DZLM Deutsches Zentrum für Lehrerbildung Mathematik

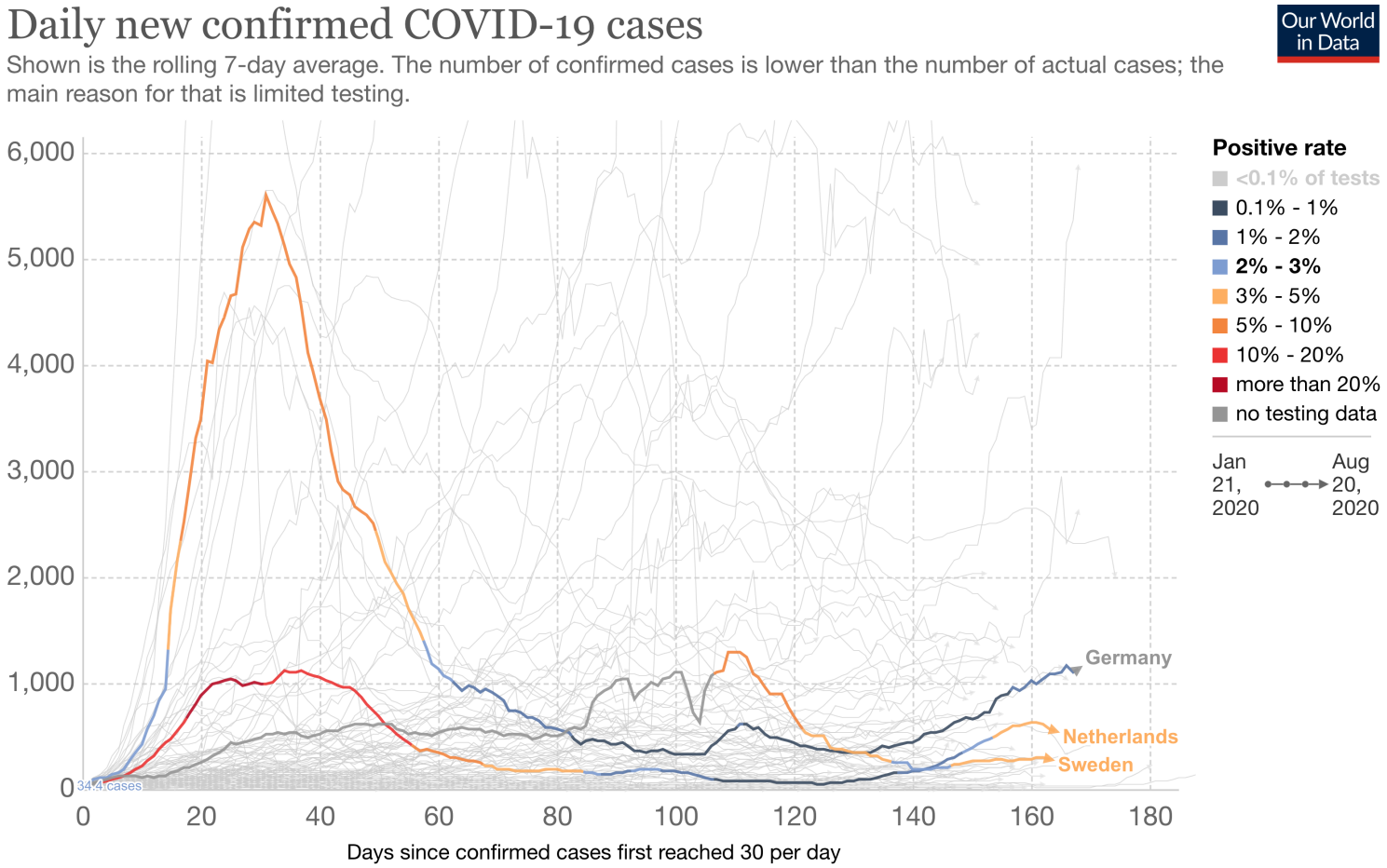
Professional development Language of tables and graphs

Session 2 (of 3)

Utrecht University

To start with ……. From the news today

What do you notice? What is the story with this graph/graphic?



Source: European CDC – Situation Update Worldwide – Last updated 20 August, 09:04 (London time), Official data collated by Our World in Data

Program of the course 3 sessions

Session 1: The language of graphs and tables

some background

examples of tasks and student work in general and vocational contexts

Session 2: Focusing on line graphs

mathematical concepts

related language

Session 3: Rich communicatie practices involving graphs and tables in vocational situations

Program session 2

1. Starter
2. Sharing outcomes homework
3. Background on language of line-graphs
4. Activity: reflecting on student work
5. Research into the language of line graphs
6. What does this mean for your teaching practice?
7. Reflection and looking forward

Homework you did

1. Prepare and design a language-sensitive teaching activity with a diagram/graph

Use the plan and evaluation form in the handout

Include all student materials

2. Try this activity with your students (whole class or small group)

Write a brief report (you can us the form): what went well? What problems arose? What improvements would you make to overcome these? Include some examples of the work of your students.

Bring all materials to session 2.

Prepare a language-sensitive activity on graphs/diagrams

- Select an approriate graph/diagram
- What is the mathematical content and goal for the activity with this graph/table/diagram? What task(s) do you give students?
- What are the linguistic demands in this activity and what goal(s) do you set related to the use of (mathematical) language?
- How do you plan to activate your students in producing language in this activity?
- What language support do you provide?

Sharing materials and experience

- In groups of 3 share your findings (15 min)
  - use the forms you filled in!
  - Focus on the aspect of (mathematical) language
- At the end note for each participant (5 min):
  - one top – this went very well
  - one tip – this can be improved
- Share these outcomes with the whole group (10 min)
  - focus on 'lessons learned'

