

DIGITALLY INCREASING THE QUALITATIVE UNDERSTANDING OF THE DERIVATIVE



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HUIZERMAAT
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RATIONAL AND AIM

How can we improve the qualitative understanding of the derivative using a digital environment?

Students often struggle with making a sketch of a derivative in the absence of a formula that can be computed

Five levels of understanding the derivative:

Adapted from: Vos, Braber, Roorda, and Goedhart (2010)

L0: no operable knowledge

L1: knowledge of some connection between the slope of the function and the derivative

L2: knowledge of the location of points on the graph of the derivative relative to the horizontal axes

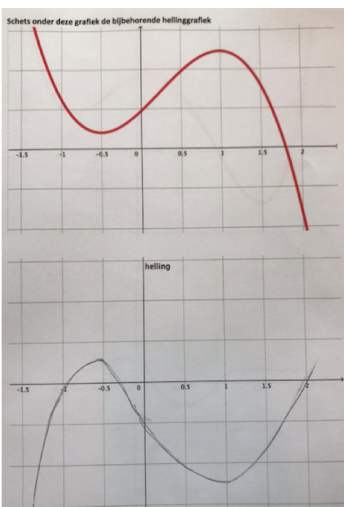
L3: understanding the derivative as slope that is, the derivative represents the course of the slope of a graph

L4: understanding the derivative as gradient, that is a point on the graph of the derivative represents the gradient of a tangent

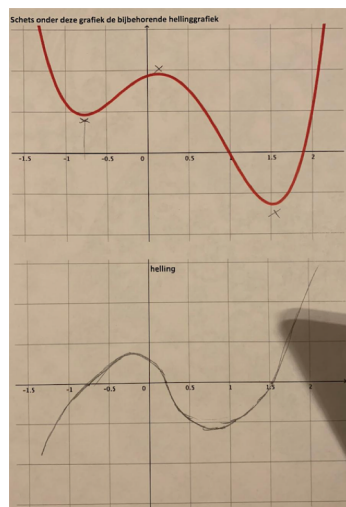
METHOD

- Topics: derivatives slopes tangents
- Animation video containing an explanation
- Digital environment in which feedback on a sketch can be obtained
- Additional GeoGebra worksheet illustrating tangents
- Experimental design: digital method (D) and control group (C)
- Thinking aloud protocols (TAPs) during the intervention
- Semistructured interviews after the intervention
- TAP pretest before intervention and TAP posttest after intervention
- One session with the digital environment
- One session with GeoGebra worksheet
- Follow-up TAPs after three weeks
- Finally interaction with GeoGebra worksheet for all participants followed by a semistructured interview
- Experimental group: two 17 year old pupils
- Control group: two 17 year old pupils

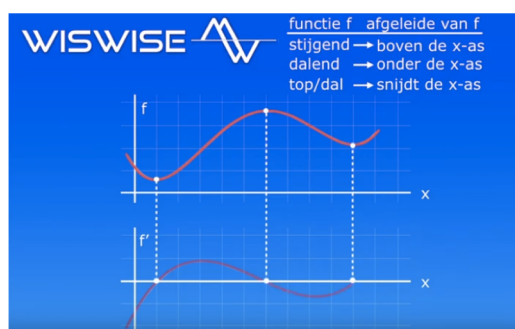
EXAMPLE TASK AND LEARNING ARRANGEMENT



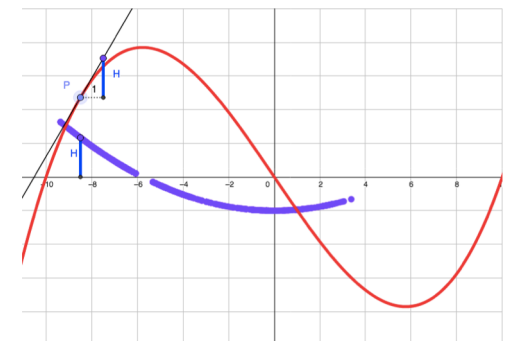
Example of a pretest:
The assignment was to sketch the derivative of the red graph



Example of a posttest:
The assignment was to sketch the derivative of the red graph



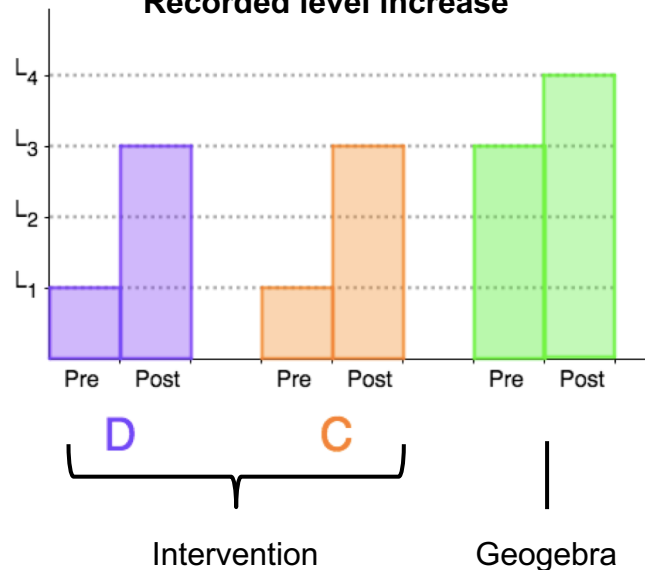
Thumbnail of the explanation video



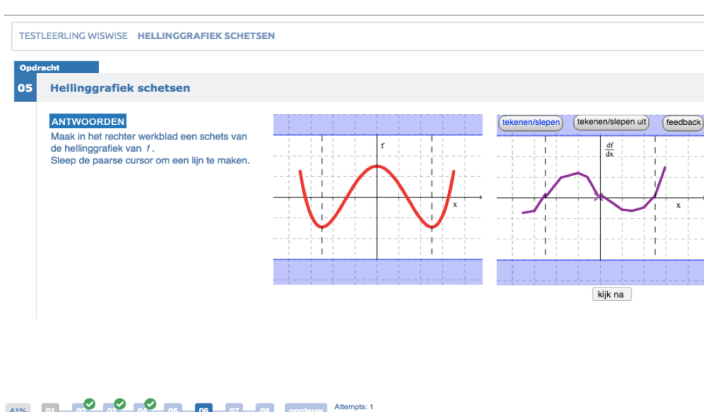
GeoGebra worksheet for dynamically constructing the derivative

FINDINGS

Recorded level increase



Although the environment contributes to the qualitative understanding of the derivative It's contribution does not seem greater than the contribution that can be attained by use of a textbook. However the GeoGebra worksheet did give a student a more profound understanding of the relationship between a function and its derivative. Perhaps this is because the digital environment was modelled to emulate the way of learning similar to that of a textbook while the GeoGebra worksheet provided an extra element: dynamical construction. Adding dynamical constructions to the environment might pose an improvement.



Example of a page in the digital environment. A sketch of the derivative can be made digitally. Feedback on the sketch can be obtained by a button.

Dynamical examples of the material available at: <https://www.geogebra.org/m/a6hhpepx> Or scan the QR code

Reference: Vos, P., Braber, N. D., Roorda, G., & Goedhart, M. J. (2010). Hoe begrijpen en gebruiken docenten van de schoolvakken natuurkunde, scheikunde en economie het wiskundige concept 'afgeleide'. Tijdschrift voor Didactiek der Bètawetenschappen, 27, 37-62.

