FLEXIBLE THINKING WHEN WORKING WITH GEOGEBRA

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In the field of mathematical-related affect, one demand is the connection between affective constructs and cognition (Hannula et al., 2019). The contribution of GeoGebra to learning and problem solving has been widely informed and its potential to foster students' motivation and involvement is recognized. But the question remains open about how to capitalize on this initial motivation to build sound, positive mathematics attitudes, such as Flexible Thinking, tightly linked to mathematical activity and cognition. Flexible Thinking implies being able to change the direction of mental processes when the situation so requires. A student shows this attitude when: (a) it doesn't get blocked solving a task in a steady way, but considers alternatives and redirects its mental processes; and (b) it doesn´t change its mind without conviction, but understands it is the right way to proceed (Zaldívar et al., 2006).

To date, much research on mathematics-related affect relies on the participants´ self-reports where doing mathematics is simply a context. We intend to transcend this lack of mathematical specificity through a design-research study that addresses the "how" question. The study was carried out with 46 students, 14-15 years old, at a public school in Spain. Along two months (25 one-hour sessions), two sequences of geometrical tasks were implemented with the same methodological principles, except for the use of the GeoGebra, which was introduced in the second sequence to work on plane tessellations. Data were taken observationally, using (a) and (b) as indicators, and through the students' productions and audio recordings while solving the tasks, which were analyzed by means of the software Atlas.ti. Quantitative results show that the percentages of sessions in which most of students (over 2/3 of the total) manifested Flexibility of Thought was 11.5% for paper and pencil tasks and 66.7% for GeoGebra tasks. Qualitative data show how, by shortening the time to do mosaic calculations and representations, GeoGebra enabled the students to try to solve tasks in different ways and think of alternatives. The feedback offered by the software after each action (interactivity) allowed the students to calibrate the rightness of their strategies, changing track if deemed necessary. The accuracy for calculations and representations (constructivity) made the students realize that errors were due to an inappropriate strategy or action, which led them to a justified change in their procedure.

References

Hannula, M. S., Leder, G. C., Morselli, F., Vollstedt, M., & Zhang, Q. (Eds.) (2019). *Affect and mathematics education*. Springer.

Zaldívar, M., Sosa, Y., & López, J. (2006). Definición de la flexibilidad del pensamiento desde la enseñanza. *Revista Iberoamericana de Educación*, *37*(4), 1-5.

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