

# BRINGING APPROPRIATE MENTAL IMAGES TO THE FOREGROUND USING DYNAMIC GEOMETRY AS A SEMIOTIC MEDIATOR: WHEN IS A RECTANGLE A RECTANGLE?

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*Abstract: We claim that a Dynamic Geometry Environment could be an effective semiotic mediator to bring a correct mental image to the foreground, despite the prevalence of a primeval and incorrect image.*

*Keywords: Dynamic Geometry Environments; mental images; mental models; semiotic mediators.*

## A GEOMETRIC PROBLEM: WHAT IS A RECTANGLE?

Elisa Gallo (1994, 1989) studied experimental settings to recognize formed or not formed, appropriate or not appropriate models (Ackermann-Valladao et al. 1983). In particular, pupils aged 14–15 were asked to perform the following activity: “Draw a rectangle ABCD, with the side AB lying on the line  $r$  and the points A, C as given” —where the line  $r$ , a point A of  $r$  and a point C outside of the line are drawn on the text of the activity with—this is paramount! — the line  $r$  not parallel to the sides of the sheet. (Fig. 1)

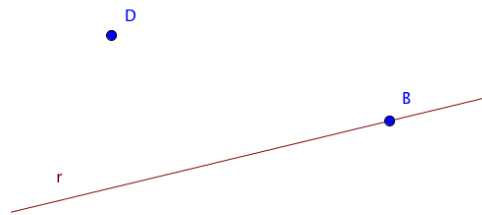


Fig. 1. Elisa Gallo’s activity

401 answers were collected and classified in 37 different models (some are shown in Fig. 2), only one of them being correct: the correct answer appears 100 times, 60 more answers are rectangles, 206 answers are about parallelograms and 35 answers are other figures (right trapetia, triangles, etc.). Notice that pupils were asked not to erase any attempt.

An informal observation while displaying the present work at ICTMT showed about a third of the observees drawing a parallelogram (the third item in Fig. 2) with their finger before giving the correct answer.

## THE CONCEPTUAL FRAMEWORK

Following D'Amore (1999) we define a *mental model* of a phenomenon as a collection of mental images that arose from the different manifestations of that phenomenon. Thus, many of the results (Fig. 2) of E. Gallo's experiment could be read as the emergence of a primeval mental image, branded in primary school: *a rectangle is the part of the plane limited by a couple of horizontal lines and by a couple of vertical lines. A formed but not appropriate image, in Ackermann-Valladao's framework.*

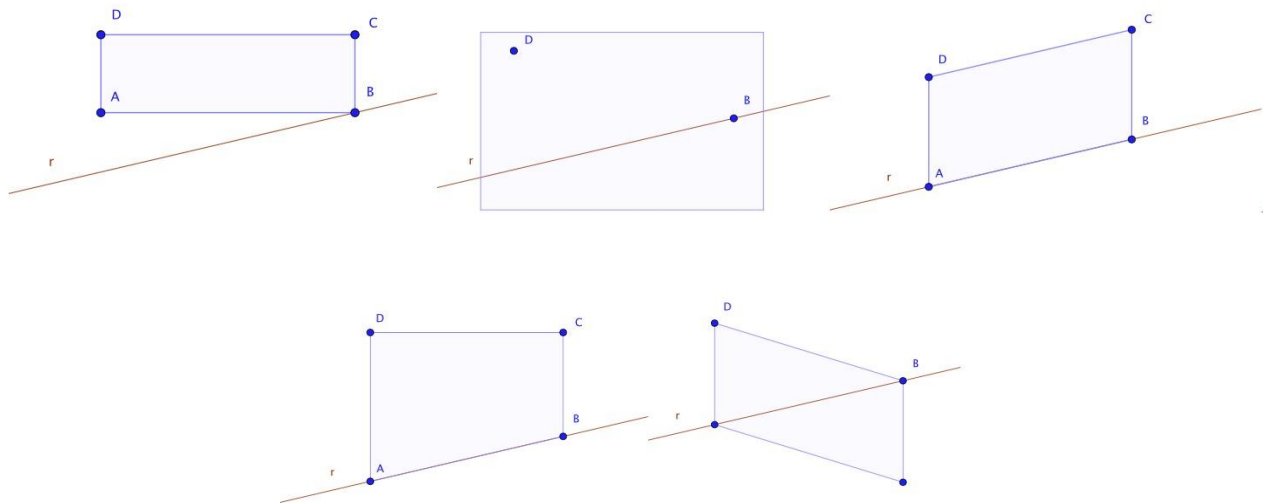


Fig. 2. Some of the results

Rabardel and Samurçay (2001) define an *instrument* as a mixed entity “made up of both artifact-type components and schematic components that we call utilization schemes.” A double semiotic link appears between such an instrument, a task and a piece of knowledge (Bartolini Bussi & Mariotti, 2008).

#### EXPERIMENTAL HYPOTHESIS

Mariotti & Bartolini Bussi (1998) and Mariotti (2002) show that dragging in a Dynamic Geometry Environment (DGE) carries the pupil—through an “expected although not simple and spontaneous” process—to internalize the construction of a geometric figure (a square, in their case).

We expect that, in a similar way, the use of a DGE perpendicular line *instrument* (as defined by Rabardel) through its capability to manage and facilitate (Bu, Spector e Haciomeroglu 2011) would effectively mediate in bringing to the foreground the mental image of a rectangle as an equiangular quadrilateral.

#### PLANNING THE EXPERIMENT

The experimentation will be carried out during the 2017/2018 school year, in eighth and ninth grade classes of teachers in the Milan area with whom we are collaborating.

#### DUO OF ARTIFACTS

We intend to extend the proposed experimentation to allow the use of a duo of material and digital instruments (Maschietto & Soury-Lavergne, 2013), too; developing—similarly to Faggiano, Montone, Rossi (2017)—a teaching plan based on the interplay of material (viz. a geometry set) and digital (viz. perpendicular line tool) instruments.

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