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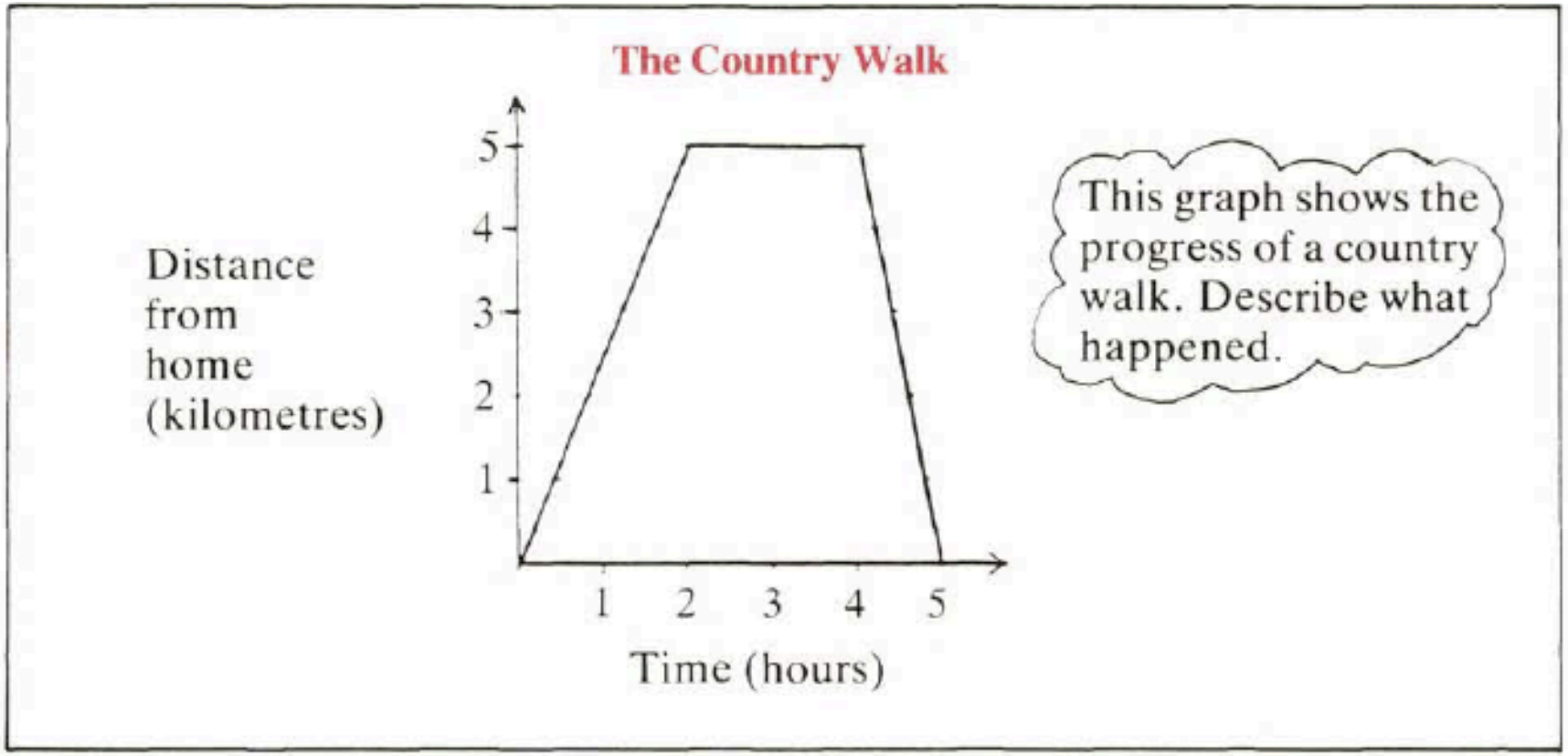
What may go wrong in students' answers?



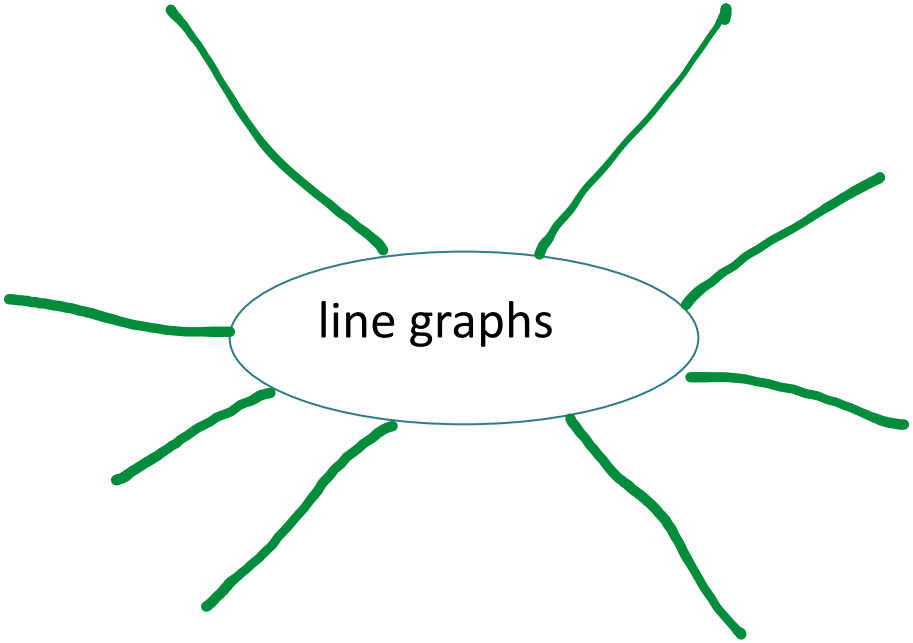
Difficulties line graphs

- Mathematical understanding of 'relations', patterns; etc.
- 'Graph as picture'
- 'Academic (mathematical) language of representations

Which of these (or related) problems do you recognize in your own teaching?

Language of line graphs

Together make an overview of words and expressions related to line graphs representing a situation.



Two ways of looking at graphs

Each with its own language

- **In detail**
  - reading information 'point by point'

'technical' math language, short, precise, numbers, "a table will do"

- **As a whole**
  - seeing the process of change
  - detecting a pattern
  - noticing 'movement'

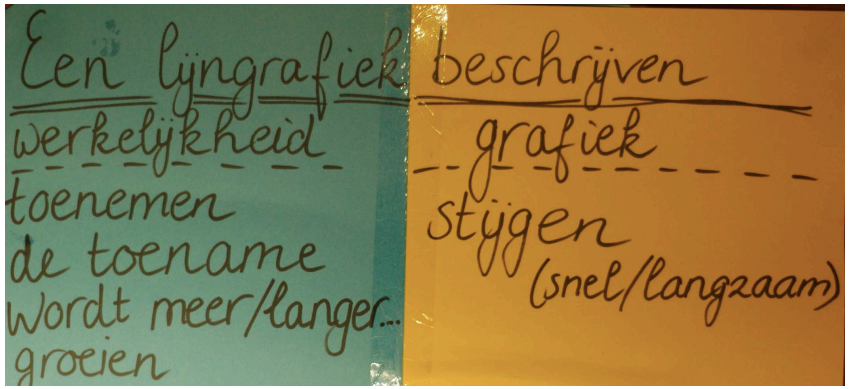
varied language, also terms related to the situation

Language of Graphs

Organising your wordweb

- Distuingish mathematical and other language

- For each mathematical expression describing a line graph, give a situational example of its meaning
  - The graph ascends -> the baby is getting taller

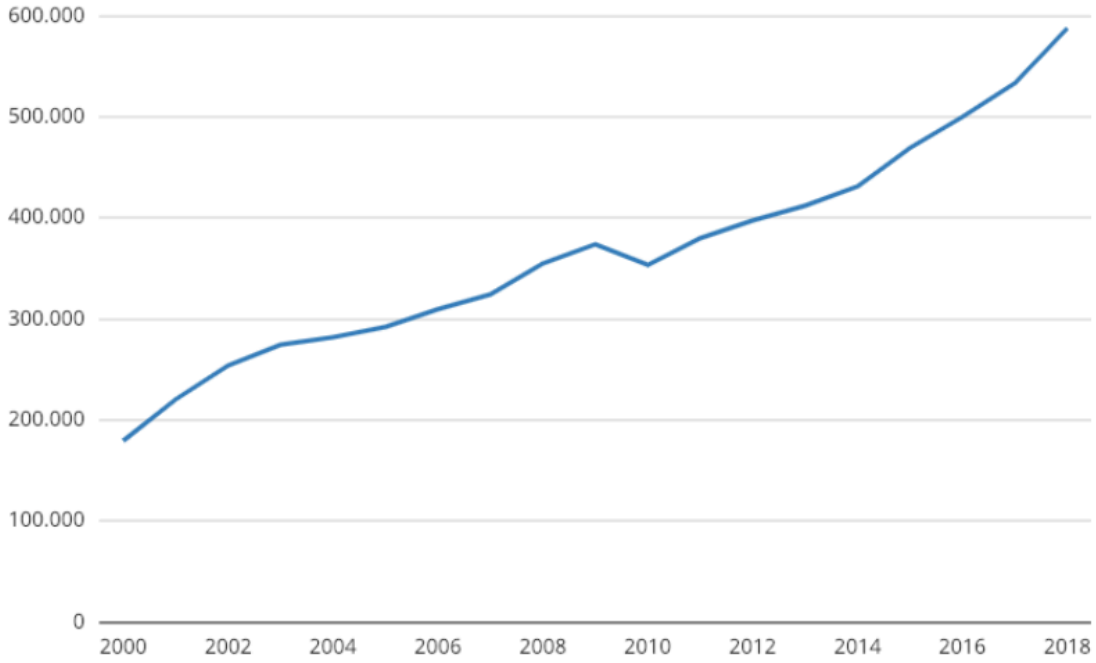


Examplary didactical sequence for language if linegraphs

- Matching graphs and stories (descriptions)
  - Reflecting on the distinction between mathematical language of graphs and situational language.
- Drawing a graph for a story
  - Translating from text of situation to representation in a graph
- Telling an d writing a story for a graph
  - Translating from mathematical respresentation to context
- Connecting the langauge of the story to the language of the graph

