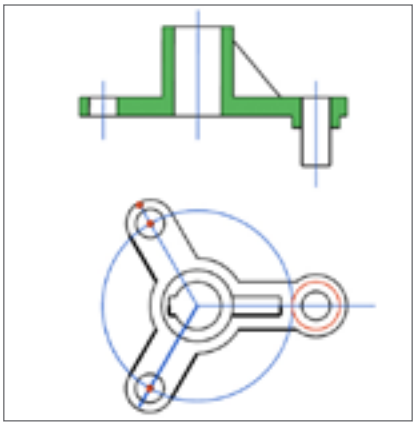


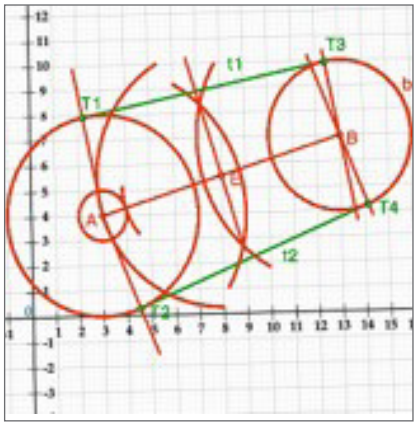
Having coded the steps, we can 'play' the construction, just like a Video. A teacher can import someone else's construction and add/remove or modify the commands, and include hints while demonstrating the steps of geometrical constructions; similarly, students can replay the whole construction or play a single step at a time.

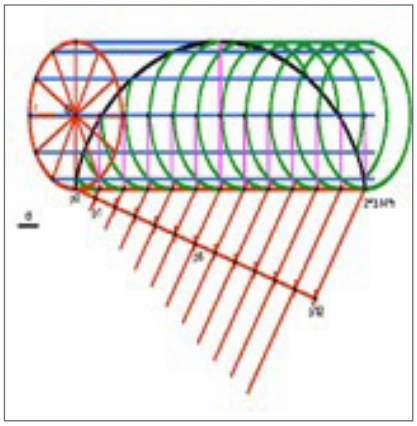
Apart from basic constructions, we may also demonstrate key geometrical ideas such as dilation of a geometric figure using Robocompass.

Building Complex Geometrical Constructions

The simplicity of the commands and the look of the 3D environment might give Robocompass a game-like aura, but many complex geometrical constructions are already being developed and published by expert mathematicians.







That the geometrical primitives can be colour-coded differently and commented upon is another aspect that greatly enhances the comprehensibility of complex constructions.

Code the Construction

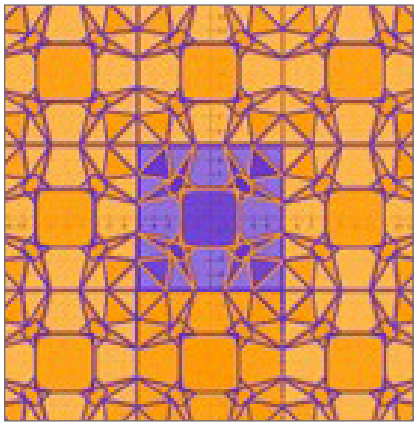
One of the positive (but unintended!) consequences of the Robocompass command-based system is how gently it introduces *coding practices* to students. Naturally, to create the correct code for a construction process, the student needs to understand the steps that will lead to the final desired output.

Against the backdrop of many developed countries already incorporating coding into the curriculum, many teachers have appreciated this aspect of Robocompass. Today coding is the new expression of literacy, and Robocompass can facilitate the exposure of such a vital skill to students early on through curriculum oriented geometrical concepts.

Robocompass as a Creative Tool

Beyond the basic commands used for building geometrical constructions, Robocompass comes with a rich set of commands to do creative mathematical art and tessellations using basic geometrical transformations such as reflection, translation, and rotation. This has encouraged many schools in the US and Canada to give creative project assignments to students using Robocompass.

The flexibility of Robocompass to deconstruct each step of the actual mathematical art in animated fashion reinforces the essential ideas such as symmetry, perpendicularity, and parallelism.



Classroom Integration

Teachers who are new to Robocompass do not have to create any new worksheets from scratch. They can download many ready to use worksheets (based on the NCERT syllabus) from the Mumbai website of the Kendriya Vidyalaya Sangathan, Zonal Institute of Education and Training:

http://zietmumbai.gov.in/homedir/public_html/OldResources.html

(Solutions to constructions: Class VI to X using Robocompass)

Teachers can modify these worksheets as required and project them to a smartboard. Teachers will find Robocompass to be a great supplementary tool in teaching Geometrical Constructions and this will lead to greater student engagement in the classroom.

M SRINIVASAN has been with the Zonal Institute of Education, a training wing of Kendriya Vidyalaya Sangathan, Mumbai as a mathematics training associate, since 2012. He conducts workshops for mathematics teachers on the effective use of Instructional Technology in the classroom, using software such as GeoGebra, Microsoft Mathematics, Robocompass, Quiz.com, etc. He has contributed several worksheets to the open source community. He can be reached at srinivasan.pgt.kvs@gmail.com