

Influence of Initial Didactics Training in the Teaching of Quadratic Functions and Equations : A case Study in French-Speaking Belgium

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Context

We present ongoing research that highlights **teachers' choices** regarding chapter organisation, comparing teachers **with and without didactics training**. We analyse the **"Lessons" section** and the **exercises** proposed, emphasising differences in the diversity and complexity of examples, as well as in the use of **registers of representation** and their conversions. These results are illustrated by excerpts from interviews and teaching materials. Finally, we discuss the **impact of didactics training** on teaching choices and outline perspectives for analysing classroom practices.

Theoretical tools and research question

- **Relief study** (Robert in Vandebrouck, 2013): epistemological, curricular, and cognitive analysis of the content used to describe the possible conceptualisation of the notions to be taught.
→ diversity of registers of representation (Duval, 1993) and the need to move between them to address the tasks prescribed for students (Dumonceau, 2023)
- **Mathematical Knowledge for Teaching model** (Ball, Thames & Phelps, 2008) used to study the understanding of the content that teachers will teach.

How can specific teaching on the concept of registers of representation influence teaching practices for quadratic equations, inequalities and functions?

Results

- Interviews with 14 teachers: DP1 to DP9 had received didactics training, while P10 to P14 had received other training.
- Interviews completed with an analysis of the materials used by teachers in the classroom, focusing on the treatment and conversion of registers of representation.

Organisation

- Three DPs begin the chapter with quadratic functions, introduce the discriminant method when dealing with zeros and continue with quadratic equations and inequalities.
- The other eleven chose to begin the chapter with quadratic equations, followed the functions, concluding with the inequalities.

Difference in their justifications :

- The DPs tend to offer justifications based more on **didactic reasons** or content analysis.
- The other encounter challenges in substantiating their decisions.

DP3: *And for me, I think it's still a wiser choice because, for example, in quadratic functions, everything still relies on the use of delta and delta. [...]. Finally, equations are the best way to introduce delta, because that's really why we have the delta formula, so that we can solve equations.*

DP7: *I start with equations, because in fact they are already used to solving equations, mainly first-degree equations, but also some second-degree equations.*

P10: *We all do the same thing. [...] We free ourselves from the constraints of having second degree equations, which can be factored by Horner's method or by highlighting.*

P11: *I've always done it this way... I started three years ago, and I liked it that way. I can't give a reason for it now.*

P13&14: *We were following a book too, and in the book it was done that way.*

Exercises

- Common basis among all teachers: quadratic equations, remarkable products, characteristics of a quadratic function and its graphical representation, relationship between an expression and its representation, and solving inequalities.
→ **conversions between algebraic, graphical, and tabular registers**

- DPs offer more varied exercises that make greater **use of different registers** of representation, as tables. **Conversions between registers are also more frequent**, particularly from graphical to tabular or between tabular and algebraic. (See Figure 1 and Figure 2)

Examples of exercises

Exercise 2.6 :

Using the tables of values for different quadratic functions, find the axis of symmetry and the vertex. Give the analytical expression for these functions.

x	y	x	y	x	y
-5	30	-5	15	-5	47
-4	21	-4	8	-4	29
-3	14	-3	3	-3	15
-2	9	-2	0	-2	5
-1	6	-1	-1	-1	-1
0	5	0	0	0	-3
1	6	1	3	1	-1
2	9	2	8	2	5
3	14	3	15	3	15
4	21	4	24	4	29
5	30	5	35	5	47

Figure 1 : Excerpt from the DP9 teacher's course

- Students must identify where the function changes its variation to determine the vertex $S(\alpha, \beta)$ and thus the axis of symmetry $x = \alpha$.
→ **transition from the tabular to the algebraic register**
- Students can use the canonical form $f(x) = a(x - \alpha)^2 + \beta$. To determinate a , they use the coordinates of a point in the table and solve the corresponding equation with a as the unknown quantity.
→ **several transitions between the tabular and algebraic registers**

Exercise 20 :

Determine the algebraic expression for each function, as well as its sign table and its variation table.