Exemplary worksheet 1 – telling a story for a graph

Number of goats in the Netherlands (2000-2018)



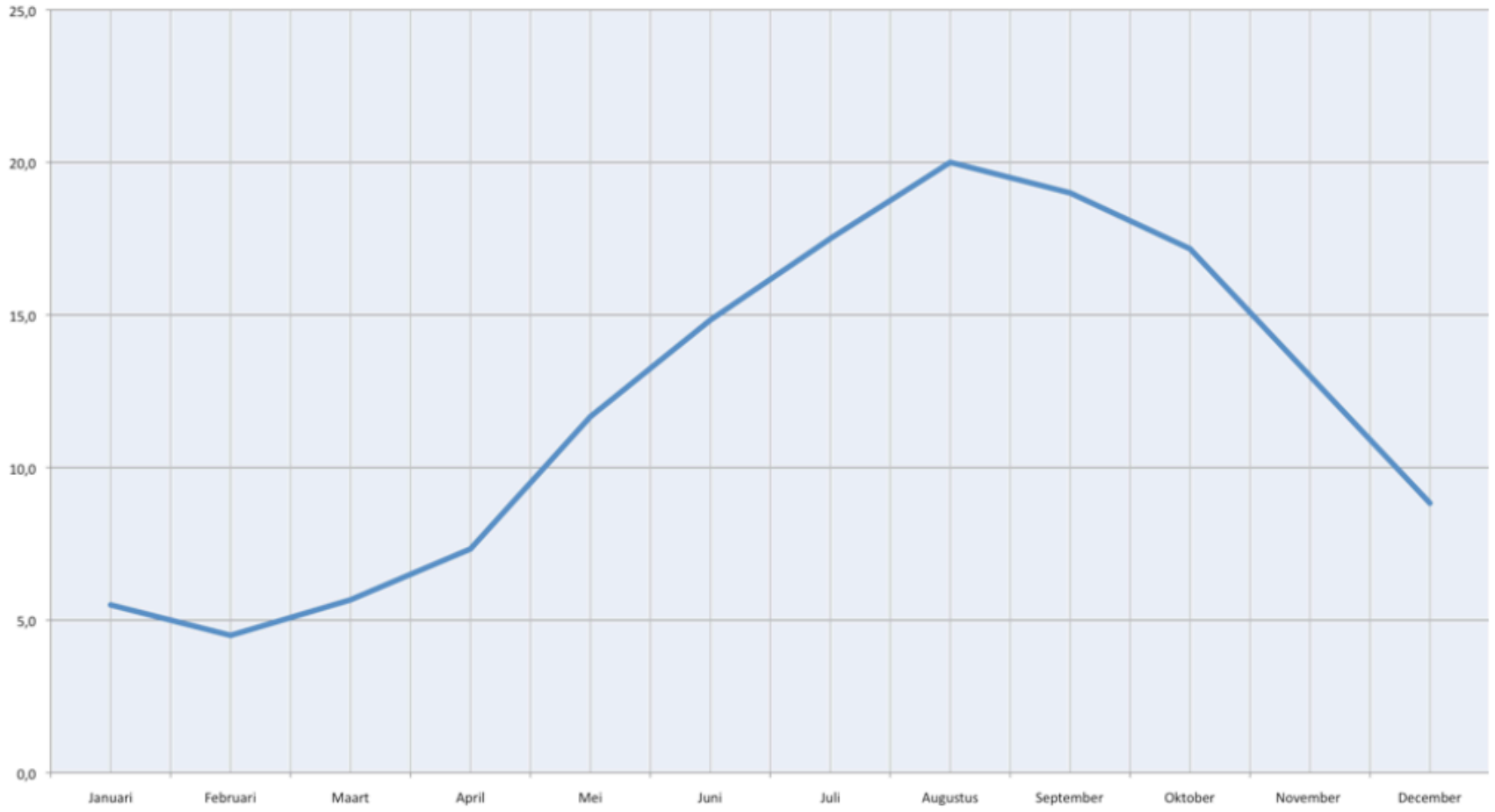
Discuss and answer the following questions
- What is the graph about?
- What do you notice?

Tell the story that goes with the graph.
Record your story with your mobile phone.

Listen to the stories in pairs and discuss them together.
- Which are the most important words in your story?
- Write them down below.

Examplary worksheet 2

Temperature of water in the North sea during 1 year



What tasks/questions would you give your students?

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Analysing student work

In groups of three analyse the student work on worksheets 1 & 2

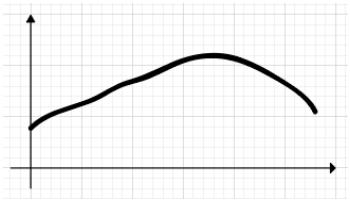
Use the following questions to guide your analysis:

- What does each student appear to understand? How do you know?
- List errors and difficulties that are revealed by the students' work.
- Try to identify the thinking of each student?
- What feedback would you give each student?

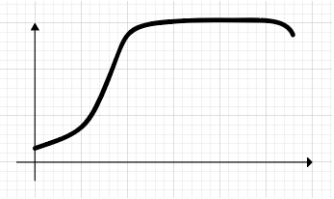
Discuss in what ways you would support your students in the learning of (the language of) line graphs? Be as specific as possible.

2 – Matching graph & title

A



B



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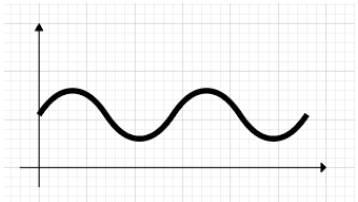

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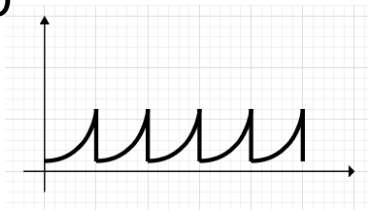


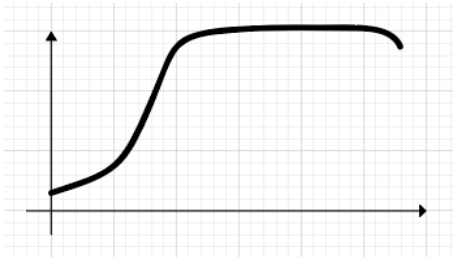
1. Length of a man during his life
2. Temperature during a day
3. Height of weed over several years
4. Sea level during a day
5. Height of water in plastic bottle with a hole in the bottom
6. Your bicycle route from home to school

