GEOMETRICAL RIGIDITY: AN OBSTACLE IN USING DYNAMIC GEOMETRY SOFTWARE IN A GEOMETRY COURSE

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This paper is a summary of a pilot experiment which is part of a main project designed in order to study middle school students' obstacles during proof constructions with the use of a dynamic geometry software (DGS), specifically *Cabri-géomètre*. This pilot experiment was carried out in one suburban zone, public middle school in Mexico, with 13 and 14 years old students. Those students were in the 2nd middle school grade and their background with computer was poor or null.

Some of the students' behaviors observed during experiment activities show some preferences on figure representations which may imply obstacles when DGS is used. The reason could be that students use only one kind of figures for their observations, and due to a phenomenon called "geometrical rigidity". I had previously observed that this rigidity phenomenon seemed to hinder students' work when dynamic diagrams were used.

By *geometrical rigidity,* I mean that certain students cannot mentally handle a figure when it is not in certain "standard" positions or they cannot imagine the figure when moved (under a translation) or when its shape changes (the sides change of position or the angles are modified, for example). In other words, I am not referring to students' capacity or inability to identify one figure, but I refer to students' "comfort" handling figures with certain orientation or shape. This might be related to students' inability to imagine the possible motion of figures or constructions parts (precisely one of DGS main features) which transforms it in another construction. It may also come from their inability to mentally explore other possibilities of construction. This inability is reflected in students' preference for handling figures with one certain orientation.

Maracci (2001) mentions that when students draw figures, when they try to harmonize conceptual and figural aspects, they have to make an effort to construct *satisfactory* drawings for themselves, which turns out in a certain figure with one specific orientation. Furthermore, we must add the trend on textbooks and geometry classes to orient figures in a standard way.

After the experimental activities, two main observations about students' behavior can be drawn out from the analysis of the protocols and the Cabri files of constructions :

- there was a tendency to draw triangles (with Cabri) whose shape was more or less regular (isosceles triangles) and with one horizontal side; and
- in some processes of figures' or constructions' modification, when some of its independent elements is dragged, I noticed an inability of some students to

visualize all the steps (or moments) of this transformation as particular cases of the figure or the construction. In other words, when we (researcher and teacher) deformed students' constructions through dragging one vertex, we noticed that they perceived something, that we called *discreet* or *step by step dragging*, since students considered just two cases: the construction she/he has made before the dragging operation and the last one obtained when dragging operation is stopped. The intermediate moments of moving are not perceived as other possible cases of construction, but they are considered as intermediate diagrams, which do not have the same geometrical construction status than initial and final constructions; they are just one more instant of transformation between first and last steps.

Moreover, we noticed that figural components of constructions have a supremacy over the concept of figure. Although students seem to know the concept of triangle and express it without orientation aspects, when they handle figures, appears the fact that the interpretation of a figure depends on figural constraints mainly, which –with Fischbein's (1993, p. 155) words– "represents a major obstacle in geometrical reasoning". This situation implies some obstacles when we use a software which has a logical correspondence with geometry such as Cabri. Furthermore, this phenomenon might lead students to not being able to appreciate the software dynamic features, because "to appreciate this visual information [provided by the software], it is crucial that they [the students] overcome the obstacles associated with diagrams" (Yerushalmy, Chazan, 1993, p. 31). Therefore they dismiss some operations based on this kind of features, such as the dragging test of a construction, as a validity means of its correctness (Mariotti, 2000).

These observations lead us to the hypothesis that this geometrical rigidity phenomenon is one obstacle to implement DGS in courses or activities, where students have a poor or null computer background. Hence, it is necessary to take this phenomenon in consideration and be prepared in order to avoid failures. The process that makes students able to capture the potentiality of the dynamic feature of a DGS is not automatic, but it needs some specific cognitive development.

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