# REMEDYING SECONDARY SCHOOL STUDENTS' ILLUSION OF LINEARITY: A DEVELOPMENTAL RESEARCH

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A series of ascertaining studies by De Bock, Van Dooren, Verschaffel and Janssens (2001) has shown a strong and irresistible tendency among secondary school pupils to overgeneralise the linear (or proportional) model when working on applied geometrical problems about the lengths and the area/volume of similar geometrical shapes. These studies have shown that even with considerable support (such as self-made and ready-made drawings or metacognitive stimuli calling students' attention to the problematic character of the word problems), only very few students appeared to make the shift to the correct non-proportional reasoning. Moreover, a lot of information was obtained on the actual process of problem solving: although some students seem to really 'believe' that quantities are always linked proportionally, their improper use of linearity often results from superficial and intuitive reasoning, influenced by specific mathematical conceptions, habits and beliefs leading to a deficient modelling process. Altogether, these studies yielded valuable building blocks for the final stage of our research program, namely the design, implementation and evaluation of a powerful learning environment aimed at overcoming the illusion of linearity by developing in students a deep conceptual understanding of proportional reasoning including the disposition to distinguish between situations that can and cannot be modelled linearly.

This poster illustrates the major design principles of the learning environment by means of a sample of the instructional materials that were constructed in this developmental research. The learning environment is interspersed with various realistic problem situations, both linear and non-linear ones, which typically challenge students' mathematical (mis)conceptions, socio-mathematical norms and habits leading to stereotyped modelling. The relevant mathematical concepts and insights are explored and clarified from a variety of perspectives (using verbal, numerical, graphical, algebraic, and pictorial representations) serving as different lenses through which students can interpret these problems and their solutions. Finally, the learning environment relies on a combination of instructional techniques that have proven to be successful in enhancing students' deep understanding and higher-order thinking skills, such as coaching, scaffolding, articulation and reflection.

De Bock, D., Van Dooren, W., Verschaffel, L., & Janssens, D. (2001). Secondary school pupils' improper proportional reasoning: An in-depth study of the nature and persistence of pupils' errors. In M. van den Heuvel-Panhuizen (Ed.), *Proceedings of PME 25* (Vol. 2, pp. 313–320). Utrecht, The Netherlands.