A

Temperature during a day

Begins cold and in the afternoon warm, and then cooling down quietly

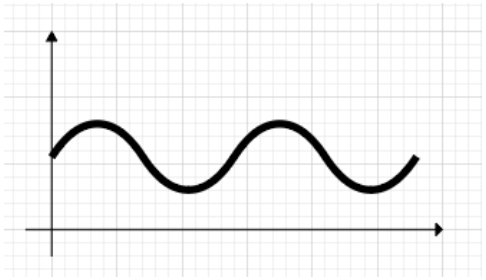
B



1.Length of a man during his life

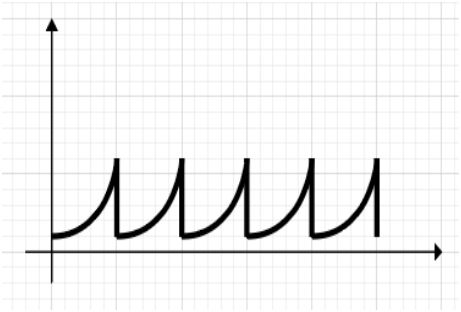
Grows very fast and only late he shrinks

C



Sea level during a day

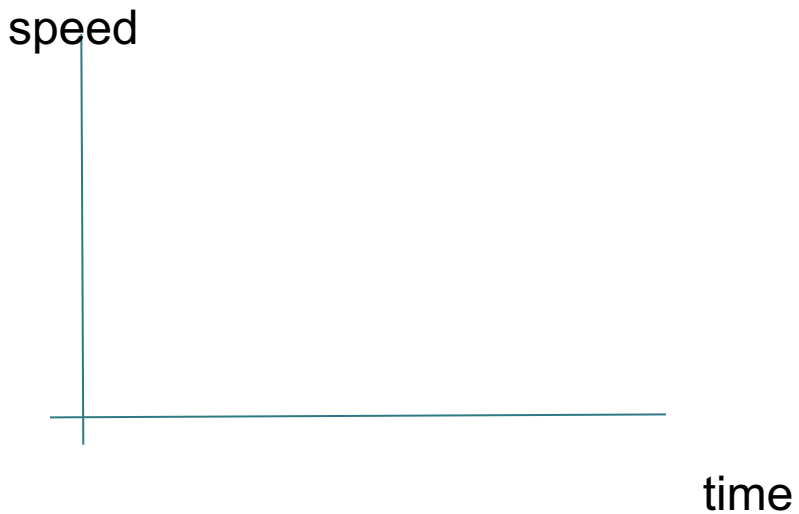
Sometimes quiet and sometimes waves



Height of wheat over several years

Becomes big and then they trim it again

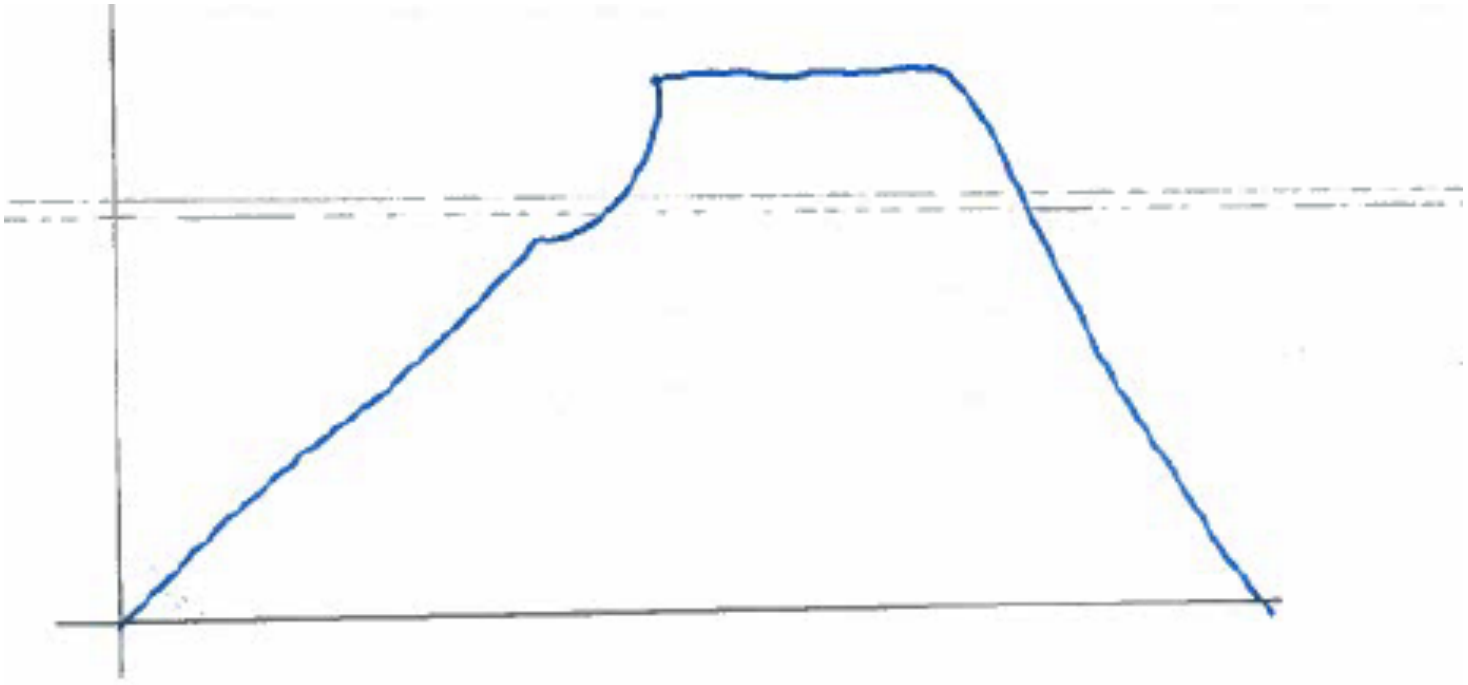
Drawing a graph for a story



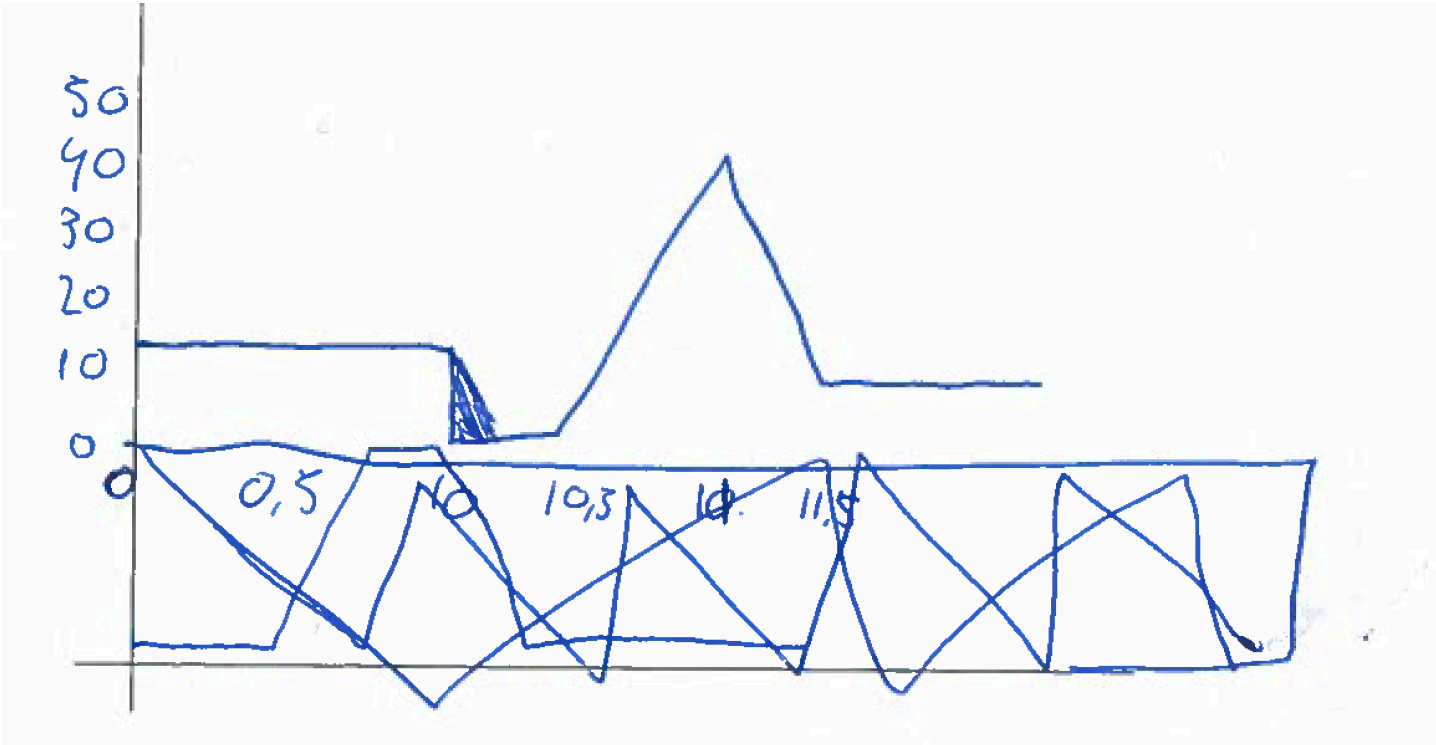
Nick gets on his bike and starts a ride from his home. Then he rides along the street with constant speed before it carves up a hill. On top of the hill, he pauses for a few minutes to enjoy the view. After that he drives back down and stops at the bottom of the hill.

Draw a graph to show how his speed changes as a function of the time.