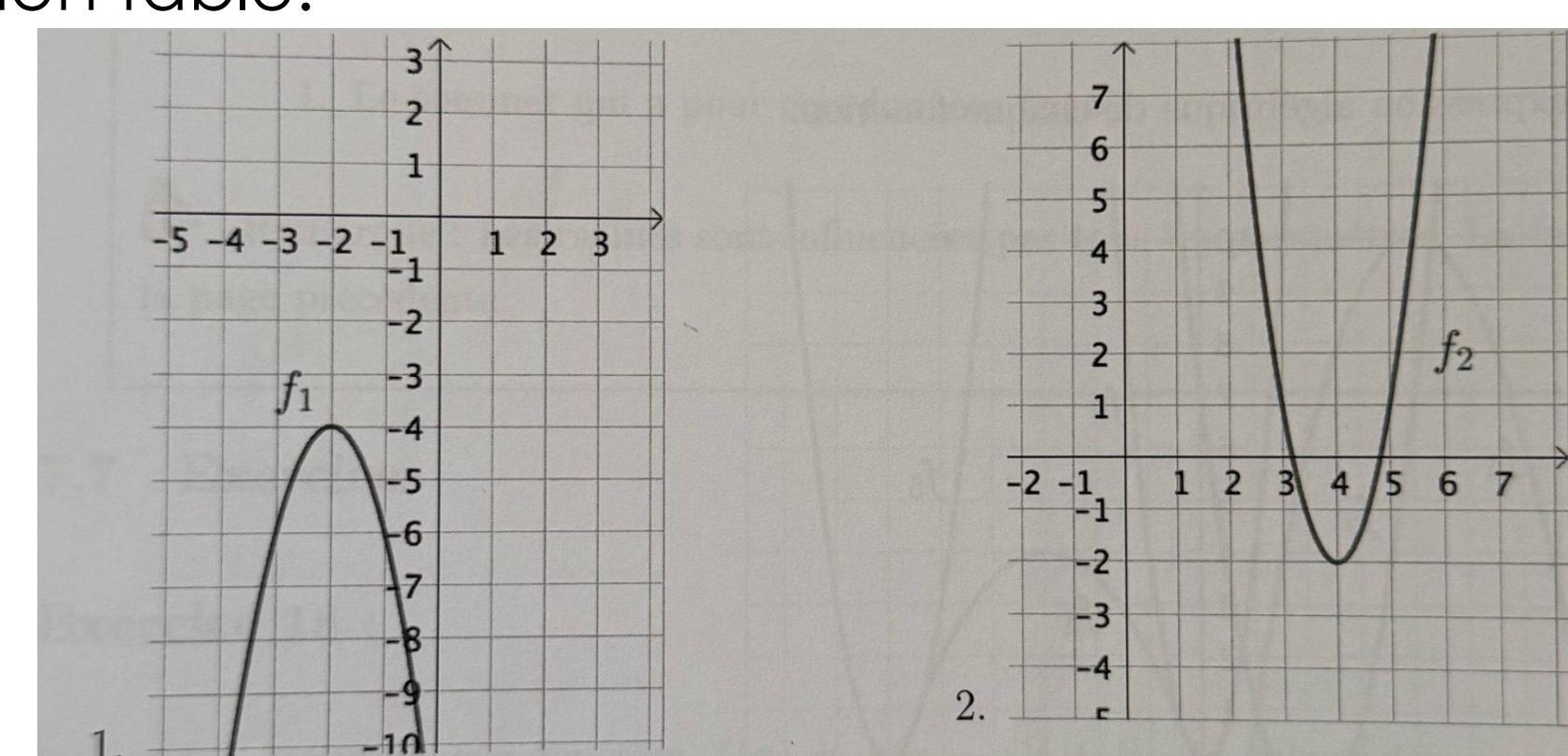


Figure 2 : Excerpt from the DP2 teacher's course

- Students must identify on the graph the x-coordinates of the points of intersection with the x-axis and the intervals where the function is positive or negative and then, the vertex and the intervals of increase and decrease on the graph
→ **transition between the tabular and graphic registers**

Discussion

Analysis of lessons and exercises reveals differences between DPs and the others in terms of chapter structure, justifications for introductory choices, and exercises:

- The DPs tend to justify their choices through **content analysis**, whereas the others tend to make choices **imposed by the institution**, mainly drawing on existing structures such as textbooks and team practices.
- DPs make choices that lead to a **different conceptualisation**: they establish more connections between concepts and articulate registers of representation more effectively; they offer more complex exercises involving various register conversions and more diverse work on certain register conversions.

These initial results, based on reported practices, will now be supplemented by classroom observations. This will enable us to compare reported and actual practices and to further compare the two teacher profiles.

References

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