# crossing language barilers in dutch math classrooms 


#### Abstract

Jana Dean is een Amerikaanse docent die onderzoek doet op het Frudenthal Instituut. Ze bezoekt veel scholen voor tweetalig onderwis en ontdekt wat er te leren valt van lesgeven in een tweede taal. We durven het aan om haar observaties onvertaald te plaatsen.


## Introduction

Sometimes I learn from what I see. In one class a boy gently taps his head on his desk as his teacher explains (again) how to solve an equation. Another lays his right cheek down as the teacher says, 'It's easy. It's the same rule.' Two girls quietly talk through what the teacher is explaining until he tells them to listen instead. Meanwhile a boy compares his paper and the board, looking back and forth. His forehead hits the desk and stays there when the teacher moves on before the boy can sort out a mistake for himself. In another class, a girl explains to her friend how the equation they are solving matches a figure they have drawn. As one talks the other nods her head. The teacher has said very little. Instead, he quietly walks around the room as the students problem solve together. These differences can't just be the difference between a teacher who talks and one who walks. If that were the case, students would learn in our silent ambling presence.

To learn more about what is happening, I interview teachers. My best informants have been teachers who are teaching in English which is a second language to them. They teach in diverse settings: in urban and suburban schools, in pre-vocational and college-bound courses. They teach students of mostly Dutch descent and students who are immigrants and children of immigrants. They are aware of language, both as learners and as teachers. Their students, who have chosen bilingual Dutch-English education, are too. Three of these teachers shared similar stories: Teaching in English changed the way they teach, and they hold onto those changes even when they return to teaching in their native language.

Patrick de Boer teaches lower secondary school and runs a professional development company, CLIL Media. CLIL stands for 'Content and Language Integrated Learning' and consists of strategies that specifically support the development of language while learning academic content.

figure 1 Patrick de Boer (standing)

CLIL changed the way Patrick teaches, even in Dutch. 'I can't go back. It is so much better. A lot of students need help with language in a lesson. Skipping it hurts their understanding.' Erik Atsma, who also teaches lower secondary students told me, 'Language is important. That is something you only notice when you are teaching in English (a second language.) I think, why don't I do the same thing in Dutch? My teaching has changed a lot in the last ten years.' A third teacher, Michelle Kuijt explained, 'Now I put what I do in my English class into my Dutch math classes. It really helps.' Her bilingual students help her see what is hard to understand linguistically. 'I really get creative with my English because when students don't understand, they tell me, so that helps me knowing what to do in my Dutch classes as well.'

These teachers differ from many of their colleagues in that they do not always teach from their textbooks. They create tasks to engage students in speaking and writing. They revoice what students say. They provide
models so that students can see as well as hear the math. Most importantly, they foreground concepts instead of procedures. This is not a coincidence: they know that the precious words they use must be as productive as possible. Procedures are dense in sequential details and prepositional phrases, and thus difficult to follow. The explanation of long division on Wikipedia provides an example of this density. It is riddled with prepositions (down, underneath, above and below, to and from) necessary for explaining how to move back and forth between subtraction and multiplying, all while dividing. It is all clear if you already understand English and the algorithm but a novice listener can easily get lost after missing a single step, even with something visual to follow.

When teachers focus on language that students can understand, instruction shifts away from the procedural toward the conceptual. I have seen such concept-rich math instruction for the youngest newcomers who are learning Dutch as well as for bilingual middle school students like Patrick's, Erik's and Michelle's who are learning English.

## In it together with newcomers

Near Utrecht, there is a small elementary school serving families who are new to the Netherlands. The youngest children join their age-alike peers all day to learn language alongside all the other subjects. Newcomer children aged seven to eleven get language instruction for half days so that they can join their age-similar peers all day as soon as possible. Teachers for both groups, like the bilingual teachers, use visual representations, facilitate children's talk, and foreground concepts.

With her younger students, Miranda is teaching addition and subtraction. She explained to me that she had pulled this group together because of their level of Dutch. Instead of explaining a procedure to them (that would be linguistically too detail-heavy for these beginning Dutch speakers) she shows them a model called a rekenrek, see figure 2.

figure 2 The rekenrek
This model allows students to connect what they know about numbers to what they can see in their hands. For example, five reds (one hand) plus two whites (the other hand) is seven.

Miranda shows a part (five) and then asks how many need to be added in order to get to seven (two.) Next she shows them parts (four and five) and asks the children to put them together and name the size of the whole (nine.) Miranda is very precise in her words, and by using the model to show the relationships she does not need to talk very much. She shows several problems and she is patient and quiet while the children think, allowing them time to find the words to explain what they understand. She challenges them to move backward and forward, from parts to the whole and back again. Instead of following a procedure, these children make sense of something much deeper: They are learning to visualize taking numbers apart and putting them back together again.

figure 3 Rekenrek tasks
When it comes time to practice, they bring whatever language they have to explain the math to themselves, their teacher and to each other. Two girls get the same model their teacher used and talk together. Another goes to a number line on the windowsill. A boy steadily works his way through the problems moving his lips as though talking to himself. Miranda has carefully provided access to the math by focusing her language on big ideas instead of procedural details and by making space for the children to make sense for themselves.

figure 4 Playing Rummikub
In the language class for the 7 to 11 year-olds, the focus is more on language than math, but still Hanneke's approach gives students access to describing big ideas. She uses the game Rummikub to help the children learn
to count, play together and to describe patterns. In this game, colored numbers on tiles create sets (3333) and runs (3456). First, she explains the rules. This involves a bit of dense step-by-step language, however, she moves the pieces so that the children can see what she means. As the children play, initially, she talks for them, modeling the language they need to talk about the game: 'I have a run.' 'Do you have a run?' 'These are all the same.' 'How many do you have?' 'My turn now.' After ten minutes, the children also invent new ways to find patterns and they explain their strategies to me, to Hanneke and to each other. Hanneke leans in and listens to every new idea, affirming without correcting their Dutch. Instead she revoices what they say. Hanneke also counts the tiles over and over again until the children count out loud themselves. She remarks, 'I scaffold. Then I move away and they don't need me anymore.' She gestures to a group of older children playing a similar game on the other side of the room. 'See,' she says, 'they are playing on their own, and in Dutch.'