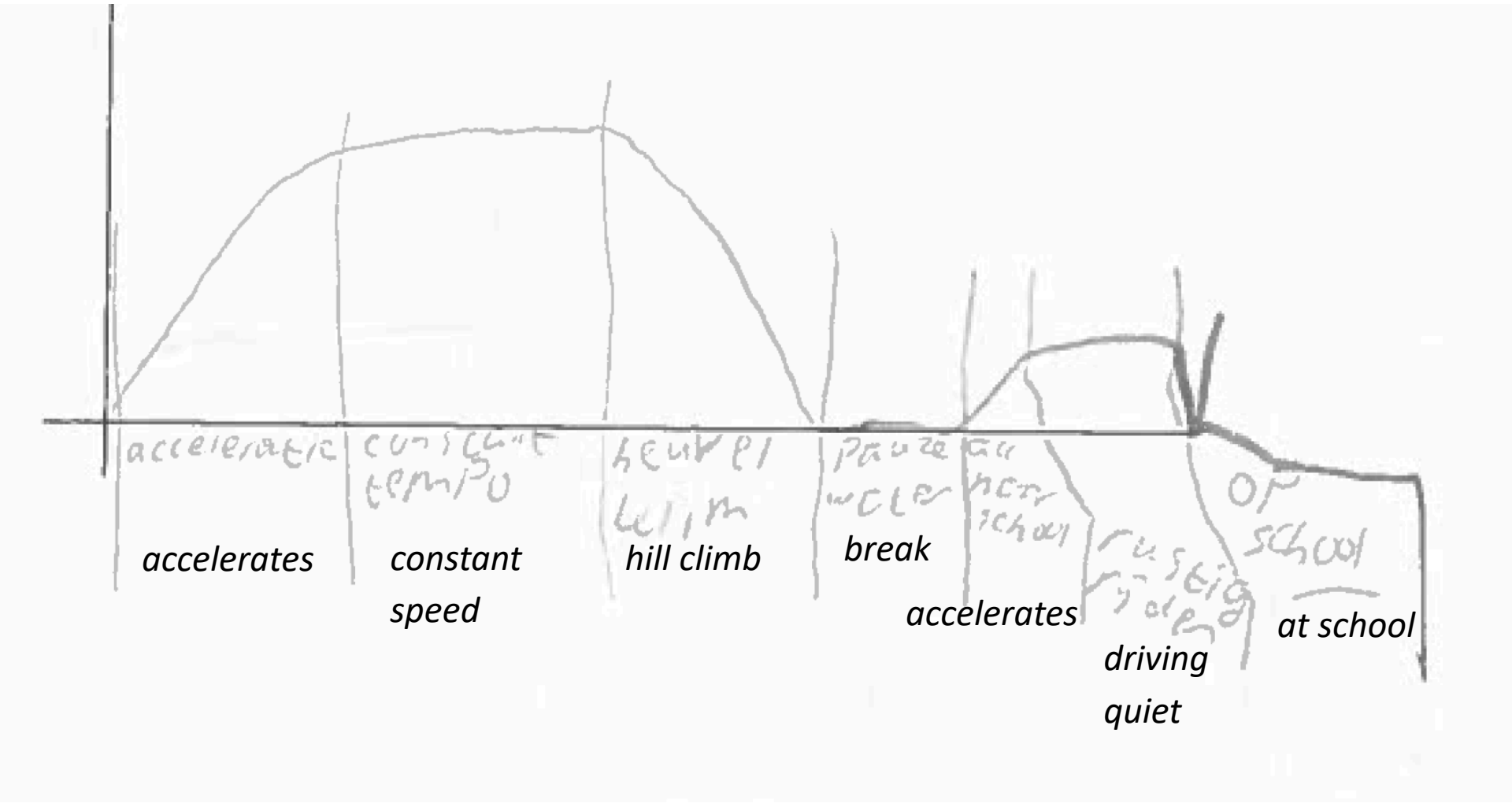
student 1



student 2



Student 3

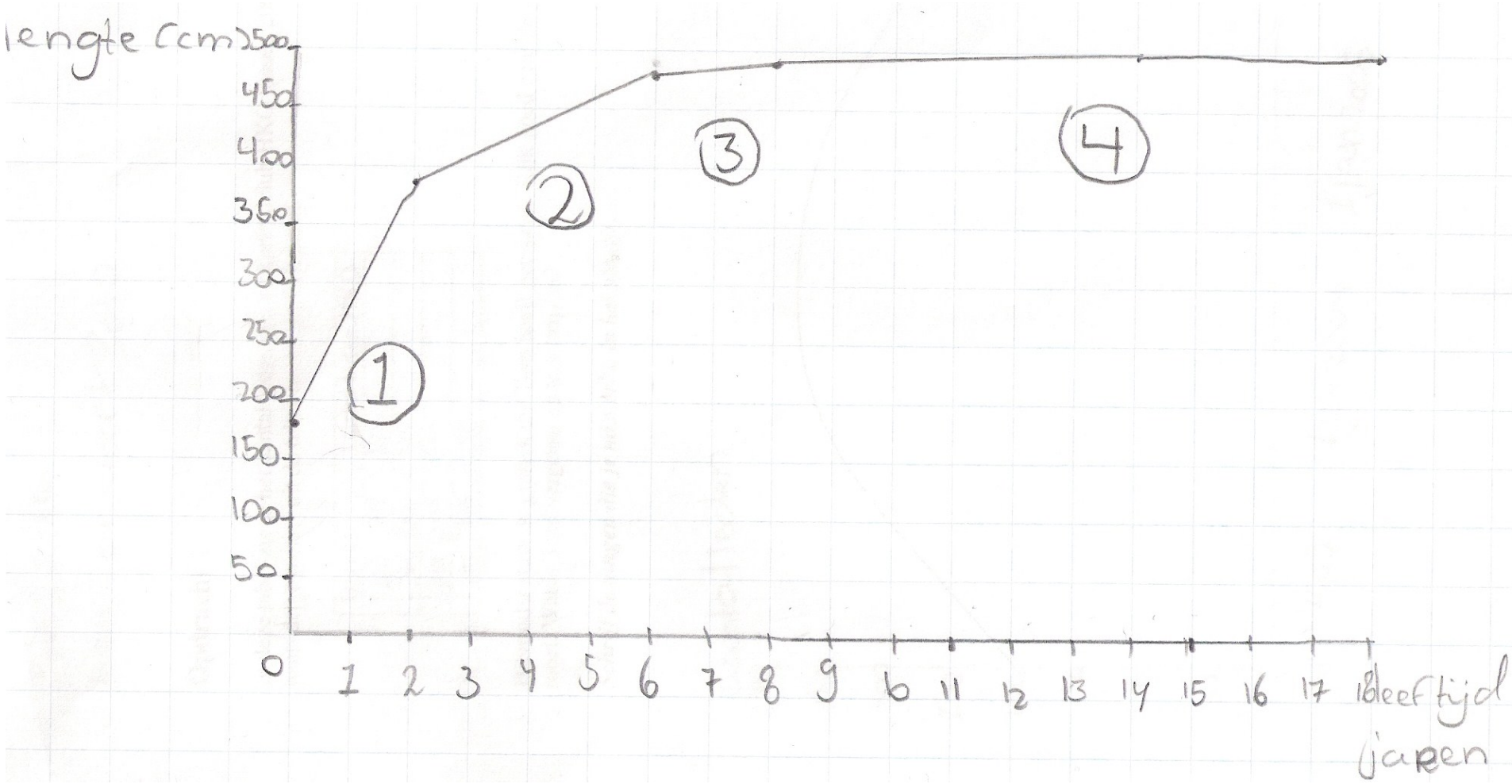

accelerates
constant speed
hill climb
break
accelerates
driving quiet
at school

Reflecting on student work

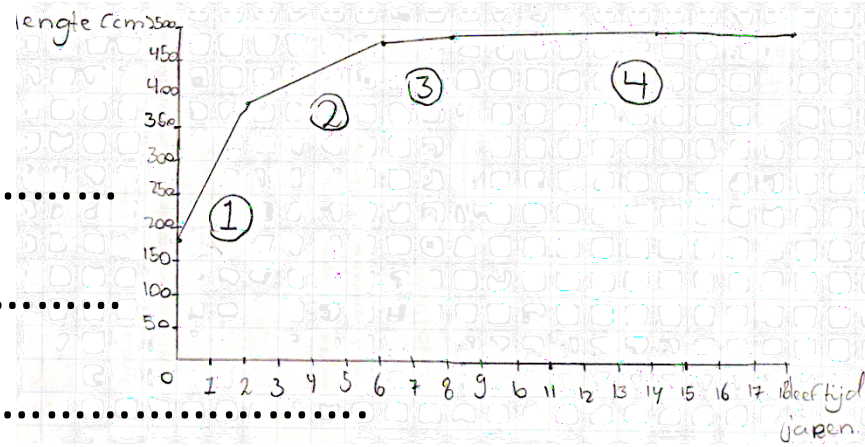
In the whole group discuss the findings of the analysis in small groups. Use the guiding questions.

- What does each student appear to understand? How do you know?
- List errors and difficulties that are revealed by the students' work.
- Try to identify the thinking of each student?
- What feedback would you give each student?
