Chapter 23
The GeoGebra Institute of Torino, Italy:
Research, Teaching Experiments, and Teacher Education

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ABSTRACT

This chapter is focused on the GeoGebra Institute of Torino, Italy (http://www.geogebra.unito.it/), founded in July 2010 at the Dipartimento di Matematica dell'Università di Torino (http://www.dm.unito.it) and operating under the auspices of the human resources of the association La Casa degli Insegnanti (http://www.lacasadegliinsegnanti.it/PORTALE/), which is in charge of organising courses for teachers. GeoGebra is a dynamic geometry software that has had a large diffusion in educational and academic institutions in recent years. This wide diffusion opens new fields of research in mathematics education, in continuity with other software of the same kind, such as Cabri-Géomètre or The Geometer's Sketchpad. The main research questions deal with teaching practice, pedagogical and methodological choices, teacher education, and teaching/learning experiments at different school levels. Furthermore, several issues relating to the learning of mathematics with GeoGebra, in the context of research and teaching practice are highlighted.

THE GEOGEBRA INSTITUTE OF TORINO

The name GeoGebra stands for Geometry and Algebra and refers to a software aimed at representing mathematical objects and manipulating them from the point of view of Geometry and Algebra. GeoGebra (http://www.geogebra.org/cms/) is an open-source dynamic geometry software, in which users can construct geometric figures using a series of commands for drawing geometric objects and/or applying further constructions and transformations to them (e.g., rotating an object, finding the middle point of a line segment, or drawing the symmetric mirrored image of a polygon). The specific feature of GeoGebra is dragging: a geometrical object, once constructed, can be dragged without changing its properties of construction. This enables students to explore properties of figures and conjecturing about them. GeoGebra

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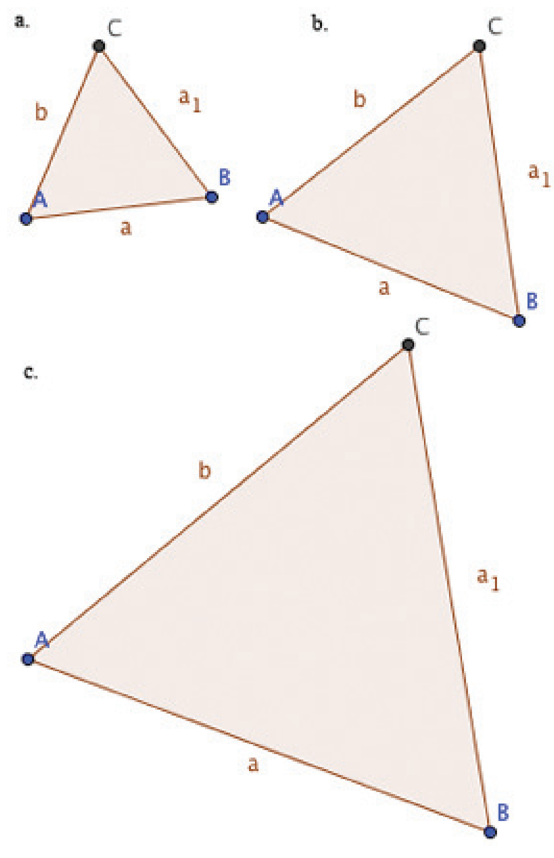
was created in 2001 by an Austrian student, Markus Hohenwarter, in his master degree thesis. Subsequently, GeoGebra was introduced all over the world and has been continuously updated and modified, with the addition of new features and new version releases. It has now been translated in multiple languages and has been used at various school levels (Hohenwarter et al., 2009). The main feature of this software is the dynamic nature of figures; figures can be translated, rotated, or enlarged, according to the rules of the construction (e.g., a square remains a square even if enlarged).

The most distinctive tool of dynamic geometry software (i.e., GeoGebra, Cabri, and Sketchpad) is the simple dragging of shapes/points using the computer mouse/touchpad, allowing users to select one or more objects and to move them continuously on the screen. Such dragging actually changes the figural aspect (Fischbein, 1993) of a construction (see for example, how the representation of an equilateral triangle changes in Figures 1a, 1b, and 1c), while maintaining the conceptual aspect of the figure (e.g., all the properties of the equilateral triangle are being maintained). This duality does not arise in a static pencil-and-paper environment, since the figural aspects are handled in a visual register and the conceptual aspects in the discursive register. Since geometric proofs are meant to concern theoretical objects–and not just specific, static drawings–the role that dragging can play in managing the figural/conceptual duality is of particular interest. For example, any conjecture about an equilateral triangle must assume that the conjecture will hold true for any configuration of an equilateral triangle. For this reason, dragging may mediate the process of proving, in particular focusing on the epistemological and cognitive implications of it (Arzarello et al., 2002; Olivero & Robutti, 2007; Laborde, 2004; Sinclair, Moss & Jones, 2010).

Compared with other dynamic geometry software (e.g., Cabri or Sketchpad, etc.), GeoGebra is open-source software, meaning that users all over the world have free access and can modify the source code. It is a representational infrastructure (Hegedus & Moreno-Armella, 2009), whose diffusion is guaranteed by the simple schemes of use and its open-source philosophy. Software like GeoGebra actually change the way geometry is taught in school, as a result of their intrinsic dynamic feature and the support they offer to exploration and formulation of conjecture and proof. The key of their success in supporting students' construction of new knowledge is the dynamic feature for moving, translating, varying figures that allows students to observe invariants, changes, and shapes. Moreover, GeoGebra has some affordances that make it not only easy to use, but also extremely powerful in exploring problems in all educational levels, from primary to tertiary. GeoGebra provides a set of integrated

Figure 1. How the representation of an equilateral triangle changes



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