## Showing. then telling each other

In Amsterdam, I sat in Erik Atsma's class of first-, secondand third-generation immigrants. While they learn in English, they all speak a language other than Dutch or English at home. Erik, like Miranda and Hanneke, provided visual representations to avoid procedural detail-dense language, and he oriented students to each other.

For his thirteen year-olds, Erik used a visual representation of multiplication to show how the distributive property could be used to simplify an equation. This representation reminds me of an area model, and it is also reminiscent of multiplication tables students encounter much younger. In the figure 5, the two tables show how to multiply the expressions $2 k+3$ and $k+7$ by 5 and 2 respectively. Instead of using preposition-heavy descriptions to indicate distribution of multiplication over addition you can see how $5(2 k+3)$ equals the product $10 k+15$ and $2(k+7)$ equals $2 k+14$.

figure 5
Being able to show instead of tell not only reduced reliance on detail-dense step-by-step explanation, it connected the lesson to the bigger idea of multiplication. Erik did not need to say much about the table, except that it represented the multiplication of one quantity by another.

Next, he provided students with a puzzle. Here, his language was straight-forward: match solutions to equations. If they were correctly matched, the puzzle would form a ring. He directed students to take turns doing the writing as they problem-solved so that everyone would have a chance to do the thinking.

figure 6 Solving the Ring Puzzle
As students worked together, Erik circulated. When students got stuck they usually turned to each other for help instead of turning to him. The materials also allowed students to take different approaches to problem-solving. If they got stuck on a problem, they could try another one. Sometimes students worked together on one problem. Sometimes they split the work and then checked solutions with each other. By the end of class, most of them had made significant progress on the puzzle and all of them had been engaged in talking about math and reasoning the whole time.

## Showing and knowing you don't yet understand

 Michelle Kuijt teaches in a Culemborg bilingual program which includes prevocational to university preparatory tracks. Both Michelle and her students know language matters. Most of them speak Dutch at home, although a handful don't. For them, English may be a third or fourth language. In her class of twelve year olds, she opened by saying, 'We are going to have to understand some words if this is going to make any sense to us.'Like Erik, Michelle made ideas accessible by showing rather than telling. Rather than providing a word-heavy explanation, her presentation featured color coded graphs and a lot of co-created discussion. If she had tried to explain step-wise how to work with a coordinate graph, her language would necessarily have become much more laden with details.

The day of my visit, Michelle's students gave her the gift not being satisfied with partial understandings. When a student provided a definition of a graph early in the discussion, she moved on. Then five minutes later, another raised his hand to say, 'I don't really understand what a coordinate grid is.' Michelle accepted the cue and slowly, through discussion, supported students to see elements
of the grid (the axes, the label, the grid itself) and what goes into making a graph, (plotting coordinate pairs.)

## If I say it, they will get it

In contrast, in many monolingual classrooms, I see well-meaning teachers provide students with difficult-tofollow procedural explanations. The teachers carefully repeat themselves, providing set-by-step instructions for 'getting the letters on the left' and 'getting the numbers on the right.' When students ask questions, teachers repeat themselves. In these classrooms, during their work time, cell phones dominate. Students may try the math but then give up. Teachers circulate and answer questions, but too few are asking. And those who do get another explanation of the rules. When I interview these patient teachers, they tell me the process they were teaching that day is one of the hardest for students. They give many reasons for this, but none are the about the nature of the language they use to teach it.

Kerslake ${ }^{[1]}$ helped me see procedures as hard-to-understand language. She observed that the children's talk about fractions was cluttered with meaningless phrases. They would suggest 'flipping fractions over,' or 'canceling' numbers randomly to make them less 'top-heavy.' She noted that step-wise procedural language creates nonsense. I infer that learning through this kind of language means more cognitive load to follow along, and less time for learning what the fractions mean. This reminds me of attempts early in my career to explain long division to my students. I would say where to put each number in relation to the others, describing an interplay of multiplication and subtraction, all while dividing. This must have been very challenging for many of my students learning in a second language or struggling with mathematics.

For a long time, I have known the importance of a classroom in which students are doing the thinking, yet these Dutch classrooms have helped me see the central role of language in turning over that thinking to students. From these generous teachers, I have learned the language-building importance of:

- patiently waiting for students to find their words;
- letting models and diagrams augment words as vehicles for communication;
- using puzzles and games to orient students to each other;
- telling students that learning math means learning language;
- recognizing the importance of teacher and students' mutual understanding;
- co-creating understanding through dialog;
- modeling language while supporting students to speak what makes sense to them;
- realizing the challenge of following step-by-step procedural language.

The teachers of language learners have the gift of learning with students who know they are learning language and math at once. The focus for both students and teachers is to understand each other. They can't resort to the rules, in confidence that 'the rules are easy.' They aren't. The teachers have learned to augment even their native-language teaching with multimodal communication that says far more about the math they expect students to learn. As Patrick de Boer writes, '(When) I had to teach some classes in Dutch again I noticed the language aspect of activities helped students. It... seemed to make mathematics easier.' Thanks to his attention for language, all his students have more space to speak a simple, 'aha.'

## Literature

[1] Kerslake, D. (1991). The language of fractions. Language in mathematical education: Research and practice, 85-94.