- In what spcific ways would you support your students in the learning of the lanaguage of line graphs?

A line graph on the growth of Niek the Giraffe:



Example of support by a Speaking and writing frame



When Niek is born, he is ……

The first years ……

You can see that in the graph that……

From his 2nd birthday on ……

The graph……

After he has become 6 ……

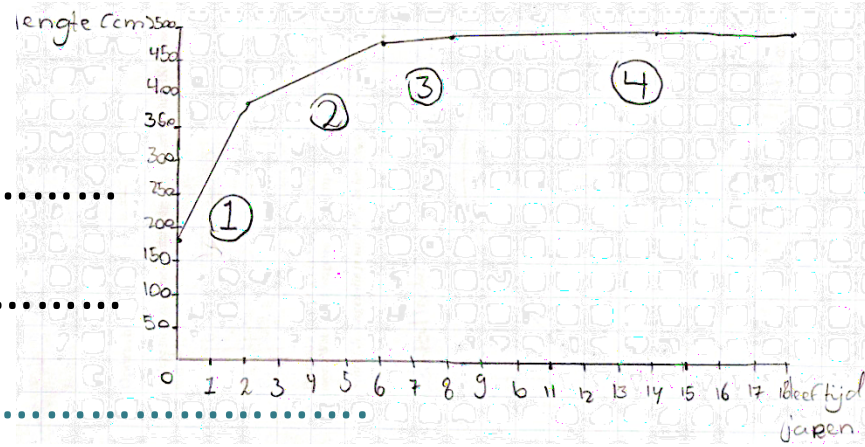
You can see that ……

When he is about 9 years old……

The graph ……

Finally Niek……

Different language systems in the dpeaking and writing frame



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Finally Niek.....

