

# CULTIVATING LEARNING THE CONCEPT OF NEGATIVE NUMBERS IN THE CONTEXT OF ALGEBRA AND VICE VERSA

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The goal of this study is to propose a learning environment that cultivates the learning of the concept of negative numbers while introducing and extending the notion of variable in a way that it contains both negative and positive numbers. We hope that the proposed learning environment let the learners perceive a symbolic representation of a variable in such a general sense. For this aim, we use the design experiment (a kind of design-based research) which have both a pragmatic bent –“engineering” particular forms of learning- and a theoretical orientation –developing domain specific theories by systematically studying those forms of learning and the means of supporting them (Cobb, Confry, diSessa, Lehrer, & Schuable, 2003).

Regarding the notion of negative number, although we accept the dual nature of the concept (operational & structural; Sfard, (1991)), we do not adhere to the “subtraction” as the process that produces negative numbers (as Sfard (1991) suggests). We introduce and support a rather radical approach in which the object perception of negative numbers precedes the process perception of those numbers. Accordingly, we will design a situation in which the negative numbers are introduced at first by geometric existing objects – it means points - and then, the “addition” would be developed on this new set of objects in such a way that the addition properties would be preserved. This would be done in an algebraic context by which the new objects – negative numbers- would be introduced in relationship with other existing objects. Also we use the history of negative numbers that supports our approach (Heefffer, 2008).

We hope the results from this design research shed light on the knowledge about learning negative numbers and the “operational, structural, *inter-structural*” conception of this mathematical concept. The “inter-structural” conception of a concept is our extension of Sfards framework which fails to describe the relationship between the new object and the older existing objects and our design will support it. In this short oral, we also show some results obtained from working with algebraically naive students who have not seen negative numbers in formal education.

## References

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