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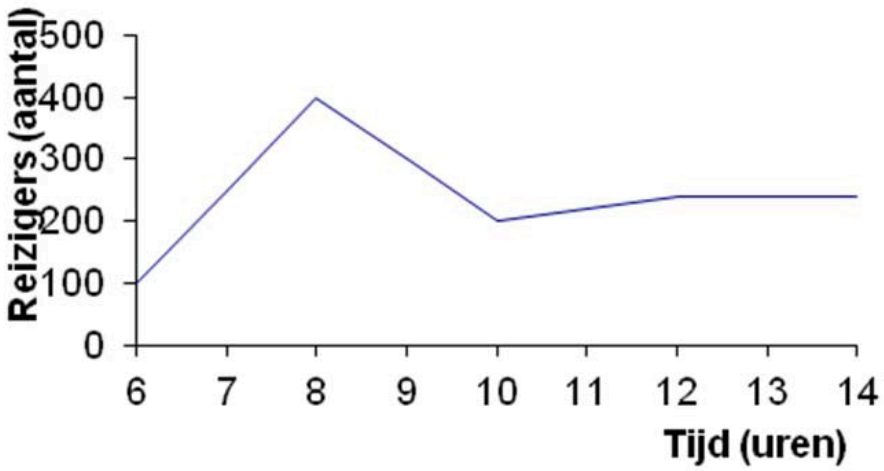
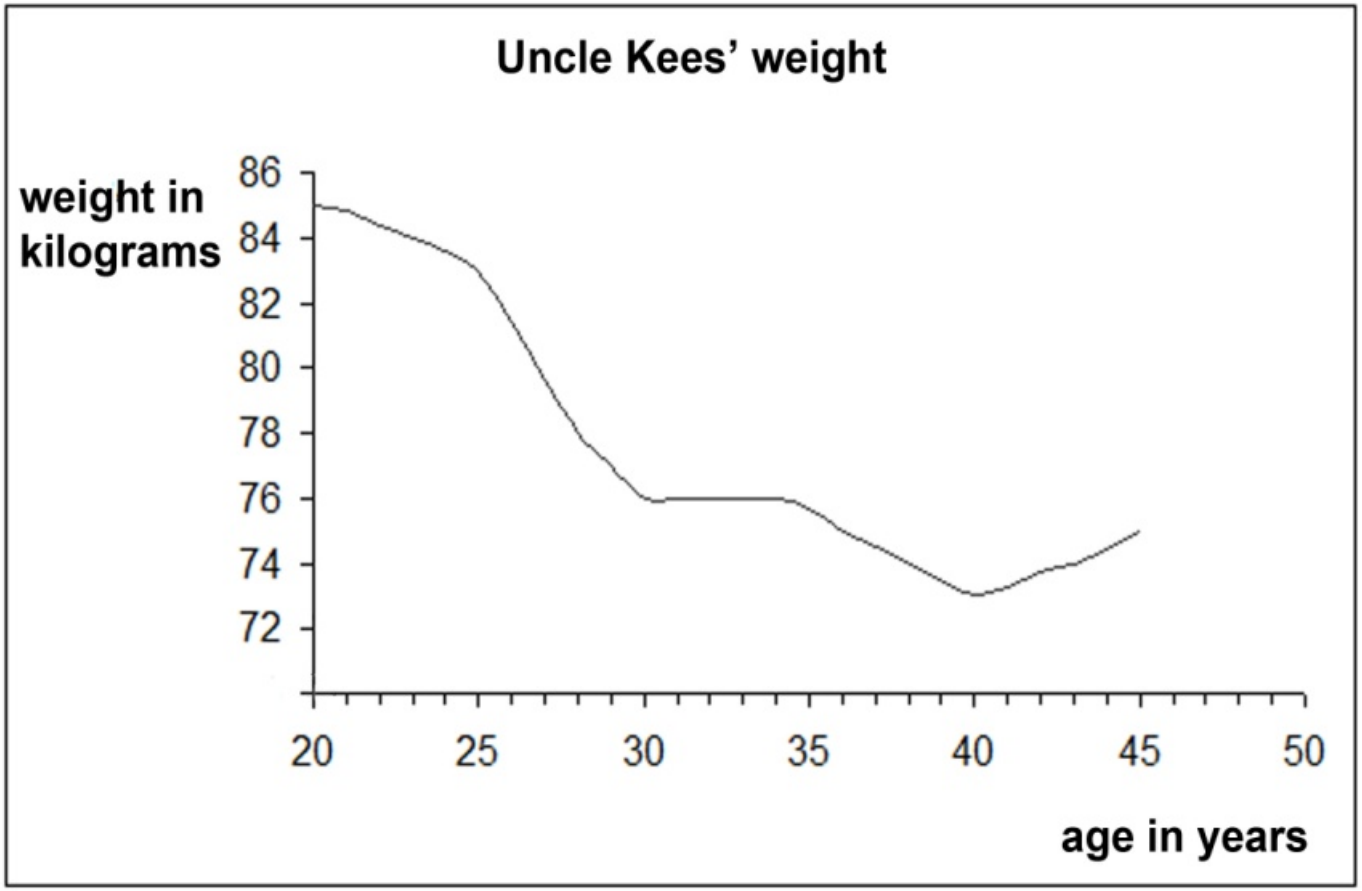
Number of travellers at the railway staion



Interpretative description of the line graph

At 6 o'clock about 100 travellers are at the station. Between 6 and 8 o'clock the number of travellers increases much. The graph shows a steep ascend. [...]

Genre: Interpretative description of a line graph



Write an interpretative description for this graph.

STRUCTURE FEATURES

s1. Describes each segment in terms of **what happens in reality**

Between his 25th and his 30th birthday his weight quickly diminishes

s2. Describes each segment **in terms of the graph's course**

The graph descends gradually.

s.3 Describes peaks and troughs when present in the graph.

When uncle Kees is 40 his weight reaches its minimum: about 74 kilograms.

LINGUISTIC FEATURES

L1. Includes general academic language in the description of reality

...his weight decreases quickly
… his weight remains constant

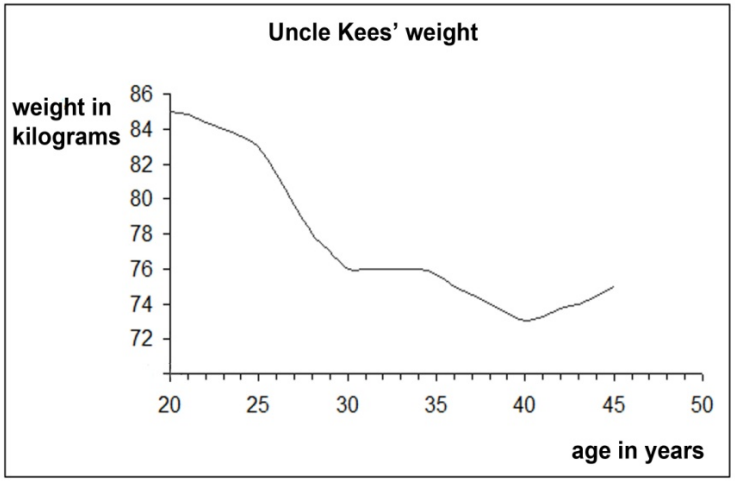
L2. Uses words such as ‘as’, ‘at’, ‘in’ and ‘when’ to refer to moments in time (i.e. points in the graphs).

At the age of 40 ...

L3. Uses word combinations such as ‘from…to’, ‘between…and’ and ‘from…onwards’ to refer to periods in time (i.e. segments of the graph).

Between his 25th and 30th ….

Interpretative description



At the age of 20 Uncle Kees weighs 85 kilograms. Between his 20th and his 25th birthday, he slowly loses weight. The graph descends gradually.

Between his 25th and his 30th birthday his weight decreases quickly. You can tell as the graph shows a steep fall. From his 30th to his 35th birthday his weight remains more or less the same. The graph is constant.

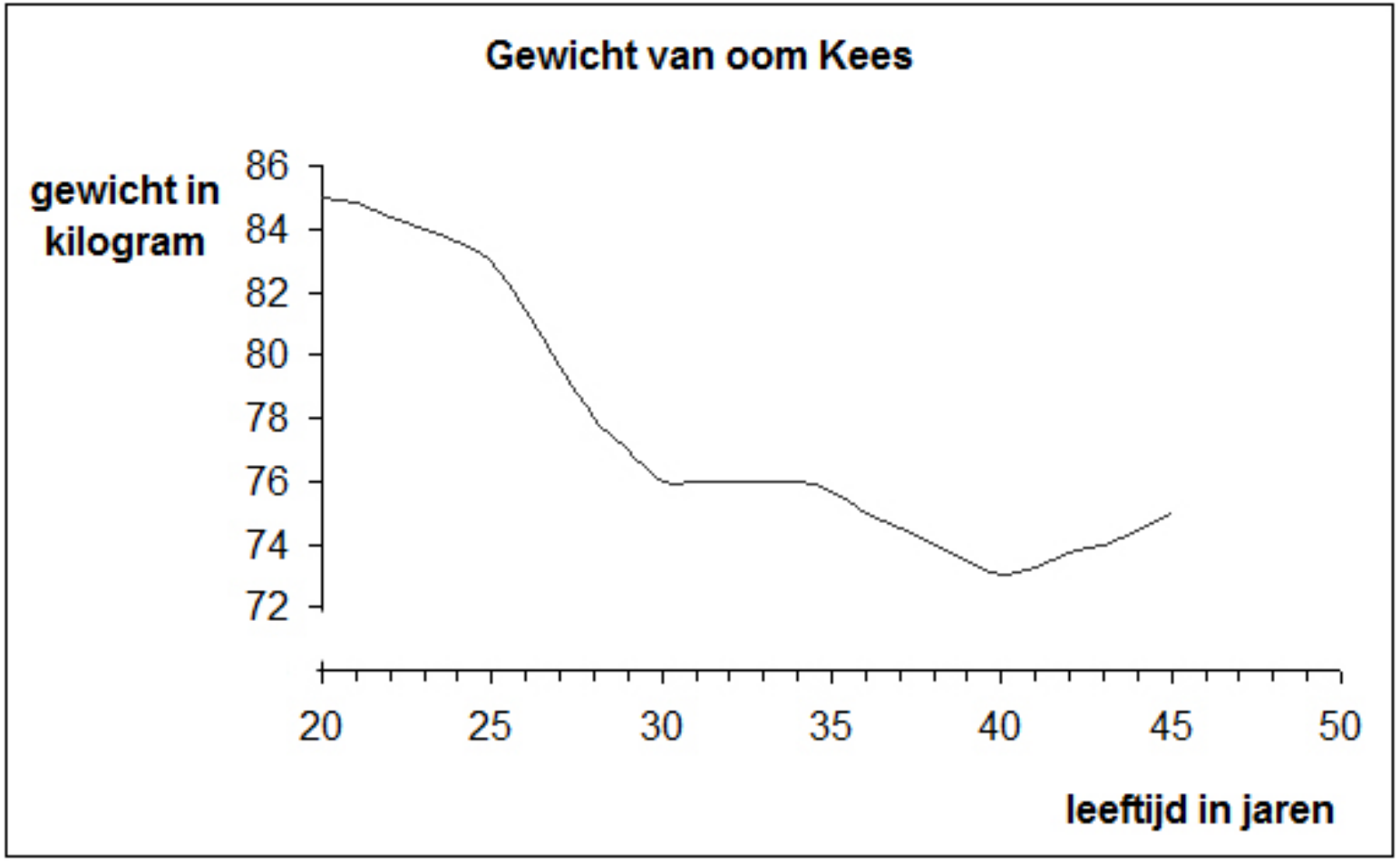
Between his 35th and his 40th birthday he slowly loses weight; the graph gradually descends.

When Uncle Kees is 40 his weight reaches its minimum: about 74 kilograms. From the age of 40 on his weight increases slightly. In this part, the graph gradually rises.

Teaching and learning cycle

1. ***building the field**:* exploring the domain of line graphs, introduction of general academic and subject-specific language (word list)
2. ***modeling the genre**:* dividing the graph in segments, using speaking and writing frames, discussing model texts, discussing pupil utterances in a subsequent lesson
3. ***joint construction**:* writing a text in the curriculum genre together: teacher-class (out loud)
4. ***independent writing**:* pupils write in the curriculum genre independently

Videofragment *scaffolding language*



Scaffolding language: an example

Teacher:	How can he tell his age? Where does he see that? Youness.
Youness:	Down below.
Teacher:	Can you speak up? We cannot hear that.
Youness:	Down below, at (…?).
Teacher:	And down below, for that we know proper mathematical language. Oussana?
Oussana:	Horizontal axis.
Teacher:	Why don’t you put that in a sentence. It’s just a word on its own like this.
Oussana:	Along the horizontal axis it says age in years.
Teacher:	That’s a beautiful sentence, isn’t it? OK.

Yassin	when he was 30 and 35, he just stays 76 kilogram (points to the numbers)
Teacher	Wait a second. How do we make this into a beautiful sentence? **When** he was 30 **and** 35. How should we do this, Oussana?
Ousana	30 til 35 he stayed the same.
Teacher	Is is 30 **till** 35?
Amir	From.
[.....]	
Yassin	Uncle stays, uncle stays constant, uncle Kees stays constant.
Teacher	Yes, do I stay constant in the same position? What stays constant? I am uncle Kees (teacher acts out 'staying in a fixed position).
Younes	The kilograms.
Teacher	And how do we say this? Not 'my kilograms
Yassin	The weight of uncle Kees stays at 76 kilograms.
Teacher	Yes. the weight remains teh same. And you see this in the graph?
Yassin	which stays constant.
Teacher	Yes, now you did use beuatiful math language

Results: proficiency in the pedagogical genre on pre-and posttest

	Pretest	Posstest	Difference
Mean of the class	3,73	6,63	+2,90

Progress in het genre is statistically significant ($t = 8,38$; $df = 21$; $p < 0,001$), effect size $d = 1,79$.

Hoe did the teacher learn to *scaffold*?

- Discussions between lessons
- Teacher as co-designer
- Stimulated recall interviews
- Reflective reports of the teacher

(see Smit & Van Eerde, 2011)

Creating conditions for scaffolsing language

- Pay attention to the interaction norms in class
- Give students enough time to think individually when posig a question
- Encourage students to produce language (in speaking and writing)
- Listen for and react on the quality of verbal utterances

How did the teacher reflect on the lessons?

- “Language is now always an *issue*.”

- “The best *scaffolds* are...like that writing plan. That we give them something which makes them think: ‘I know a first sentence’. Scaffolds like these are so important!”

- “For a teacher it is like learning a new profession. And I notice that I still have to practice. And that’s why...a professional development course wouldn’t be bad because these strategies are not easy to master.”

How do the students look back?

- “ That we have learned new words for math and language.”
- “ I now know how graphs come into being.”
- “ Writing about a graph. It is an easy and good way.”

Language development of students

Students:

- produce more language
- describe a graph in more detail (they often distuingish more parts)
- use more mathematical terms and use these in a more and more approriate way
- speak and write using proper grammar
- show more and more mathematical understanding; e.g thet distuiguish moments (points in a grpag) in time from periods or tim intervals (segments in a graph)

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Steps for designing language-sensitive math teaching

- Decide on the mathematical aims for the task
- Analyse what 'thinking steps' students have to take
- Analyse what language they need
- Support this language by scaffolding it

Scaffolding strategies

- Rephrase student utterance (oral or written).
- Remind students of the necessary thinking steps and the wording
- Ask students to improve wrong wordings (what is another way for saying this?)
- repeat correct examples or encourage students to phrase their thinking steps themselves.
- Gradually decrease the support when it is less needed.

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Reflection

- What was most valuable for you in this session?
- What will you use in your teaching practice?
- Give one tip and one top for this session

For the next session

1. **Explore part 1 of the module. Select one of the communicative activities from this part and try this with your students (whole class or small group)**

   Write a brief report: what went well? What problems arose? What improvements would you make to overcome these? Include some examples (audio, video or written) of the work of your students.

2. **Look for examples of communication in vocational settings involving graphs, diagrams or tables.**

   Talk to your vocational colleagues or ask your students about their vocational practice.

3. **Optional:**

   Design a language sensitive line-graph activity fitting your class and try it out. Pay particular attention to the way you want to scaffold discussions

Bring all materials to session 3.